GCIRC News

Global Council for Innovation in Rapeseed and Canola

"Building a World community for Innovation on Rapeseed and Canola"

N° 6, January 2020

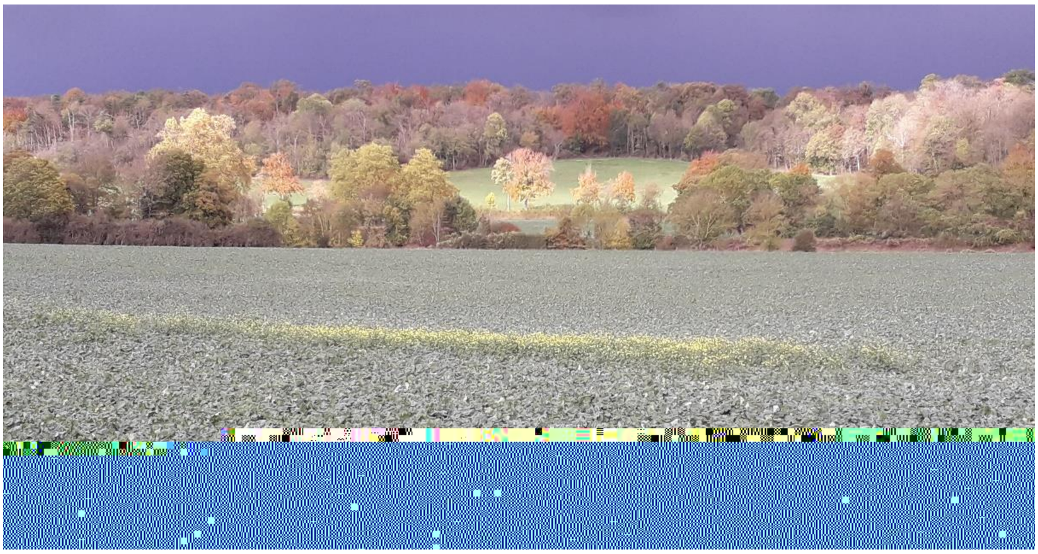

Table of contents

Editorial

2019 has been a very rich year for the GCIRC, with key steps in its life, with a very successful world congress and important evolutions in its statutes. The end of the year was also very rich for rapeseed science, with a large amount of publications, as you will notice in this newsletter.

2020 will be a transition period until the General Assembly in 2021, meaning that continuous work is needed to develop, communication and organize interactions through the GCIRC scientific committees and in thematic working groups.

Times are changing and a series of "hot topics" of different natures would deserve a specific thinking, like canola proteins, integrated insect's management, clubroot control, pan genomics, emerging technologies, policy dialogue on future development, etc.… All these issues emerged those last years, linked to the evolutions of rapeseed crop environment on different dimensions going from policies and politics to new markets, social, technical or biological changes. Developing a prospective vision on these issues – and others, the list is open and subject to evolutions – would allow to specify position papers, to identify relevant collaborations and even to consolidate consortia or projects and share efforts on the most strategic issues.

The GCIRC needs volunteers to lead, co-lead or simply contribute to these groups. The GCIRC will do its best to facilitate these interactions, and the next tangible sign of this effort will be the renewal of the GCIRC website with improved functionalities, to come soon.

Etienne Pilorgé,

GCIRC Secretary - Treasurer

Activity/ News of the association:

Next GCIRC board meeting

The next GCIRC executive board meeting will take place in Paris on March 18, 2020. All GCIRC members may contact either their national board member (see http://gcirc.org/presentation.html) or the GCIRC Secretariat (mail: contact@gcirc.org) to share any suggestion regarding the future activities of the association.

Welcome to New GCIRC members

We have the pleasure to welcome a new member, Prof Wancang SUN, rapeseed breeder from Gansu Agricultural University, China.

GCIRC at the Canola Week, Saskatoon, Canada, 4-5 December 2019

The Canola days took place in Saskatoon, Canada, on December 4th & 5th, 2019, "to get the latest information on industry priorities, production challenges, breeding and genomics, digital technologies and new opportunities affecting this valuable crop!". The organizers invited GCIRC Secretary-treasurer Etienne Pilorgé to present the last evolutions of the association and future possibilities for enhanced interactions. Further information on the presentations made during these two days will be given in the next issues of this newsletter.

Collecting the 15th IRC presentations, let us go on!

To the attention of the participants to the 15th IRC in Berlin, it is not too late to send us your presentations or posters as pdf files. They will be published on the new GCIRC website, coming soon.

Some highlights from the XVIII International Congress on Molecular Plant-Microbe Interactions (IS-MPMI) 2019

Suzana Stjelja, third-year PhD student at the Plant Biology Department at the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden attended XVIII International Congress on Molecular Plant-Microbe Interactions (IS-MPMI) from July 14th to 18th in Glasgow, Scotland, with support of the GCIRC. She points out some highlights of the conference, with a special attention to potential applications to Clubroot/ *Plasmodiophora* studies, and more generally pathogens of Brassicaceae.

<< My PhD research has an emphasis on genomics of the soil-borne plant pathogen *Plasmodiophora brassicae* that attacks plants in the Brassicaceae family and causes characteristic root galls or clubroots. The clubroot disease is rapidly spreading throughout the world including Sweden and reducing yields of economically important Brassica crops. *P. brassicae* is very difficult to control because of its extremely resilient resting spores that can survive up to two decades in the soil and which no chemicals can target. As an obligate biotroph (it cannot be cultivated on media and only exist in the soil or in living plant cells) *P. brassicae* is a challenging organism to study. Many aspects of its life cycle, infection process and genetics still remain unknown. My research focuses on refining the *P. brassicae* genomic

information by using long-read PacBio sequencing data, performing genome comparisons among a range of different *P. brassicae* pathotypes and deciphering clubroot associated microorganism communities. The long-term objective is to provide better understanding of *P. brassicae* genetics and genomics and contribute with new information that may form the basis for improved means of plant protection.
Thanks to the GCIRC support, I was able to attend the IS-MPMI congress and acquire an overview and new insights into host-microbe interactions, genomics of plant pathogens and microbiome studies, topics that are essential for my ongoing PhD projects. Furthermore, in the congress poster session I had the opportunity to present my own research and discuss results achieved by PacBio sequencing of the *P. brassicae* nuclear and mitochondrial genomes. A friendly environment at the congress encouraged me to interact with fellow PhD students and researchers at all career levels and offered a valuable opportunity to create scientific networks.
Here I present a report of the IS-MPMI congress including summaries for:

- Recurrent hybridization introduces high genetic variability in crop pathogen, a fascinating talk revealing importance of recombination and hybridization for evolution of fungal wheat pathogens. This study was of special interest for me because presented methods and findings may be applied to investigate genome-wide variation among *P. brassicae* pathotypes.
- Two poster presentations with focus on the Brassica pathogens, *Alternaria brassicae* and *P. brassicae*.
- Reproducibility in Science, a workshop that highlighted issues concerning re-use of scientific data and provided a range of valuable tools and workflows which facilitate data management and data sharing.): Dr. Benjamin Schwessinger (Research School of Biology, The Australian National University, Can-berra, Australia) addressed challenges arising when reproducing, replicating and re-using our own or someone else's data.   The slides he presented are accessible at https://figshare.com/articles/Reproducibility_for_Everyone_workshop_slides_ICMPMI2019/8874506

Recurrent hybridization introduces high genetic variability in crop pathogen (Concurrent session 15, July 17): Dr. Eva H. Stukenbrock (University of Kiel, Germany) presented findings from comparative population genomic studies on economically important fungal pathogens from *Zymoseptoria* species. These studies demonstrated the importance of recombination and recurrent hybridization for the emergence of new genetic variation in the pathogen genomes.
Zymoseptoria tritici and *Z. ardabiliae* are recently diverged sister species that evolve in highly dissimilar environments with non-overlapping hosts. *Z. tritici* causes septoria leaf blotch on wheat that is cultivated in agricultural systems while *Z. ardabiliae* infects wild grasses. *Z. tritici* has a sexual and asexual state and its haploid genome (40 Mb) comprises 21 chromosomes of which 8 are accessory chromosomes1. Due to highly variable accessory chromosomes, large structural variation in the core chromosomes and extensive nucleotide diversity, the *Z. tritici* genome has remarkable levels of genetic variation. In order to identify mechanisms that contribute to this genetic variation Stukenbrock and Dutheil2 investigated genome-wide patterns of recombination rates through linkage disequilibrium among single nucleotide polymorphisms (SNPs) in *Z. tritici* and *Z. ardabiliae.* They reported overall high recombination rates as well as higher recombination hotspot frequency and the occurrence of stronger hotspots in *Z. tritici* compared to *Z. ardabiliae*. When mapped to coding sequences, more than 50% of the *Z. tritici* hotspots co-localized with exons. This finding indicated that the recombination hotspots

in coding regions might be under selection because they enable fast emergence of new alleles and allele combinations essential for evolution of the wheat pathogen in agricultural environment.

Dr. Stukenbrock and her team generated full genome alignments and estimated distribution of intra- and interspecific genetic variation in order to further analyze highly variable regions (HVRs). Multiple genome alignments were based on de novo assemblies of 26 genomes from five *Zymoseptoria* species, sequenced with Illumina (short-read) and PacBio (long-read) technologies. After comparing coordinates between the alignments by projecting the alignments against the reference genome of *Z. tritici*, SNPs were identified. Analysis of intraspecific genetic variation showed a variable pattern with high peaks of variation restricted to short regions along the *Z. tritici* chromosomes. Furthermore, these polymorphic HVR windows included two or more distinct haplotypes. This high local variation was validated on two independent *Z. tritici* assemblies, generated by Illumina and PacBio and the haplotypes were confirmed by PCR amplification. To address the origin of the HVRs, Dr. Stukenbrock hypothesized that distinct haplotype patterns in the *Z. tritici* genome could be a product of introgression or gene flow between closely related species. This hypothesis was tested by generating a phylogenetic tree for every 1 kb window along the genome. Each window was classified as "monophyletic", if sequences of the *Z. tritici* isolates clustered together or "nonmonophyletic", if the *Z. tritici* sequences clustered with the sister species. A majority of the nonmonophyletic windows correlated with coordinates of the HVRs, suggesting that the regions with high local variation and distinct haplotypes most likely originate from introgression and recurrent hybridization between *Zymoseptoria* species. When investigating functional relevance of the genomic regions with introgression signatures, it was found that protein-coding genes were not enriched in these regions. However, it seems that fast evolving genes with "high effect" mutations and transposable elements are located in the introgressed regions.

The findings presented by Dr. Stukenbrock were recently published3, providing a prominent example of how high recombination rate and recurrent hybridization enable pathogens to rapidly evolve and overcome new host resistances. By demonstrating that genome alignments generated from de novo genome assemblies (and not by mapping reads to a reference genome) are necessary to recover highly divergent regions from genomic data, this study provides valuable guidelines for performing comparative population genomic analysis on other pathogens, including plasmodiophorids. Levels and distribution of genetic variation among *P. brassicae* pathotypes and mechanisms contributing to variation are poorly understood. Active genes coding meiotic-related proteins in the *P. brassicae* e3 nuclear genome were recently identified4. This finding suggests that the recombination events are possible in the *P. brassicae* genome. Further studies are necessary to investigate whether recombination might have an important role in evolution of *P. brassicae.*

Investigating the molecular interactions of *Plasmodiophora brassicae* with *Arabidopsis thaliana* through a genome-wide association study and gene expression analysis (Poster 853-P2): J. Ochoa (Institute of Plant Genetics, Poland) presented a poster on resistance and susceptibility to clubroot disease caused by *Plasmodiophora brassicae*. More than 140 Arabidopsis accessions were infected with a P1b pathotype predominant in Poland. Arabidopsis accessions were screened for absence/presence of clubs and DNA was extracted from samples (hypocotyl and upper parts of roots) collected at 19 dpi. DNA was used for quantitative PCR to estimate relative infection levels based on the pathogen gene (Pb18S) and the host gene (AtSK11). Screening and quantitative PCR identified twelve resistant Arabidopsis accessions. These accessions were used for genome-wide association analysis (GWAS) and results showed a significant peak on a SNP next to the RPB1 resistance locus, previously identified in the Arabidopsis accessions Tsu-0 and Ze-0. GWAS analysis of Arabidopsis susceptible accessions indicated a larger number of genes. T-DNA knockout lines were created for selected gene candidates. Validation of resistance caused by the RPB1 locus as well as evaluation of T-DNA knockout lines and gene expression analysis (RNA-Seq) are ongoing.

Whole-genome analyses reveal novel pathogenic features of the necrotrophic pathogen–*Alternaria brassicae* (Poster 849-P2) : Dr. Sivasubramanian (National AgriFood Biotechnology Institute, India) presented a poster with focus on *Alternaria brassicae*, a fungal pathogen that causes leaf blight/spot disease of Brassica crops. The disease is economically important, causing 10-70% yield losses worldwide and with no known source of resistance among cultivated Brassica species.
By using Nanopore sequencing, Dr. Sivasubramanian and his team described *A. brassicae* whole-genome assembly (34 Mb) with 50% GC content, 11,593 predicted genes and 9.33% repeats. They were first to report dispensable chromosomes in *A. brassicae*. Annotation procedure predicted various effectors, secondary metabolites and carbohydrate-active enzymes some of which were solely present in *A. brassicae*. Most of the predicted effectors were common among Alternaria genus indicating a broad mechanism of pathogenesis. Synteny analysis between six Alternaria species identified a genetic basis for exclusive production of Destruxin B, a known pathogenicity factor coded by a secondary metabolite cluster. Two genes from this cluster coding for the key enzymes, the DtxS1 (nonribosomal peptide synthetase) and DtxS3 (aldo-keto reductase), were absent from all other species except *A. brassicae*. In addition, seven secondary metabolite gene clusters, including a cluster coding for HC toxin were identified on otherwise gene sparse and repeat reach dispensable chromosomes. Among six *Alternaria* species, the *A. brassicae* genome has the highest repeat content and abundant transposable elements. Moreover, a significant overlap was found between repeat-rich regions and regions with effectors and secondary metabolites.

References

1. Goodwin SB, Ben M'Barek S, Dhillon B, Wittenberg AHJ, Crane CF, et al. (2011). Finished Genome of the Fungal Wheat Pathogen Mycosphaerella graminicola Reveals Dispensome Structure, Chromosome Plasticity, and Stealth Pathogenesis. PLOS Genetics 7(6): e1002070. https://doi.org/10.1371/journal.pgen.1002070

2. Stukenbrock EH and Dutheil JY. (2018). Fine-scale recombination maps of fungal plant pathogens reveal dynamic recombination landscapes and intragenic hotspots. Genetics 208 (3): 1209–1229. https://doi.org/10.1534/genetics.117.300502

3. Feurtey A, Stevens DM, Stephan W, Stukenbrock EH. (2019). Interspecific Gene Exchange Introduces High Genetic Variability in Crop Pathogen. Gen. Biol.& Evol. 11 (11): 3095–3105. https://doi.org/10.1093/gbe/evz224

4. Stjelja S, Fogelqvist J, Tellgren-Roth C, and Dixelius, C. (2019). The architecture of the Plasmodiophora brassicae nuclear and mitochondrial genomes. Sci Rep 9, 15753. https://www.nature.com/articles/s41598-019-52274-7

>>

Value chains and regional news

- **USA: opening a new oilseed crushing plant in Montana**

Reported by US Canola Association newsletter of January (https://www.uscanola.com/newsletter/canola-quick-bytes-january-2020/): "In early 2020, the largest oilseed crushing plant in Montana is scheduled to open. Montana Specialty Mills will crush organic canola, non-GMO canola and flax, grown by farmers in Western Canada and the northern U.S. plains. It will crush up to 10,000 bushels per day or 225 tons of oilseeds." Meaning an initial capacity of 70000 tons a year for a still small market of organic and non-GMO canola.

- **Germany: UFOP report on global market Supply: Sustainable Intensification of arable Production for Food Security and Climate Protection**

"Climate change dictates more productivity and efficiency while taking the requirements of sustainable production into account at the same time. Biofuels from cultivated biomass play a leading role when these are being produced according to the legal specifications of the Renewable Energy Directive (RED II), emphasizes the UFOP" . https://www.ufop.de/english/news/sustainable-intensification-arable-production-food-security-and-climate-protection/

- **Cooking with Canola oil**

Reported by US canola Association newsletter "Canola Quick Bytes" of January 2020, the Canadian website canolainfo.org, offering information to consumer and specially" hundreds of recipes made with heart-smart canola oil" in English, Spanish, French, Chinese and Korean. https://www.canolainfo.org/recipes/find-canola-oil-recipes.php

- **Canola: boosting canola and peas protein ingredients**

Reported by Food ingredient 1st website on Jan 14th, 2020 : « Canada's Merit Functional Foods, in consortium with seed processor Pitura Seeds and health brand The Winning Combination, has raised new capital to rapidly expand its ability to meet market demand for plant-based proteins and by-products, including trending peas and canola. » The co-investment comes from the super cluster Protein Industries Canada (PIC), an industry-led, non-profit organization that aims to boost Canada's market viability as a global source of plant protein ingredients ». Merit uses the Burcon Nutras Science's technology, developed for more than 19 years and is currently building its plant-based protein processing facility, where it will produce what is marketed as the "world's first high-purity, non-GMO canola protein." Read more on https://www.foodingredientsfirst.com/news/pea-and-canola-boost-funding-will-merit-functional-foods-to-expand-disruptive-plant-protein-technology.html

- **Pakistan OSR oil imports:** Pakistan: Oilseeds and Products Update

USDA, Foreign Agricultural Service news Dec 27th, 2019: "Rapeseed imports are up ten percent from a year ago at 907,485 metric tons, while imports of soybean oil and palm oil are up 60 percent and four percent respectively. The imports offset the lower domestic cotton production. Pakistan remains one of the world's largest vegetable oil importers."

• **Ukraine-China:** Ukraine Signed A Rapeseed Meal Export Protocol with China

From USDA Foreign Agriculture Service news: USA GAIN Reports from Monday, December 23rd, 2019: "Ukraine signed a Protocol for veterinary and phytosanitary requirements for exports of rapeseed meal to China. This agreement will further stimulate rapeseed processing in Ukraine."

• **France**: drop in winter OSR acreage

Sowings of cereals and rapeseed show a general decline, in "a context of bad weather which makes the estimates of areas uncertain", said on December 10th the statistical service of the French Ministry of Agriculture (Agreste).

"The winter cereal acreage would reach 6.55 Mha in 2020, 5% down compared to 2019 and 7.8% compared to the 2015-19 average. Winter rapeseed would see its acreage shrink to 1.049 Mha (- 4.9% compared to 2019). In detail, the soft winter wheat sole would reach 4.729 Mha, down 4.8% over one year and 5.6% compared to the 2015-19 average. Winter rapeseed sole would drop 4.9% year-on-year and 26.8% from the 2015-19 average, to 1.049 Mha, the lowest since 2002.

• **Russia**

During the Canola days, Dec 2019, Sergey Tuchin, from the German Seed Alliance, reported that Russia planted nearly 1.9 million ha rapeseed in 2019 , mainly as spring OSR (about 80%) and 20% winter oilseed rape for a production of 2.2 MT, and eyes expansion to over 4.9 million by 2024. For longer term, the potential acreage in the Northern West and Siberian territories is considerable, ranging about 115Mha and offering good opportunities for spring OSR, only possible oil crop in these regions. Rapeseed fits well in cereal rotations and is oriented to export after processing in Russia, targeting in future the Chinese market with productions of Siberia and far East. Average yields are still low, less than 1.5t/ha due to low input practices in most regions and dry conditions, and technical challenges remain important.

Scientific news

Publications:

BREEDING

Blanc, N. Knock-out of the phytic acid synthesis gene BnIPK2β in rapeseed by CRISPR/Cas9. Master thesis University of Kiel. https://www.ufop.de/files/4115/5541/5630/Noelle_Blanc_MSc_thesis_10_04_18.pdf

Yu, K., Wang, X., Li, W. et al. Identification and physical mapping of **QTLs** associated with **flowering time** in Brassica napus L. Euphytica 215, 152 (2019) https://doi.org/10.1007/s10681-019-2480-8

Wolko, J., Dobrzycka, A., Bocianowski, J., & Bartkowiak-Broda, I. (2019). Estimation of **heterosis for yield**-related traits for single cross and three-way cross hybrids of oilseed rape (Brassica napus L.). Euphytica, 215(10), 156. https://doi.org/10.1007/s10681-019-2482-6

Luo, X., Tan, Y., Ma, C., Tu, J., Shen, J., Yi, B., & Fu, T. (2019). High-throughput identification of SNPs reveals extensive **heterosis** with intra-group hybridization and genetic characteristics in a large rapeseed (Brassica napus L.) panel. Euphytica, 215(10), 157. https://doi.org/10.1007/s10681-019-2484-4

Afrose, R., Hossain, M. M., Shahinur, N. N., Mostofa, M., & Shamsuzzoha, M. Gene action and **heterosis studies for yield** and yield contributing traits in Rapeseed (Brassica napus L.) genotypes by line x tester analysis. http://azarianjournals.ir/?p=3388

Dezfouli, P. M., Sedghi, M., Shariatpanahi, M. E., Niazian, M., & Alizadeh, B. (2019). Assessment of general and specific **combining abilities** in doubled haploid lines of rapeseed (Brassica napus L.). Industrial Crops and Products, 141, 111754. https://doi.org/10.1016/j.indcrop.2019.111754

Gul, S., Uddin, R., Khan, N. U., Khan, S. U., Ali, S., Ali, N., ... & Hussain, D. (2019). Heterotic response and **combining ability** analysis in F1 diallel populations of Brassica napus L. Pakistan Journal of Botany, 51(6), 2129-2141.http://dx.doi.org/10.30848/PJB2019-6(36)

Yun, D., Yi, W., Feng-wei, J., Li-juan, X., Yan, F., & Zheng-ying, Z. JIA-2019-0220 Differentially expressed miRNAs in anthers may contribute to the **fertility** of a novel Brassica napus **genic male sterile** line CN21A miRNAs . Journal of Integrative Agriculture. http://www.chinaagrisci.com/Jwk_zgnykxen/EN/article/searchArticle.do

Dhaliwal, I., Mason, A., Banga, S., Bharti, S., & Banga, S. S. (2019, October). Amelioration of **genetic diversity** and its assessment in Brassica napus-carinata introgression lines. In IOP Conference Series: Earth and Environmental Science (Vol. 346, No. 1, p. 012073). IOP Publishing. https://iopscience.iop.org/article/10.1088/1755-1315/346/1/012073/meta

AmosovaA V, ZoshchukS A, Volovik VT,Shirokova AV, Horuzhiy NE, Mozgova GV, et al.(2019) Phenotypic, biochemical and genomic variability in generations of the rapeseed (Brassica napus L.) **mutant lines** obtained via chemical mutagenesis. PLoSONE 14(8):e0221699. https://doi.org/10.1371/journal.pone.0221699

Nikzad, A., Kebede, B., Pinzon, J., Bhavikkumar, J., Yang, R. C., & Rahman, H. (2019). Potential of the **C Genome** of Different Variants of Brassica oleracea for the Improvement of Agronomic and Seed Quality Traits of B. napus Canola. Crop Science, 59(6), 2608-2620. https://doi.org/10.2135/cropsci2019.05.0304

Nikzad, A., Kebede, B. D., Pinzon, J., Bhavikkumar, J., Wang, X., Yang, R. C., & Rahman, H. (2019). Potential of the **C genome** of the different variants of Brassica oleracea for heterosis in spring B. napus canola. Frontiers in Plant Science, 10, 1691. https://doi.org/10.3389/fpls.2019.01691

Bocianowski, J., Nowosad, K., Dobrzycka, A., & Wolko, J. (2019). Estimation of additive and **epistatic gene effects** for phenotypic and biochemical traits in double haploid lines of winter rapeseed (Brassica napus L.). Indian J. Genet, 79(3), 563-570.https://doi.org/10.31742/IJGPB.79.3.6

Khan, S. U., Yangmiao, J., Liu, S., Zhang, K., Khan, M. H. U., Zhai, Y., ... & Zhou, Y. (2019). Genome-wide association studies in the genetic dissection of **ovule number, seed number, and seed weight** in Brassica napus L. Industrial Crops and Products, 142, 111877. https://doi.org/10.1016/j.indcrop.2019.111877

Jia, Y., Li, K., Liu, H., Zan, L., & Du, D. (2019). Characterization of the BnA10. tfl1 Gene Controls **Determinate Inflorescence Trait** in Brassica napus L. Agronomy, 9(11), 722. https://doi.org/10.3390/agronomy9110722

Kuai, J., Xu, S., Guo, C., Lu, K., Feng, Y., & Zhou, G. (2019). Prediction Model of the Key Components for **Lodging Resistance** in Rapeseed Stalk Using Near-Infrared Reflectance Spectroscopy (NIRS). Journal of Spectroscopy, 2019. https://doi.org/10.1155/2019/9396718

Xiao, Z., Zhang, C., Tang, F., Yang, B., Zhang, L., Liu, J., ... & Du, H. (2019). Identification of candidate genes controlling **oil content** by combination of genome-wide association and transcriptome analysis in the oilseed crop Brassica napus. Biotechnology for biofuels, 12(1), 216. https://doi.org/10.1186/s13068-019-1557-x or https://search.proquest.com/openview/e40c1b139520063709e8a4612ad7d5fc/1?pq-origsite=gscholar&cbl=55236

Kaur, H., Wang, L., Stawniak, N., Sloan, R., van Erp, H., Eastmond, P., & Bancroft, I. (2019). The impact of reducing **fatty acid desaturation** on the composition and thermal stability of rapeseed oil. Plant biotechnology journal. https://doi.org/10.1111/pbi.13263

Gong, J., Li, D., Li, X., Yu, X., Guo, Y., & Chen, M. (2019). The possible role of BnaA10. SOI. a in seed **fatty acid biosynthesis** of rapeseed. Plant Breeding. https://doi.org/10.1111/pbr.12766

Zafar, S., Tang, M. Q., Wang, Y. K., Sarwar, R., Liu, S. Y., & Tan, X. L. (2020). Candidate genes-association study to identify loci related to **oleic acid** in Brassica napus using SNP markers and their heterologous expression in yeast. Plant Physiology and Biochemistry, 146, 294-302. https://doi.org/10.1016/j.plaphy.2019.11.026

Zhu Q, King GJ, Liu X, Shan N, Borpatragohain P, Baten A, et al. (2019) Identification of SNP loci and candidate genes related to four important **fatty acid composition** in Brassica napus using genomewide association study. PLoSONE 14(8):e0221578. https://doi.org/10.1371/journal.pone.0221578

Yin, N. W., Wang, S. X., Jia, L. D., Zhu, M. C., Yang, J., Zhou, B. J., ... & Qu, C. M. (2019). Identification and Characterization of Major Constituents in Different-**Colored Rapeseed Petals** by UPLC–HESI-MS/MS. Journal of agricultural and food chemistry, 67(40), 11053-11065. https://doi.org/10.1021/acs.jafc.9b05046

Zaman, Q. U., Chu, W., Hao, M., Shi, Y., Sun, M., Sang, S. F., ... & Hu, Q. (2019). CRISPR/Cas9-Mediated Multiplex Genome Editing of JAGGED Gene in Brassica napus L. Biomolecules, 9(11), 725. https://doi.org/10.3390/biom9110725 (**pod shattering** resistance)

Zhai, Y., Yu, K., Cai, S., Hu, L., Amoo, O., Xu, L., ... & Khan, M. H. U. (2019). Targeted mutagenesis of BnTT8 homologs controls **yellow seed coat** development for effective oil production in Brassica napus L. Plant biotechnology journal. https://doi.org/10.1111/pbi.13281

Bisht N.C., Augustine R. (2019) Development of Brassica Oilseed Crops with Low Antinutritional **Glucosinolates** and Rich in Anticancer Glucosinolates. In: Jaiwal P., Chhillar A., Chaudhary D., Jaiwal R. (eds) Nutritional Quality Improvement in Plants. Concepts and Strategies in Plant Sciences. Springer, Cham https://doi.org/10.1007/978-3-319-95354-0_10

Dolatabadian, A. (2019). Characterising the role of Brassica napus genomic structural variation in **disease resistance**. PhD thesis University of Western Australia. https://pdfs.semanticscholar.org/c331/a3a7ef2c1c205c944e9d032813c1e648cd01.pdf

Wang, X., Zeng, L., Xu, L., Chen, W., Liu, F., Yang, H., ... & Fang, X. (2019). **Clubroot resistance** introgression in interspecific hybrids between Raphanus sativus and Brassica napus. Oil Crop Science, 4(3), 139-151. http://www.cnki.com.cn/Article/CJFDTotal-OICR201903002.htm

Li, L., Long, Y., Li, H., & Wu, X. (2019). Comparative transcriptome analysis reveals key pathways and hub genes in rapeseed during the early stage of **Plasmodiophora brassicae** infection. Frontiers in Genetics, 10, 1275. https://doi.org/10.3389/fgene.2019.01275

Farid, M., Yang, R. C., Kebede, B., & Rahman, H. (2019). Evaluation of Brassica oleracea accessions for resistance to **Plasmodiophora brassicae** and identification of genomic regions associated with resistance. Genome, (999), 1-11. https://doi.org/10.1139/gen-2019-0098

Ding, L. N., Li, M., Guo, X. J., Tang, M. Q., Cao, J., Wang, Z., ... & Tan, X. L. (2019). Arabidopsis GDSL1 overexpression enhances rapeseed **Sclerotinia sclerotiorum resistance** and the functional identification of its homolog in Brassica napus. Plant biotechnology journal. https://doi.org/10.1111/pbi.13289

Neik, T. X. (2019). Identification of a candidate Blackleg resistance gene in Brassica napus and a candidate avirulence gene in **Leptosphaeria maculans** in the B. napus-L. maculans pathosystem. . PhD thesis University of Western Australia. https://doi.org/10.26182/5d7b34e93aa39

Fu, F., Liu, X., Wang, R., Zhai, C., Peng, G., Yu, F., & Fernando, W. D. (2019). Fine mapping of Brassica napus **blackleg resistance gene Rlm1** through bulked segregant RNA sequencing. Scientific reports, 9(1), 1-10. https://doi.org/10.1038/s41598-019-51191-z

Yang, H. (2019). Identification of candidate genes for **blackleg resistance** in the new Brassica juncea canola. PhD thesis University of Queensland, Australia. https://doi.org/10.14264/uql.2019.886

Alahakoon, A. M. A. Y. (2019). Engineering **disease resistance and frost tolerance** in canola (Brassica napus L.) using ACYL-COENZYME A-BINDING PROTEINS (Doctoral dissertation). https://minerva-access.unimelb.edu.au/handle/11343/228921?show=full

Wrucke, D. F., Talukder, Z. I., & Rahman, M. (2019). Genome-wide association study for **frost tolerance** in rapeseed/canola (Brassica napus) under simulating freezing conditions. Plant Breeding. https://doi.org/10.1111/pbr.12771

French, B., Miyan, S., & Azam, G. (2019). Towards improved **aluminium tolerance** in canola. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_French_Bob_165.pdf

Zhang, Y., Ali, U., Zhang, G., Yu, L., Fang, S., Iqbal, S., ... & Guo, L. (2019). **Transcriptome** analysis reveals genes commonly responding to **multiple abiotic stresses** in rapeseed. Molecular Breeding, 39(11), 158. https://doi.org/10.1007/s11032-019-1052-x or researchgate.net

Gubaev, R. F., Boldyrev, S. V., Goryunov, D. V., & Goryunova, S. V. (2019). **High-throughput genotyping** for association mapping of agronomically important traits in rapeseed: a brief review of the current status. Current Challenges in Plant Genetics, Genomics, Bioinformatics, and Biotechnology, 24, 230. http://publ.icgbio.ru/wp-content/uploads/2019/10/230-231.pdf

Corlouer, E., Gauffreteau, A., Bouchet, A. S., Bissuel-Bélaygue, C., Nesi, N., & Laperche, A. (2019). **Envirotypes** Based on Seed Yield Limiting Factors Allow to Tackle **G× E Interactions**. Agronomy, 9(12), 798. https://doi.org/10.3390/agronomy9120798

Raman, H. (2019). Untangling and unifying **adaptive and productivity traits** in canola. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Raman_Harsh_286.pdf

Zhang, H., Berger, J., Herrmann, C., Brown, A., & Flottmann, S. (2019). **Canola yield** and its association with phenological, architectural and physiological **traits** across the rainfall zones of southwestern Australia. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Zhang_Heping_314.pdf

Stanic, M. (2019). Increasing Reproductive Output of Brassica napus (canola) Through Manipulation of **Shoot Architecture** (Unpublished master's thesis). University of Calgary, Calgary, AB. http://hdl.handle.net/1880/111263

US Patent US20190254247A1 SHAOHONG, F. U., LI, Yun, YANG, Jin, et al. Method for breeding brassica napus varieties and materials with double haploid induction line of rapeseed. U.S. Patent Application No 16/310,497. https://patents.google.com/patent/US20190254247A1/en

U.S. Patent Application No. 16/310,627 Yang, Jin, et al. "Method for breeding cruciferous vegetable materials and varieties with double haploid induction line of rapeseed.". https://patents.google.com/patent/US20190327923A1/en

CROP PROTECTION

Hu, S., Xu, Q., Zhang, Y., & Zhu, F. (2020). Stimulatory effects of boscalid on virulence of **Sclerotinia sclerotiorum** indicate hormesis may be masked by inhibitions. Plant Disease, (ja). https://doi.org/10.1094/PDIS-07-19-1421-RE

Yu, Y., Cai, J., Ma, L., Huang, Z., Wang, Y., Fang, A., ... & Bi, C. (2019). Population structure and aggressiveness of **Sclerotinia sclerotiorum** from rapeseed (Brassica napus) in Chongqing City. Plant Disease, (ja). https://doi.org/10.1094/PDIS-07-19-1401-RE

Ni, L., & Punja, Z. K. (2020). Effects of a foliar fertilizer containing boron on the development of Sclerotinia stem rot (**Sclerotinia sclerotiorum**) on canola (Brassica napus L.) leaves. Journal of Phytopathology, 168(1), 47-55. https://doi.org/10.1111/jph.12865

Chakma, T., Sinha, B., Lalhruaitluangi, C., Chakrapani, K., & Tampakleimachanu, W. (2019). Variability of **Albugo candida** causing white rust in rapeseed and mustard under Manipur conditions. Plant Disease Research, 34(1), 54-57. https://doi.org/10.5958/2249-8788.2019.00011.8

Yadav, P., Mir, Z. A., Ali, S., Papolu, P. K., & Grover, A. (2020). A combined transcriptional, biochemical and histopathological study unravels the complexity of **Alternaria resistance** and susceptibility in Brassica coenospecies. Fungal Biology, 124(1), 44-53. https://doi.org/10.1016/j.funbio.2019.11.002

Al-lami, H., You, M. P., & Barbetti, M. Role of foliage component and host age on **Alternaria leaf spot** (Alternaria japonica and A. brassicae) severity in canola and mustard and yield loss in canola. https://doi.org/10.1071/CP19262

Zou, Z., Liu, F., Chen, C., & Fernando, W. G. (2019). Effect of Elevated **CO2 Concentration on the Disease Severity** of Compatible and Incompatible Interactions of Brassica napus–Leptosphaeria maculans Pathosystem. Plants, 8(11), 484. https://doi.org/10.3390/plants8110484

Peng, G., Song, T., Tonu, N., Wen, R., & Solutions, N. A. (2019). Enhancing the Durability of **Clubroot Resistance** with Multiple Genes. https://www.saskcanola.com/quadrant/System/research/reports/report-Peng-clubrootresistance-long.pdf

Sedaghatkish, A., Gossen, B. D., Yu, F., Torkamaneh, D., & McDonald, M. R. (2019). Whole-genome DNA similarity and population structure of **Plasmodiophora brassicae** strains from Canada. BMC genomics, 20(1), 744. https://doi.org/10.1186/s12864-019-6118-y

Chapara, V., Kalwar, N., Lubenow, L., & Chirumamilla, A. (2019). Prevalence of **clubroot** on canola in North Dakota. J Agron Agri Sci, 2(008). See researchgatre.net

Cao, T., Manolii, V., Zhou, Q., Hwang, S. F., & Strelkov, S. (2019). Effect of canola (Brassica napus) cultivar rotation on **Plasmodiophora brassicae** pathotype composition. Canadian Journal of Plant Science, (ja). https://doi.org/10.1139/CJPS-2019-0126

Al-Daoud, F., Gossen, B. D., & McDonald, M. R. (2020). Maturation of resting spores of **Plasmodiophora brassicae** continues after host cell death. Plant Pathology, 69(2), 310-319. https://doi.org/10.1111/ppa.13124

Wen, R., Lee, J., Chu, M., Tonu, N., Dumonceaux, T., Gossen, B., ... & Peng, G. (2019). Quantification of **Plasmodiophora brassicae** Resting Spores in Soils Using Droplet Digital PCR (ddPCR). Plant Disease, (ja). https://doi.org/10.1094/PDIS-03-19-0584-RE

Poveda, J., Hermosa, R., Monte, E., & Nicolás, C. (2019). The **Trichoderma harzianum** Kelch protein ThKEL1 plays a key role in root colonization and the induction of systemic defense in Brassicaceae plants. Frontiers in Plant Science, 10, 1478. https://doi.org/10.3389/fpls.2019.01478

BRASSET A. Master thesis: Remote-sensing **of bushy rapeseed** using satellite images Sentinel-2 / Télédétection du colza buissonnant à partir des images satellites Sentinel-2. French with English abstract / https://ecosys.versailles-grignon.inra.fr/SpatialAgronomy/publications/2019-10_teledetection_AntoineBrasset.pdf

Todorov, I., Boyadzhiev, P., Teofilova, T., Elshishka, M., & Peneva, V. (2019, November). **Chalcidoid fauna** (Hymenoptera: Chalcidoidea) of grasslands situated in rapeseed (Brassica napus L.) surroundings in Bulgaria. In ARPHA Conference Abstracts (Vol. 2, p. e46451). Pensoft Publisher https://doi.org/10.3897/aca.2.e46451

Binns, M., Hoffmann, A., van Helden, M., Heddle, T., & Umina, P. Earwigs–latest research on these **damaging pests.** https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2019/08/earwigs-latest-research-on-these-damaging-pests

Abdel-Galil, F. A., & Mahmoud, M. A. (2019). Biotic Factors Responsible for Management the Population Trend of Cabbage Aphid **Brevicoryne brassicae** L, Inhabiting Canola Plants. Egyptian Academic Journal of Biological Sciences. A, Entomology, 12(5), 89-98. https://eajbsa.journals.ekb.eg/article_53418.html

AGRONOMY

Warner, D. J., & Lewis, K. A. (2019). Evaluation of the risks of **contaminating** low erucic acid rapeseed with high **erucic rapeseed** and identification of mitigation strategies. Agriculture, 9(9), 190. https://doi.org/10.3390/agriculture9090190

Yedilova, A. K., Volkov, D. V., Shamekova, M. H., & Zhambakin, K. Z. (2019). MONITORING THE DISTRIBUTION OF **TRANSGENES** FROM THE GENETICALLY MODIFIED RAPESEED LINE. OF BIOLOGICAL AND MEDICAL, 31. https://doi.org/10.32014/2019.2519-1629.18

Kumari, S., Singh, H. V., Jat, R. S., Yadav, G. L., Dotaniya, M. L., & Choudhary, R. L. (2019). Impact of **Transplanting** on Productivity and Profitability of Indian Mustard: A Pilot Study. Int. J. Curr. Microbiol. App. Sci, 8(9), 1658-1665. https://doi.org/10.20546/ijcmas.2019.809.188

Wei, X., Mingliang, W., Jiangnan, L., Lan, M., Wei, Q., & Jiajie, L. (2019, April). Design and Testing of **Transplanting Hole-Forming Machine** for Potted Rapeseed Seedlings. In 2019 11th International Conference on Measuring Technology and Mechatronics Automation (ICMTMA) (pp. 49-56). IEEE. https://doi.org/10.1109/ICMTMA.2019.00018

Das, A., Ray, M., & Murmu, K. (2019). **Yield** and Yield Attributes of Hybrid Mustard as Affected by **Crop Geometry** and Varieties. International Journal of Current Microbiology and Applied Science, 8(04), 2160-2166. https://doi.org/10.20546/ijcmas.2019.804.253

Eihe, P., Vebere, L. L., Grinfelde, I., Pilecka, J., Sachpazidou, V., & Grinberga, L. (2019, November). The effect of acidification of **pig slurry** digestate applied on winter rapeseed on the **ammonia emission reduction**. In IOP Conference Series: Earth and Environmental Science (Vol. 390, No. 1, p. 012043). IOP Publishing. https://iopscience.iop.org/article/10.1088/1755-1315/390/1/012043/meta

Kadioglu, H., Hatterman-Valenti, H., Jia, X., Chu, X., Aslan, H., & Simsek, H. (2019). **Groundwater Table Effects on the Yield**, Growth, and Water Use of Canola (Brassica napus L.) Plant. Water, 11(8), 1730. https://doi.org/10.3390/w11081730

Marjanović-Jeromela, A., Terzić, S., Jankulovska, M., Zorić, M., Kondić-Špika, A., Jocković, M., ... & Nagl, N. (2019). Dissection of year related **climatic variables** and their effect on winter rapeseed (Brassica napus L.) development and yield. Agronomy, 9(9), 517. https://doi.org/10.3390/agronomy9090517

Chen, Y., Donohue, R. J., McVicar, T. R., Waldner, F., Mata, G., Ota, N., ... & Lawes, R. A. (2019). Crop-SI, a **yield estimation model** based on earth observation and meteorological-driven stress indices. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Chen_Yang_84.pdf

Kirkegaard, J., & Lilley, J. (2019). Frontiers of **farm productivity**: using more of the soil and more of the season. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Kirkegaard_John_328.pdf

Farre, I., Harries, M., Bucat, J., & Seymour, M. (2019). **Optimum sowing window** to maximise canola yield in Western Australia. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Farre_Imma_224.pdf

Simpson, M. (2019). Geographic targeting of **canola genotypes to environments** using spatial data and multi-environment trial data analysis. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Simpson_Marja_171.pdf

Qian, B., Jing, Q., Zhang, X., Shang, J., Liu, J., Wan, H., ... & De Jong, R. (2019). Adapting estimation methods of daily solar radiation for **crop modelling applications in Canada**. Canadian Journal of Soil Science, 99(4), 533-547. https://doi.org/10.1139/cjss-2019-0018

Britton, T. (2019). Determining **evapotranspiration** and crop coefficient values using an adjusted Penman-Monteith equation over canola (Brassica napus) in southern Manitoba. Master thesis http://hdl.handle.net/1993/34189

Berry, P. A. (2019). Decomposition of **Brassicaceae Residue** in the Willamette Valley. PhD thesis Oregon State University. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/8w32rb75k

Roberts, P., Moodie, M., & Wilhelm, N. (2019). **Intercropping** increases **productivity** in the South Australian Mallee. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Roberts_Penny_66.pdf

Graham, R. (2019). Canopeo, a new mobile device application with potential to **measure seed colour change** in canola. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Graham_Rick_362.pdf

Riffkin, P. (2019). **Components of yield** in winter and spring canola types in the HRZ of southern **Australia.** http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Riffkin_Penny_30.pdf

Brill, R., Ware, A., Kirkegaard, J., McCaffery, D., McMaster, C., Graham, R., & Taylor, C. (2019). Horses for courses–benefits of adjusting canola **sowing date and phenology choice** based on fallow and in-crop rainfall. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Brill_Rohan_280.pdf

Hossain, Z., Johnson, E. N., Wang, L., Blackshaw, R. E., Cutforth, H., & Gan, Y. (2019). **Plant establishment, yield** and yield components of Brassicaceae oilseeds as potential biofuel feedstock. Industrial Crops and Products, 141, 111800. https://doi.org/10.1016/j.indcrop.2019.111800

Wallace, A. (2019). **Mid-row banding urea: effect on NUE** and productivity in wheat and canola. http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Wallace_Ashley_203.pdf

Becker, F., MacLaren, C., Brink, C. J., Jacobs, K., le Roux, M. R., & Swanepoel, P. A. (2019). High **nitrogen rates** do not increase canola yield and may affect soil bacterial functioning. Agronomy Journal. https://doi.org/10.1002/agj2.20066

Gulden, R. H. Developing **Methods To Estimate Pod-drop and Seed-shatter** In Canola. https://pdfs.semanticscholar.org/7b8e/e1566ea95d103999d3f72e592c51b7f9f1dc.pdf

Mwendwa, J. (2019). Mechanisms of **weed suppression** in wheat (Triticum aestivum L.) and Canola (Brassica napus L.) in Southeastern Australia (Doctoral dissertation, Charles Sturt University Wagga Wagga, Australia).https://researchoutput.csu.edu.au/ws/portalfiles/portal/34619691/Mechanisms_of_weed_suppression_in_wheat_and_canola_in_Southeastern_Australia_PhD.pdf

Physiology

Zhang, Z. H., Zhou, T., Tang, T. J., Song, H. X., Guan, C. Y., Huang, J. Y., & Hua, Y. P. (2019). A multiomics approach reveals the pivotal role of subcellular reallocation in determining rapeseed resistance to **cadmium toxicity**. Journal of Experimental Botany, 70(19), 5437-5455. https://doi.org/10.1093/jxb/erz295

Rao, G., Huang, S., Ashraf, U., Mo, Z., Duan, M., Pan, S., & Tang, X. (2019). Ultrasonic seed treatment improved **cadmium (Cd) tolerance** in Brassica napus L. Ecotoxicology and environmental safety, 185, 109659. https://doi.org/10.1016/j.ecoenv.2019.109659

Tan, X., Long, W., Zeng, L., Ding, X., Cheng, Y., Zhang, X., & Zou, X. (2019). Melatonin-Induced Transcriptome Variation of Rapeseed Seedlings under **Salt Stress**. International journal of molecular sciences, 20(21), 5355. https://doi.org/10.3390/ijms20215355

Zhu, B., Xu, Q., Zou, Y., Ma, S., Zhang, X., Xie, X., & Wang, L. (2019). Effect of **potassium deficiency** on growth, antioxidants, ionome and metabolism in rapeseed under **drought stress**. Plant Growth Regulation, 1-12. https://doi.org/10.1007/s10725-019-00545-8

Tóth, J., Gergely, I., Berzsenyi, Z., & Ördög, V. Influence of Nostoc entophytum and Tetracystis sp. on **Winter Survival** of Rapeseed. https://doi.org/10.17265/2161-6264/2019.04.004

Harirforoush, M., Sorooshzadeh, A., & GHANATI, F. (2019). Study the growth and biochemical characteristics of canola **under flooded conditions**, using potassium nitrate and polyamines putrescine. Journal of Plant Process and Function, 8(30), 341-351. https://jispp.iut.ac.ir/article-1-861-en.html

Song, D., Zhou, J., Lai, L., Alarcon, I., Tar'an, B., & Abrams, S. (2019). Development of ABA Antagonists to Overcome ABA-and **Low Temperature-Induced Inhibition** of Seed Germination in Canola, Lentil, and Soybean. Journal of Plant Growth Regulation, 1-11. https://doi.org/10.1007/s00344-019-10036-9

PROCESSING and USES

LAGUNA, Oscar. Valorization of rapeseed and sunflower **phenolics** : from the dry fractionation of raw materials to the synthesis of multifunctional molecules / Valorisation des composés phénoliques de colza et de tournesol : du fractionnement des matières premières à la synthèse de molécules multifonctionnelles. (French, English summary) 2019. Thèse de doctorat. Université de Montpellier. https://agritrop.cirad.fr/593466/

Zardo, I., Rodrigues, N. P., Sarkis, J. R., & Marczak, L. D. (2020). Extraction and identification by mass spectrometry of **phenolic compounds** from canola seed cake. Journal of the Science of Food and Agriculture, 100(2), 578-586. https://doi.org/10.1002/jsfa.10051

Remón J., Matharu A.S., Clark J.H. (2020) Microwave-Assisted Hydrothermal Valorisation of Rapeseed Meal for the Co-Production of **High Purity Lignin and Saccharide**-Rich Aqueous Solutions. In: Sayigh A. (eds) Renewable Energy and Sustainable Buildings. Innovative Renewable Energy. Springer, Cham. DOI https://doi.org/10.1007/978-3-030-18488-9_61

Jiang, D., Ju, X., & Wang, L. Identification and Quantification of DPP-IV-Inhibitory Peptides from Hydrolyzed-**Rapeseed-Protein**-Derived Napin with Analysis of the Interactions between Key Residues and Protein Domains. Agric. Food Chem.2019, 67, 3679−3690. https://dl.uswr.ac.ir/bitstream/Hannan/61107/1/2019%20JoAFC%20Volume%2067%20Issue%2013%20April%20%2829%29.pdf

Kalaydzhiev, H., Brandão, T. R. S., Ivanova, P., Silva, C. L. M., & Chalova, V. I. (2019). A two-step factorial design for optimization of **protein extraction** from industrial rapeseed meal after ethanol-assisted reduction of antinutrients. International Food Research Journal, 26(4). https://pdfs.semanticscholar.org/7b0f/324cf28222b75027dfa445b4f371a5ab8776.pdf

Ahlström, C. (2019). Optimization of **Protein Recovery** from Rapeseed Press Cake. Master thesis, Lund University, https://lup.lub.lu.se/student-papers/search/publication/8994327

Östbring, K., Tullberg, C., Burri, S., Malmqvist, E., & Rayner, M. (2019**). Protein Recovery** from Rapeseed Press Cake: Varietal and Processing Condition Effects on Yield, Emulsifying Capacity and Antioxidant Activity of the Protein Rich Extract. Foods, 8(12), 627. https://doi.org/10.3390/foods8120627

U.S. Patent Application No. 16/314,867. Willemsen, J. H. M., Vermunt, J. H. A. J., Hylkema, N. N., & Smolders, G. J. F. (2019). Process for making a soluble rapeseed **protein isolate** https://patents.google.com/patent/US20190307149A1/en

U.S. Patent Application No. 16/315,087. Shi, J., Van Den Burg, A. C., & Smolders, G. J. F. (2019). Foam comprising soluble **rapeseed protein isolate** https://patents.google.com/patent/US20190307160A1/en

Östbring, K., Malmqvist, E., Nilsson, K., Rosenlind, I., & Rayner, M. (2020). The Effects of Oil **Extraction Methods** on Recovery Yield and Emulsifying Properties of **Proteins** from Rapeseed Meal and Press Cake. Foods, 9(1), 19. https://doi.org/10.3390/foods9010019

Baker, P. W., & Charlton, A. (2020). A comparison **in protein extraction** from four major crop residues in Europe using chemical and enzymatic processes-a review. Innovative Food Science & Emerging Technologies, 59, 102239. https://doi.org/10.1016/j.ifset.2019.102239

Guo, T., Wan, C., & Huang, F. (2019). Extraction of rapeseed cake oil using subcritical R134a/butane: **Process optimization** and quality evaluation. Food science & nutrition, 7(11), 3570-3580. https://doi.org/10.1002/fsn3.1209

Forero-Hernandez, H. A. (2019). PhD thesis, Validation and Improvement of Property and **Process Modeling** for Oleochemicals. Technical University of Denmark https://backend.orbit.dtu.dk/ws/portalfiles/portal/194456519/Thesis_hafh.pdf

Asl, P. J., Niazmand, R., & Jahani, M. (2020). Theoretical and experimental assessment of supercritical CO2 in the **extraction of phytosterols** from rapeseed oil deodorizer distillates. Journal of Food Engineering, 269, 109748. https://doi.org/10.1016/j.jfoodeng.2019.109748

Mao, X., Zhao, X., Huyan, Z., Liu, T., & Yu, X. (2019). Relationship of Glucosinolate Thermal Degradation and Roasted Rapeseed **Oil Volatile Odor**. Journal of agricultural and food chemistry, 67(40), 11187-11197. https://doi.org/10.1021/acs.jafc.9b04952

Rusinek, R., Siger, A., Gawrysiak-Witulska, M., Rokosik, E., Malaga-Toboła, U., & Gancarz, M. (2019). Application of an **electronic nose** for determination of **pre-pressing treatment** of rapeseed based on the analysis of volatile compounds contained in pressed oil. International Journal of Food Science & Technology. https://doi.org/10.1111/ijfs.14392

Bikker, P., Kreis, A., Oberholzer, T., Royer, E., & Bach Knudsen, K. E. (2019). Evaluation of fractionation as a method to improve the **nutritional value of rapeseed meal.** In EAAP Scientific Series (pp. 265-277). Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-891-9_34

Böttger, C., Weber, T., Mader, F., & Südekum, K. H. (2019). Application of three laboratory methods to **estimate the protein value** of rapeseed meal for ruminants. In Proceedings of the 10th Nordic Feed Science Conference, Uppsala, Sweden, 11-12 June 2019 (pp. 34-39). Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences. https://www.cabdirect.org/cabdirect/abstract/20193404502

Mandaluniz, N., Díaz, D. O., Arranz, J., García-Rodriguez, A., & Ruiz, R. (2019). Effect of cold-pressed rapeseed cake formulated out of the concentrate in **dairy sheep**. XVIII Jornadas sobre Producción Animal, Zaragoza, España, 7 y 8 de mayo de 2019, 209-211. https://www.cabdirect.org/cabdirect/abstract/20193404631

Novikova Galina, Osokin Vladimir, Korobkov Alexey, Sharonova Tatyana. Development of the Installation for **Peeling Rapeseed** in the Electromagnetic Field of Ultrahigh Frequency (Russian with English abstract) https://elibrary.ru/item.asp?id=39134849

Pińkowska, H. A. N. N. A., Krzywonos, M. A. Ł. G. O. R. Z. A. T. A., & Wolak, P. A. W. E. Ł. (2019). Valorization of **rapeseed meal by hydrothermal treatment**—effect of reaction parameters on low molecular products distribution. Cellul Chem Technol, 53(7–8), 755-765 http://www.cellulosechemtechnol.ro/pdf/CCT7-8(2019)/p.755-765.pdf

Békri, K., Roussi, A., Lapierre, H., Pellerin, D., & Ouellet, D. R. (2019). **Amino acid digestibility** of canola meal estimated with pulse-dose in dairy cows or in roosters. In EAAP Scientific Series (pp. 1701-1714). Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-891-9_137

Ashayerizadeh, A., Dastar, B., Shams Shargh, M., Shabani, A., Jazi, V., & Soumeh, E. A. (2019). Effect of feeding **fermented rapeseed meal** on nutrients digestibility and digestive enzymes activity in

broiler chickens. In EAAP Scientific Series (pp. 2113-2122). Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-891-9_85

Watts, E. S., Rose, S. P., Mackenzie, A. M., & Pirgozliev, V. R. (2019). The effects of supercritical carbon dioxide extraction and cold-pressed hexane extraction on the chemical composition and feeding value **of rapeseed meal for broiler chickens**. Archives of animal nutrition, 1-15. https://doi.org/10.1080/1745039X.2019.1659702

Qaisrani, S. N., Van Krimpen, M. M., Verstegen, M. W. A., Hendriks, W. H., & Kwakkel, R. P. (2019). Effects of three major protein sources on performance, gut morphology and fermentation characteristics in **broilers**. British poultry science, 1-8. https://doi.org/10.1080/00071668.2019.1671958

Bryan, D. D., MacIsaac, J. L., McLean, N. L., Rathgeber, B. M., & Anderson, D. M. (2019). Nutritive Value of Expeller-Pressed Yellow Canola Meal for **Broiler Chickens** Following Enzyme Supplementation. The Journal of Applied Poultry Research, 28(4), 1156-1167. https://doi.org/10.3382/japr/pfz082

Oryschak, M. A., Smit, M. N., & Beltranena, E. (2020). Brassica napus and Brassica juncea extruded-expelled cake and solvent-extracted meal as feedstuffs for **laying hens**: Lay performance, egg quality, and nutrient digestibility. Poultry science, 99(1), 350-363. https://doi.org/10.3382/ps/pez501

Mnisi, C. M., & Mlambo, V. (2019). Canola meal as an alternative dietary protein source in **quail (Coturnix coturnix)** diets–A review. Acta Agriculturae Scandinavica, Section A—Animal Science, 1-12. https://doi.org/10.1080/09064702.2019.1679873

Hansen, J. Ø., Øverland, M., Skrede, A., Anderson, D. M., & Collins, S. A. (2019). A **meta-analysis** of the effects of dietary canola/double low rapeseed meal on growth performance of **weanling and growing-finishing pigs.** Animal Feed Science and Technology, 114302. https://doi.org/10.1016/j.anifeedsci.2019.114302 or see Researchgate.net

Kjos, N. P., Sundaram, A. Y., Mydland, L. T., Ånestad, R., Tauson, A. H., & Øverland, M. (2019). Effects of long-term feeding of **rapeseed meal** on skeletal muscle transcriptome, production efficiency and meat quality traits in Norwegian Landrace growing-**finishing pigs.** https://doi.org/10.1371/journal.pone.0220441

Oliveira, M. S. F., Htoo, J. K., Wiltafsky, M. K., González-Vega, J. C., & Stein, H. H. (2019). Amino acid digestibility and metabolizable energy in a heating double-low rapeseed meal fed to **pigs**. In EAAP Scientific Series (pp. 299-300). Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-891-9_80

Velayudhan, D. E., Hossain, M. M., Stein, H. H., & Nyachoti, C. M. (2019). Standardized ileal **digestibility** of amino acids in canola meal fed to gestating and **lactating sows**. Journal of animal science, 97(10), 4219-4226. https://doi.org/10.1093/jas/skz283

Micek, P., Słota, K., & Górka, P. (2019). Effect of heat treatment and heat treatment in combination with lignosulfonate on in situ **rumen degradability** of canola cake crude protein, lysine and methionine. Canadian Journal of Animal Science, (ja). https://doi.org/10.1139/CJAS-2018-0216

Gan, L., Wu, P., Feng, L., Jiang, W. D., Liu, Y., Jiang, J., ... & Zhou, X. Q. (2019). Erucic acid inhibits growth performance and disrupts intestinal structural integrity of on-**growing grass carp** (Ctenopharyngodon idella). Aquaculture, 513, 734437. https://doi.org/10.1016/j.aquaculture.2019.734437

Long, X., Wu, R., Wu, X., Hou, W., Pan, G., Zeng, C., & Cheng, Y. (2019). Effects of dietary fish oil replacement with blended vegetable oils on growth, lipid metabolism and antioxidant capacity of subadult **swimming crab** Portunus trituberculatus. Aquaculture Nutrition, 25(6), 1218-1230. https://doi.org/10.1111/anu.12936

Yuan, Y., Wang, X., Jin, M., Jiao, L., Sun, P., Betancor, M. B., ... & Zhou, Q. (2020). Modification of nutritional values and flavor qualities of muscle of **swimming crab** (Portunus trituberculatus): Application of a dietary lipid nutrition strategy. Food chemistry, 308, 125607. https://doi.org/10.1016/j.foodchem.2019.125607

von Danwitz, A., & Schulz, C. (2020). Effects of dietary rapeseed **glucosinolates,** sinapic acid and phytic acid on feed intake, growth performance and **fish health in turbot** (Psetta maxima L.). Aquaculture, 516, 734624. https://doi.org/10.1016/j.aquaculture.2019.734624

Mu, H., Wei, C., Xu, W., Gao, W., Zhang, W., & Mai, K. (2020). Effects of replacement of dietary fish oil by rapeseed oil on growth performance, anti-oxidative capacity and inflammatory response in large **yellow croaker** Larimichthys crocea. Aquaculture Reports, 16, 100251. https://doi.org/10.1016/j.aqrep.2019.100251

Ruyter, B., Sissener, N. H., Østbye, T. K., Simon, C. J., Krasnov, A., Bou, M., ... & Berge, G. M. (2019). n-3 Canola oil effectively replaces fish **oil** as a new safe dietary source of DHA in feed for juvenile Atlantic **salmon**. British Journal of Nutrition, 122(12), 1329-1345. https://doi.org/10.1017/S0007114519002356

Sagan, A., Blicharz-Kania, A., Szmigielski, M., Andrejko, D., Sobczak, P., Zawiślak, K., & Starek, A. (2019). Assessment of the Properties of Rapeseed Oil Enriched with Oils Characterized by **High Content of α-linolenic** Acid. Sustainability, 11(20), 5638. https://doi.org/10.3390/su11205638

Zhou, Q., Jia, X., Deng, Q., Chen, H., Tang, H., & Huang, F. (2019). Quality evaluation of rapeseed oil in Chinese traditional **stir-frying.** Food science & nutrition, 7(11), 3731-3741. https://doi.org/10.1002/fsn3.1232

Forero-Hernandez, H., Jones, M. N., Sarup, B., Jensen, A. D., Abildskov, J., & Sin, G. (2020). Comprehensive development, uncertainty and sensitivity analysis of a **model** for the **hydrolysis of rapeseed oil.** Computers & Chemical Engineering, 133, 106631. https://doi.org/10.1016/j.compchemeng.2019.106631

Wu, Y., Wang, M., Yu, L., Tang, S. W., Xia, T., Kang, H., ... & Cheng, L. (2019). A mechanism for efficient cadmium **phytoremediation** and high **bioethanol** production by combined mild chemical pretreatments with desirable **rapeseed stalks**. Science of The Total Environment, 135096. https://doi.org/10.1016/j.scitotenv.2019.135096

Paciorek-Sadowska, J., Borowicz, M., Isbrandt, M., Czupryński, B., & Apiecionek, Ł. (2019). The Use of Waste from the Production of **Rapeseed O**il for Obtaining of **New Polyurethane Composites**. Polymers, 11(9), 1431. https://doi.org/10.3390/polym11091431

Kurańska, M., Pinto, J. A., Salach, K., Barreiro, M. F., & Prociak, A. (2020). Synthesis of thermal insulating **polyurethane foams from lignin** and rapeseed based polyols: A comparative study. Industrial Crops and Products, 143, 111882. https://doi.org/10.1016/j.indcrop.2019.111882

Li, Y., Zhang, L., Xu, Y. J., Li, J., Cao, P., & Liu, Y. (2019). Evaluation of the **functional quality of rapeseed oil** obtained by different extraction processes in a Sprague-Dawley rat model. Food & function, 10(10), 6503-6516. https://pubs.rsc.org/en/content/articlelanding/2019/fo/c9fo01592b/unauth#!divAbstract

Jian, F., Tang, P., Al Mamun, M. A., & Jayas, D. S. (2019). Effect of Field Treatment on Microfloral Respiration and **Storability of Canola** under Different Storage Conditions. American Journal of Plant Sciences, 10(11), 1989.https://doi.org/10.4236/ajps.2019.1011139

Jian, F., Liu, J., & Jayas, D. S. (2019). A new mathematical **model** to simulate sorption, desorption and hysteresis of **stored canola** during aeration. Drying Technology, 1-12. https://doi.org/10.1080/07373937.2019.1690501

ECONOMY and MARKET

Chekhova, I., & Chekhov, S. (2019). Assessment of the efficiency of rape production in **Ukraine**. Agricultural and Resource Economics: International Scientific E-Journal, 5(3), 141-151. 5U (Ukrainian, English summary) https://doi.org/10.22004/ag.econ.293990

Woźniak, E., Waszkowska, E., Zimny, T., Sowa, S., & Twardowski, T. (2019). The Rapeseed Potential in **Poland and Germany** in the Context of Production, Legislation and Intellectual Property Rights. Frontiers in plant science, 10, 1423. https://doi.org/10.3389/fpls.2019.01423

Fischer, Carolyn and Meyer, Timothy, Baptists and Bootleggers in the **Biodiesel Trade:** EU-Biodiesel (Indonesia) (October 1, 2019). Robert Schuman Centre for Advanced Studies Research Paper No. RSCAS 2019/80. Available at SSRN: https://ssrn.com/abstract=3489187 or http://dx.doi.org/10.2139/ssrn.3489187

Shi, R., Archer, D. W., Pokharel, K., Pearlson, M. N., Lewis, K. C., Ukaew, S., & Shonnard, D. R. (2019). Analysis of **Renewable Jet** from Oilseed Feedstocks Replacing Fallow in the **US** Northern Great Plains. ACS Sustainable Chemistry & Engineering, 7(23), 18753-18764. https://doi.org/10.1021/acssuschemeng.9b02150

Paull, J. (2019). **Contamination** of Farms by Genetically Modified Organisms (**GMOs**): Options for Compensation. Journal of Organics, 6(1), 31-46. https://orgprints.org/36398/

Meier, E., Lilley, J., Kirkegaard, J., Whish, J., & McBeath, T. (2019, August). Profitable management packages for canola. In Proceedings of the 2019 Agronomy Australia Conference (pp. 25-29). http://agronomyaustraliaproceedings.org/images/sampledata/2019/2019ASA_Meier_Elizabeth_68.pdf

Malla, S., & Brewin, D. G. Biotechnology, Crop R&D and Public Policy: The Case of Canola. https://www.athensjournals.gr/business/2019-3263-AJBE-ECO-Malla-02.pdf

Zhao, Y., Deng, H., Yu, C., & Hu, R. (2019). The **Chinese** public's awareness and attitudes toward genetically modified foods with different labeling. NPJ science of food, 3(1), 1-7. https://doi.org/10.1038/s41538-019-0049-5

MUSTARD and Other Brassicae

Singh, J., Singh, A. K., Chaubey, A. K., & Baghel, M. S. (2019). Impact of technological interventions on **productivity** of mustard in Kymore Plateau and Satpura hills zone of Madhya Pradesh. Int. J. Curr. Microbiol. App. Sci, 8(2), 2848-2855. https://pdfs.semanticscholar.org/6f58/56b890607c33385be7fb66ec66b8de0b6af8.pdf

Singh, J., & Sharma, P. C. (2019). CS 15000-1-2-2-2-1 (IC0624502; INGR17051), an Indian mustard (Brassica juncea) Germplasm with High **Tolerance to Salinity** (ECe 12 dS/m) and Alkalinity (pH 9.4). Indian Journal of Plant Genetic Resources, 32(2), 258-259. http://www.indianjournals.com/ijor.aspx?target=ijor:ijpgr&volume=32&issue=2&article=039

Meena, S. S., Meena, P. D., Singh, V. V., Meena, H. S., Singh, D., Yadav, R., ... & Singh, Y. P. (2019). DRMR-2019 (IC0598622; INGR17077), An Indian Mustard (Brassica juncea) Germplasm with

White Rust Resistance. Indian Journal of Plant Genetic Resources, 32(2), 281-281. http://www.indianjournals.com/ijor.aspx?target=ijor:ijpgr&volume=32&issue=2&article=065

Miscellaneous

Imaging, artificial intelligence

Hu, L., Liu, C., & Wu, X. (2019, July). Image Segmentation of Rape Based on EXG and Lab Spatial Threshold Algorithms. In Proceedings of the 2019 International Conference on Artificial Intelligence and Computer Science (pp. 384-389). https://doi.org/10.1145/3349341.3349436

Liu, Y., Liu, S., Li, J., Guo, X., Wang, S., & Lu, J. (2019). Estimating biomass of winter oilseed rape using vegetation indices and texture metrics derived from UAV multispectral images. Computers and Electronics in Agriculture, 166, 105026. https://doi.org/10.1016/j.compag.2019.105026

Upcoming International and national events

3-5 February 2020. iCROPM2020. Crop modelling for Agriculture and Food Security under Global Change. Montpellier, France.
https://www.icropm2020.org/

9-12 February 2020. World congress on oils and fats. Sidney, Australia.
www.wcofsydney2020.com

26-29 April 2020. AOCS Annual Meeting. Montreal, Canada.
https://annualmeeting.aocs.org/

6-10 September 2020. 32nd Annual Meeting AAIC Association for the Advancement of Industrial Crops. Bologna, Italy.
www.aaic.org

Abstract Submission Deadline: April 20, 2020

27-30 September 2020. Brassica 2020, Saskatoon, Canada.
http://cruciferseq.ca/Brassica2020

29 September – 1st October 2020. IOBC-WPRS Working Group "Integrated Control in Oilseed Crops", Rennes, France.
http://www.iobc-wprs.org/events/index.html

24-27 September 2023. 16th International Rapeseed Congress, Sydney, Australia**.**
www.irc2023sydney.com

We invite you to share information with the rapeseed/canola community: let us know the scientific projects, events organized in your country, crop performances or any information of interest in rapeseed/canola R&D.

Contact GCIRC News:

Etienne Pilorgé, GCIRC Secretary-Treasurer: e.pilorge@terresinovia.fr

Contact GCIRC: contact@gcirc.org