


Article

Identification of high-yielding soybean lines with exceptional seed composition qualities

Jay Gillenwater^{1,2,†,*} , John Doe^{2,†,‡}

¹ Muenster University of Applied Sciences - Institute for Infrastructure, Water, Resources, Environment
Correnstr. 25, 48149 Muenster, Germany; leutnant@fh-muenster.de

² Your department Street, City, Country; jhgille2@ncsu.edu

* Correspondence: leutnant@fh-muenster.de; Tel.: +XX-000-00-0000.

† Current address: Updated affiliation

‡ These authors contributed equally to this work.

Version April 11, 2022 submitted to Journal Not Specified



Simple Summary: A Simple summary goes here.

Abstract: A single paragraph of about 200 words maximum. For research articles, abstracts should give a pertinent overview of the work. We strongly encourage authors to use the following style of structured abstracts, but without headings: 1) Background: Place the question addressed in a broad context and highlight the purpose of the study; 2) Methods: Describe briefly the main methods or treatments applied; 3) Results: Summarize the article's main findings; and 4) Conclusion: Indicate the main conclusions or interpretations. The abstract should be an objective representation of the article, it must not contain results which are not presented and substantiated in the main text and should not exaggerate the main conclusions.

Keywords: keyword 1; keyword 2; keyword 3 (list three to ten pertinent keywords specific to the article, yet reasonably common within the subject discipline.).

1. Version

This Rmd-skeleton uses the mdpi Latex template published 2019/02. However, the official template gets more frequently updated than the 'rticles' package. Therefore, please make sure prior to paper submission, that you're using the most recent .cls, .tex and .bst files (available [here](#)).

2. Introduction

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be reviewed carefully and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. Citing a journal paper [1,2]. And now citing a book reference Gujer [3]. Please use the command [2] for the following MDPI journals, which use author-date citation: Administrative Sciences, Arts, Econometrics, Economies, Genealogy, Humanities, IJFS, JRFM, Laws, Religions, Risks, Social Sciences.

3. Materials and Methods

3.1. Population development

In 2018, oil mapping populations 201 and 202 were grown at the Central Crops Research Station in Clayton, NC. These populations consisted of 273 and 237 recombinant inbred lines (RILs) respectively. Several agronomic traits were scored in the field for each population. These included height, lodging, maturity date, and a composite agronomic score. Lodging was scored on a scale of 1-5 where 5 indicates that all plants in a plot are on the ground, and a score of 1 indicates that all plants are erect[Feh87]. The agronomic score aimed to capture other traits of value such as visual estimation of pod load and plot uniformity to provide a general score of a line's agronomic desirability. Agronomic score was recorded on a scale of 1-5 as well, with 1 identifying the best lines of a population, and 5 the worst. Maturity was recorded at the R8 maturity date. Height was measured in centimeters from the soil to the top of the plant. Following harvest, yield, seed weight, protein, and oil content were measured after seed was air dried to approximately 7% moisture content in a greenhouse. Protein and oil contents were measured on a dry basis using a Perten DA 7250 NIR® instrument. Yield and seed weight were measured after seed had been sifted and cleaned of debris and cracked seed. To select lines for the 2019 growing season, lines with abnormally low bulk weights or extreme maturity dates from 2018 were first removed from consideration. Two yield trials were then developed for each mapping population. The maturity data of RILs were considered when forming tests such that the lines of each test would have a maturity data range approximately half that of the total mapping population from which it was derived. RILs were selected for each test which were also representative of the distribution of seed protein and seed oil traits for each population. Eighty unique lines were selected from each population which satisfied these criteria, and each yield test was comprised of 40 RILs. Three high-yielding check cultivars and the two parents of the respective population were also included in each test. Yield check cultivars Dunphy, Osage, and Roy were used in tests 1 and 2, while Dunphy, Dilday, and N.C. Raleigh were used for tests 3 and 4. These lines were selected to represent the estimated maturities of the RILs in each test. The parents for tests 1 and 2 were cultivars LMN09-119 and N09-09, and the parents for tests 3 and 4 were LMN09-19 and N13-47.

These four tests were grown in two locations in 2019: the Tidewater Research Station in Plymouth, NC (PLY) and the Caswell Research Farm in Kinston, NC (CAS). The same data was collected for each test in this season that was collected in the previous season. Selections were done using this data by first identifying the lines with a yield within or above a least significant difference (LSD) of the average yield of the checks for each test. Further selection was done using the seed composition traits by identifying the thirty lines with the highest protein + oil content.

These thirty lines were then grouped into two new tests of 15 RILs each which were then grown in both the 2020 and 2021 seasons. These tests were grown in CLA and CAS in 2020 and CAS and PLY in 2021.

3.2. Statistical Analysis

The data for seed yield, seed oil, and seed protein contents were analyzed using a mixed model with the `metan[?] R` package. Environment, replication nested with environment, and the interaction of genotype with environment were considered to be random effects while genotype was considered to be a fixed effect.

Materials and Methods should be described with sufficient details to allow others to replicate and build on published results. Please note that publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the availability of materials or information. New methods and protocols should be described in detail while well-established methods can be briefly described and appropriately cited.

Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.

Interventionary studies involving animals or humans, and other studies require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

4. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

4.1. Subsection Heading Here

Subsection text here.

4.1.1. Subsubsection Heading Here

Bulleted lists look like this:

- First bullet
- Second bullet
- Third bullet

Numbered lists can be added as follows:

1. First item
2. Second item
3. Third item

The text continues here.

All figures and tables should be cited in the main text as Figure 1, Table 1, etc.

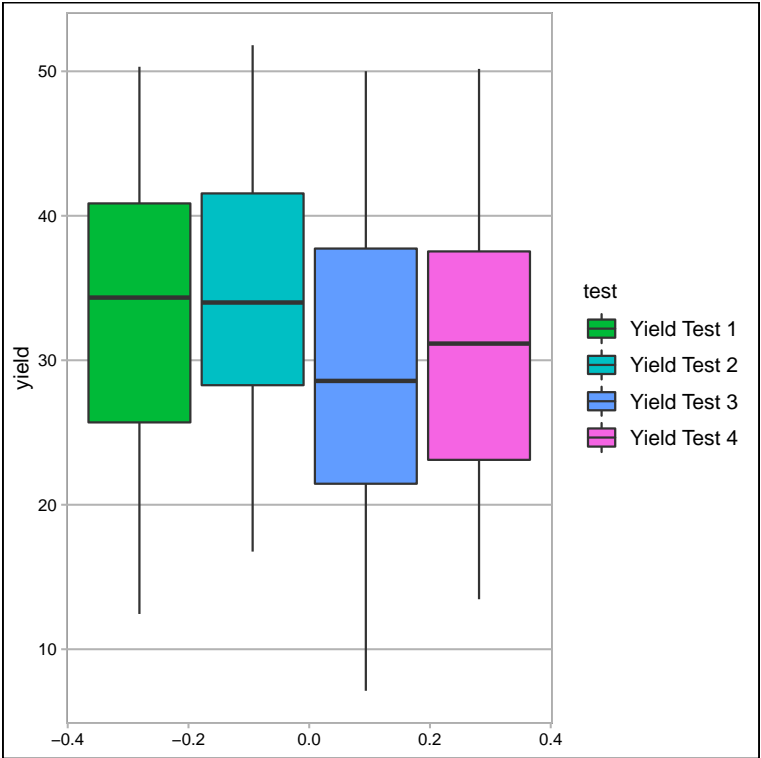


Figure 1. This is a figure, Schemes follow the same formatting. If there are multiple panels, they should be listed as: (a) Description of what is contained in the first panel. (b) Description of what is contained in the second panel. Figures should be placed in the main text near to the first time they are cited. A caption on a single line should be centered.



Figure 2. This is a figure, Schemes follow the same formatting. If there are multiple panels, they should be listed as: (a) Description of what is contained in the first panel. (b) Description of what is contained in the second panel. Figures should be placed in the main text near to the first time they are cited. A caption on a single line should be centered.

Table 1. This is a table caption. Tables should be placed in the main text near to the first time they are cited.

Title 1	Title 2	Title 3
entry 1	data	data
entry 2	data	data

96

This is an example of an equation:

$$\S \tag{1}$$

97

Example of a theorem:

98

Theorem 1. *Example text of a theorem.*

Table 2. This is a table caption. Tables should be placed in the main text near to the first time they are cited.

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

genotype	Protein + Oil					Protein					value
	value	rank	test_avg	check_avg_value	msd	value	rank	test_avg	check_avg_value	msd	
LMN09-119	69.44	1	66.02	65.22	0.73	51.67	1	45.34	44.41	1.09	40.3
N18-1855	68.07	2				47.51	4				43.1
N18-1632-1	67.49	3				46.81	5				45.2
N18-1763	67.46	4				47.98	2				39.2
N18-1632-2	67.41	5				46.79	6				46.3
N18-1595	67.04	6				47.73	3				43.3
N18-1731	66.66	7				46.27	8				43.3
N18-1674	66.38	8				45.48	9				44.3
N18-1572	66.26	9				45.38	10				38.3
N09-09	66.26	10				46.74	7				41.3
N18-1956	66.13	11				45.26	12				34.3
N18-1682	65.87	12				45.27	11				43.3
N18-1751	65.23	13				44.85	13				41.3
N18-1635	65.22	14				43.79	16				46.3
N18-1604	65.19	15				43.99	14				43.3
N18-1620	65.15	16				43.98	15				46.3
N18-1641	64.83	17				43.73	17				41.3
Dilday	63.54	18				41.40	19				46.3
NC-Raleigh	63.53	19				40.32	20				41.3
Dunphy	63.34	20				41.94	18				47.3

The text continues here. Proofs must be formatted as follows:

Example of a proof:

Proof of Theorem 1. Text of the proof. Note that the phrase ‘of Theorem 1’ is optional if it is clear which theorem is being referred to. □

The text continues here.

5. Discussion

Authors should discuss the results and how they can be interpreted in perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

6. Conclusion

This section is not mandatory, but can be added to the manuscript if the discussion is unusually long or complex.

7. Patents

This section is not mandatory, but may be added if there are patents resulting from the work reported in this manuscript.

Acknowledgments: All sources of funding of the study should be disclosed. Please clearly indicate grants that you have received in support of your research work. Clearly state if you received funds for covering the costs to publish in open access.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "X.X. and Y.Y. conceive and designed the experiments; X.X. performed the experiments; X.X. and Y.Y. analyzed the data; W.W. contributed reagents/materials/analysis tools; Y.Y. wrote the paper." Authorship must be limited to those who have contributed substantially to the work reported.

Conflicts of Interest: Declare conflicts of interest or state 'The authors declare no conflict of interest.' Authors must identify and declare any personal circumstances or interest that may be perceived as inappropriately influencing the representation or interpretation of reported research results. Any role of the funding sponsors in the design of the study; in the collection, analyses or interpretation of data in the writing of the manuscript, or in the decision to publish the results must be declared in this section. If there is no role, please state 'The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, an in the decision to publish the results'.

Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	linear dichroism

Appendix A

Appendix A.1

The appendix is an optional section that can contain details and data supplemental to the main text. For example, explanations of experimental details that would disrupt the flow of the main text, but nonetheless remain crucial to understanding and reproducing the research shown; figures of replicates for experiments of which representative data is shown in the main text can be added here if brief, or as Supplementary data. Mathematical proofs of results not central to the paper can be added as an appendix.

Appendix B

All appendix sections must be cited in the main text. In the appendixes, Figures, Tables, etc. should be labeled starting with 'A', e.g., Figure A1, Figure A2, etc.

References

1. Bertrand-Krajewski, J.L.; Chebbo, G.; Saget, A. Distribution of pollutant mass vs volume in stormwater discharges and the first flush phenomenon. *Water Research* **1998**, *32*, 2341–2356.
2. Leutnant, D.; Muschalla, D.; Uhl, M. Stormwater Pollutant Process Analysis with Long-Term Online Monitoring Data at Micro-Scale Sites. *Water* **2016**, *8*, 299. 00000, doi:10.3390/w8070299.
3. Gujer, W. *Systems Analysis for Water Technology*; Springer-Verlag: Berlin, Heidelberg, Germany, 2008.

Sample Availability: Samples of the compounds are available from the authors.

© 2022 by the authors. Submitted to *Journal Not Specified* for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).