Data in Brief 54 (2024) 110352

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

A dataset for analyzing the climate change response of grain quality of 48 Japanese rice cultivars with contrasting levels of heat tolerance

Hitomi Wakatsuki[a], Takahiro Takimoto[a], Yasushi Ishigooka[b], Motoki Nishimori[a], Mototaka Sakata[c], Naoya Saida[c], Kosuke Akagi[c], David Makowski[d], Toshihiro Hasegawa[a,*]

[a] *Institute for Agro-Environmental Sciences, NARO, 3-1-3 Kannondai, Tsukuba, Ibaraki 305-8604, Japan*
[b] *Hokkaido Agricultural Research Center, NARO, 082-0081, Japan*
[c] *Kochi Prefectural Agricultural Research Center, Nankoku 783-0023, Japan*
[d] *Applied Mathematics and Computer Science (MIA-PS), INRAE AgroParisTech, Université Paris-Saclay, Palaiseau 91120, France*

ARTICLE INFO

Article history:
Received 28 October 2023
Revised 22 February 2024
Accepted 18 March 2024
Available online 28 March 2024

Dataset link: A dataset for determining the dependence of rice grain quality of 48 Japanese cultivars with varying heat tolerance on weather conditions during grain filling (Original data)

Keywords:
Chalky grain
High temperature
Climate change adaptation
Systematic literature search
Oryza sativa

ABSTRACT

Climate change has a significant impact on rice grain appearance quality; in particular, high temperatures during the grain filling period increase the rate of chalky immature grains, reducing the marketability of rice. Heat-tolerant cultivars have been bred and released to reduce the rate of chalky grain and improve rice quality under high temperatures, but the ability of these cultivars to actually reduce chalky grain content has never been demonstrated due to the lack of integrated datasets. Here, we present a dataset collected through a systematic literature search from publicly available data sources, for the quantitative analysis of the impact of meteorological factors on grain appearance quality of various rice cultivars with contrasted heat tolerance levels. The dataset contains 1302 field observations of chalky grain rates (%) - a critical trait affecting grain appearance sensitive to temperature shocks - for 48 cultivars covering five different heat-tolerant ranks (HTRs) collected at 44 sites across

* Corresponding author.
E-mail address: thase@affrc.go.jp (T. Hasegawa).

https://doi.org/10.1016/j.dib.2024.110352
2352-3409/

Japan. The dataset also includes the values of key meteorological variables during the grain filling period, such as the cumulative mean air temperature above the threshold temperature (TaHD), mean solar radiation, and mean relative humidity over 20 days after heading, obtained from a gridded daily meteorological dataset with a 1-km resolution developed by the National Agriculture and Food Research Organization. The dataset covers major commercial rice cultivars cultivated in Japan in different environmental conditions. It is a useful resource for analyzing the climate change impact on crop quality and assess the effectiveness of genetic improvements in heat tolerance. Its value has been illustrated in the research article entitled "Effectiveness of heat tolerance rice cultivars in preserving grain appearance quality under high temperatures - A meta-analysis", where the dataset was used to develop a statistical model quantifying the effects of high temperature on grain quality as a function of cultivar heat tolerance.

Specifications Table

Subject	Agronomy and Crop Science
Specific subject area	Climate change impacts on agriculture; genetic variability in heat tolerance in rice; crop environmental responses
Data format	Raw, Filtered
Type of data	Tables, Figures, Chart, Reference list
Data collection	Chalky grain percentage (CG) and heading dates of major rice cultivars in Japan were obtained through a systematic literature search using three data sources: 1) NARO's Rice Cultivar and Characteristics Database; 2) four scientific databases (J-STAGE, CiNii Research, SCOPUS, and AgriKnowledge); 3) Kochi Prefectural Agricultural Research Center's Performance Tests for Recommended Varieties of Rice data from 2013 to 2020. The gridded daily meteorological dataset with a 1-km resolution developed by NARO provided daily mean, minimum, and maximum air temperature, relative humidity, and solar radiation.
Data source location	The 1302 field observations were collected at 44 sites in 33 prefectures (out of 47), covering seven regions (out of eight) in Japan. Weather data were obtained from the gridded daily meteorological dataset with a 1-km resolution developed by NARO, which was created based on ground-based observations at around 1,300 sites (about every 17 km) across Japan. All articles provided the data is listed in the reference list file in the repository.
Data accessibility	Repository name: Mendeley data Data identification number: 10.17632/xwv7bpp5rn.2 Direct URL to data: https://data.mendeley.com/datasets/xwv7bpp5rn/2
Related research article	Wakatsuki, H., Takimoto, T., Ishigooka, Y., Nishimori, M., Sakata, M., Saida, N., Akagi, K., Makowski D. (2024) Effectiveness of heat tolerance rice cultivars in preserving grain appearance quality under high temperatures in Japan - A meta-analysis, Field Crops Research [1].

1. Value of the Data

- The dataset includes 1,302 field observations of chalky grain content - a major rice quality criterion.
- It covers almost all standard cultivars registered in all regions in Japan except Hokkaido, with contrasted levels of heat tolerance (susceptible, moderately susceptible, intermediate, mod-

erately tolerance, and tolerant) and can be used to analyze the impact of weather conditions on chalky grain for the most important regions and rice variety of Japan.
- All the data were collected in open fields, without any additional artificial warming, in conditions resembling those observed on real farms. The data collection also includes critical meteorological variables and geographical information for each observation, making it ready to study quality-climate relationships.
- This dataset offers useful resources to validate models predicting rice grain quality, and conduct meta-analysis to quantify the climate change impact on crop quality [1].

2. Background

Climate change, specifically rising temperatures, has a negative impact on rice grain quality by increasing the chalky grain percentage (CG). Since the 2000s, heat-tolerant cultivars have been bred and released to reduce CG under high temperatures, but the ability of these cultivars to actually reduce CG has never been demonstrated. The aim of this dataset is to facilitate analysis of the effect of different weather conditions on CG, taking into account the heat tolerance of rice cultivars during grain filling.

3. Data Description

(1) "CG_database_8.25.xlsx" is the main data spreadsheet file containing the values of the variables listed in "Meta-data_CGdatabase.xlsx.
(2) "Meta-data_CGdatabase_8.25.xlsx" is a summary of the dataset that includes information such as the definition and unit of the variables used in "CG_database_8.25.xlsx".
(3) Table 1 is the list of cultivars used for the systematic literature search.
(4) Fig. 1 is the PRISMA diagram, depicting the systematic literature search processes.
(5) Table 2 is the list of cultivars for each heat tolerance rank (HTR) groups and their years of release, breeding institutes, and prefectures where these institutes are located, included in "CG_database.xlsx".
(6) "Reference list.pdf provides a list of 49 studies identified from the search on the four scientific research databases considered.

Table 1
List of 63 cultivars used for the systematic literature search.

	Cultivars
Standard cultivars registered by Ministry of Agriculture, Forestry, and Fisheries (MAFF) [2,3],	Akanezora, Akisayaka, Aoinokaze, Hatsuboshi, Hinohikari, Komanomai, Matsuribare, Sainokagayaki, Sasanishiki, Satojiman, Tomohonami, Kinuhikari, Koganebare, Sinrei, Tachiharuka, Akitakomachi, Haenuki, Hitomebore, Koshihikari, Mutsuhomare, Nikomaru, Nipponbare, Mizuhonokagayaki, Akisakari, Fukei227, Hanaechizen, Koganemasari, Kokoromachi, Mineharuka, Natsuhonoka, Nishihikari, Satonouta, Shifukunominori, Tochiginohoshi, Tsuyahime, Natsuhonoka, Eminokizuna, Fusaotome, Otentosodachi
Other heat-tolerant cultivars	Akihonami, Fufufu, Harumoni, Koisomeshi, Yumiazusa, Chihominori, Inahokkori, Koinoyokan, Akiharuka, Kumasannnochikara, Koshijiwase, Nijinokirameki, Tsukiakari, Toyama81, Tsuyakirari Emidawara, Kankinokaze, Genkitsukushi, Natsuhikari, Mie23, Oidemai, Sagabiyori, Sainokizuna, Yosakoibijin

Table 2
Name of cultivars and their detailed information for each heat tolerance rank (HTR) group included in the main dataset file “CG_database.xlsx”.

HTR	Cultivar name	Year of release	Breeding Institute	Prefecture
3	Akanezora[1)]	1986	Aichi Prefectural Agricultural Research Center	Aichi
	Akisayaka	1996	Fukuoka Prefectural Agriculture and Forestry Research Center	Fukuoka
	Aoinokaze	1986	Aichi Prefectural Agricultural Research Center	Aichi
	Hatsuboshi	1972	Aichi Prefectural Agricultural Research Center	Aichi
	Hinohikari	1986	Miyazaki Agricultural Research Institute	Miyazaki
	Matsuribare	1990	Aichi Prefectural Agricultural Research Center	Aichi
	Sainokagayaki	2000	Saitama Agricultural Technology Research Center	Saitama
	Satojiman	2001	Institute of Crop Science, NARO	Ibaraki
4	Kinuhikari	1983	Central Region Agricultural Research Center (Hokuriku Research Station), NARO	Niigata
	Koganebare	1977	Aichi Prefectural Agricultural Research Center	Aichi
	Koisomeshi[3)]	2015	Western Region Agricultural Research Center, NARO	Hiroshima
	Shinrei	1974	Miyazaki Agricultural Research Institute	Miyazaki
	Tachiharuka	2010	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
	Yumiazusa[2)]	2014	Tohoku Agricultural Research Center, NARO	Miyagi
5	Akitakomachi	1984	Akita Prefectural Agriculture, Forestry and Fisheries Research Center	Akita
	Chihominori	2012	Tohoku Agricultural Research Center, NARO	Miyagi
	Emidawara	2014	Institute of Crop Science, NARO	Ibaraki
	Haenuki	1990	Yamagata Integrated Agricultural Research Center	Yamagata
	Harumoni[4)]	2009	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
	Hitomebore	1988	Miyagi Prefectural Furukawa Agricultural Experiment Station	Miyagi
	Inahokkori	2011	Western Region Agricultural Research Center, NARO	Hiroshima
	Kankinokaze	2012	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
	Koshihikari	1953	Fukui Agricultural Experiment Station	Fukui
	Mutsuhomarre	1980	Aomori Agricultural Research Center	Aomori
	Nikomaru	2002	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
	Nipponbare	1961	Aichi Prefectural Agricultural Research Center	Aichi
6	**Akiharuka**	2013	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
	Akisakari	2009	Fukui Agricultural Experiment Station	Fukui
	Fukei227	2009	Aomori Agricultural Research Center	Aomori
	Hanaechizen	1988	Fukui Agricultural Experiment Station	Fukui
	Koganemasari	1973	Miyazaki Agricultural Research Institute	Miyazaki
	Koinoyokan	2009	Western Region Agricultural Research Center, NARO	Hiroshima
	Kokoromachi	1993	Miyagi Prefectural Furukawa Agricultural Experiment Station	Miyagi
	Mineharuka	2002	Aichi Prefectural Agricultural Research Center	Aichi
	Nijinokirameki	2015	Central Region Agricultural Research Center (Hokuriku Research st.), NARO	Niigata
	Nishihikari	1977	Miyazaki Agricultural Research Institute	Miyazaki
	Shifukunominori	2015	Tohoku Agricultural Research Center, NARO	Miyagi
	Tochiginohoshi	2008	Tochigi Prefectural Agricultural Experiment Station	Tochigi
	Tsukiakari	2013	Central Region Agricultural Research Center (Hokuriku Research st.), NARO	Niigata
	Tsuyahime	2005	Yamagata Integrated Agricultural Research Center	Yamagata
	Tsuyakirari	2012	Kyusyu Okinawa Agricultural Research Center, NARO	Fukuoka
7	Eminokizuna	2008	Central Region Agricultural Research Center (Hokuriku Research st.), NARO	Niigata
	Fusaotome	1994	Chiba Prefectural Agriculture and Forestry Research Center	Chiba
	Genkitsukushi[5)]	2005	Fukuoka Prefectural Agriculture and Forestry Research Center	Fukuoka
	Natsuhikari[6)]	1980	Kagoshima Prefectural Institute for Agricultural Development	Kagoshima
	Natsuhonoka	2009	Kagoshima Prefectural Institute for Agricultural Development	Kagoshima
	Otentosodachi	2006	Miyazaki Agricultural Research Institute	Miyazaki
	Yosakoibijin[6)]	2014	Kochi Prefectural Agricultural Research Center	Kochi

1) Cultivars in plain text are standard cultivars designated to each HTR in the MAFF guideline [4].
2) Cultivars in bold text are recently released cultivars registered in the RCC database with their HTR classified following the MAFF guideline.
3) HTR based on [5].
4) HTR based on [6].
5) HTR based on [7].
6) HTR based on [8].

4. Experimental Design, Materials and Methods

4.1. Inclusion and exclusion criteria

Studies obtained from the literature search were selected to facilitate the analysis of the effects of meteorological factors on grain quality of major commercial cultivars with different heat tolerance levels. We selected studies satisfying the following criteria:

(1) Experiments were carried out in the open field without any warming treatments. Experiments using pots and/or glasshouse or polyhouse were excluded.
(2) Studies should include the following data: CG, heading dates, and precise experimental field locations.
(3) Cultivars whose heat tolerance ranks are not known were excluded.

4.2. Data collection

A systematic literature search was conducted using three different sources (Fig. 1).

1)NARO's Rice Cultivar and Characteristics (RCC) database (https://ineweb.narcc.affrc.go.jp/)

The database contains breeding progress, morphological and ecological characteristics, and appearance and taste quality characteristics of over 500 MAFF-registered varieties. In December 2021, we searched this database for experiments involving 63 cultivars: 39 conventional cultivars

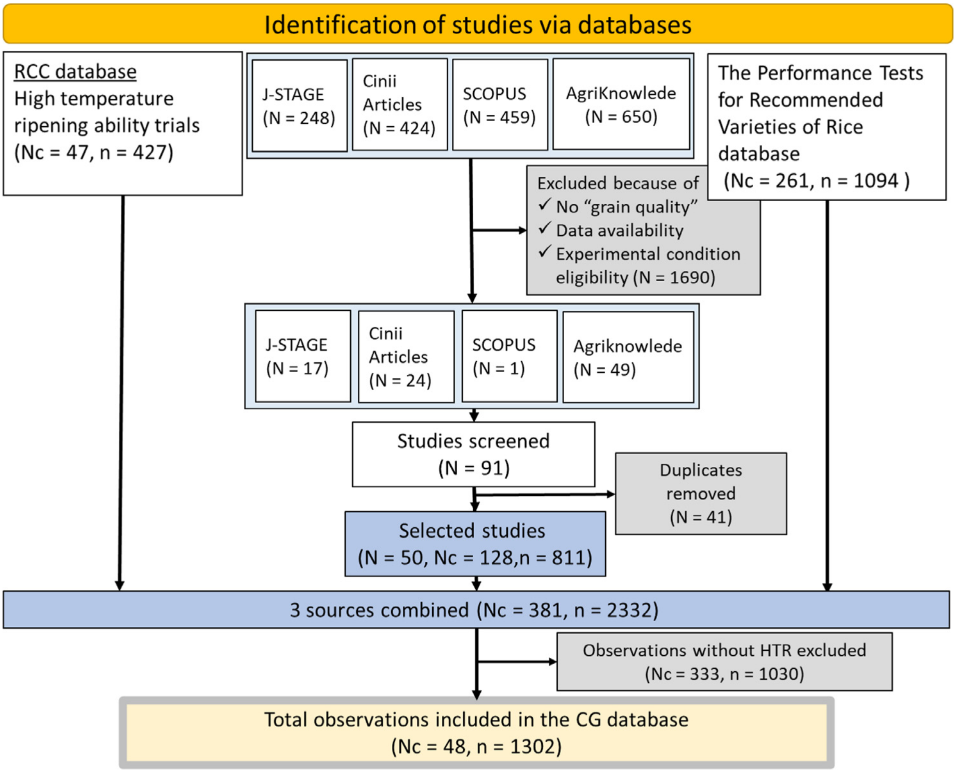

Fig. 1. A PRISMA diagram depicting data collection and selection processes. Nc is the number of cultivars, N is the number of studies, n is the number of observations.

of various heat tolerance ranks under the Plant Variety Protection and Seed Act (No. 83 of 1998) [4], and 24 heat-tolerant cultivars (Table 1). We then extracted those that met the inclusion criteria outlined in 2.1. This process yielded 427 observations for 47 cultivars.

2)Four databases containing peer-reviewed scientific publications and bulletins of national and prefectural agricultural research stations in Japan

(1) J-STAGE (https://www.jstage.jst.go.jp/browse/-char/en)
(2) CiNii Research (https://cir.nii.ac.jp/?lang=en)
(3) SCOPUS (https://www.scopus.com/)
(4) AgriKnowledge, a database for agricultural science and technology of Japan (https://agriknowledge.affrc.go.jp/),

In December 2021, we searched J-STAGE and CiNii Research using the search term "Kouon-tojuku" in Japanese, which means "grain filling under high temperatures," and received 248 and 424 results, respectively. Applying the inclusion/exclusion criteria, we selected 17 and 24 papers from J-STAGE and CiNii Research, respectively.

The SCOPUS search was conducted in December 2021, using the following code:

PUBYEAR > 2001 AND (TITLE-ABS((("heat stress tolerance" OR "heat tolerance" OR "heat stress") AND ("genotyp*" OR "cultivar" OR "grain quality" OR "nutrient quality"))) OR AUTHKEY((("heat stress tolerance" OR "heat tolerance" OR "heat stress") AND ("genotyp*" OR "cultivar" OR "grain quality" OR "nutrient quality")))) AND (TITLE-ABS({greenhouse gas} OR {global warming} OR {climate change} OR {climatic change} OR {climate variability} OR {climate warming}) OR AUTHKEY({greenhouse gas} OR {global warming} OR {climate change} OR {climatic change} OR {climate variability} OR {climate warming})) AND NOT ((TITLE-ABS(MRV) OR AUTHKEY(MRV)))

MRV stands for Measurement, Reporting, and Verification, the process for quantifying greenhouse gas emissions, and was used with "NOT" to exclude papers that focused on climate change mitigation. The SCOPUS search yielded 459 results. However, only one study met the inclusion/exclusion criteria.

Additionally, in June 2022, we conducted a literature search in AgriKnowledge, using 63 cultivar names (Table 1) as a search string, and collected 650 articles, of which 49 studies met the criteria.

Selected papers from each database were gathered and checked for duplicates, yielding 50 studies with 811 CG observations of 128 cultivars.

(3) Kochi Prefectural Agricultural Research Center's Performance Tests for Recommended Varieties of Rice data from 2013 to 2020

The record of these variety trials contains 1094 sets of field observations of 261 cultivars.

The records obtained from the three independent data sources were combined (2332 observations), and cultivars with unknown HTR (1030 observations) were excluded, yielding 1302 observations of 48 cultivars (Fig. 1).

4.3. *Data extraction*

4.3.1. *Site information*

For each of the 1302 observations, we retrieved site information such as prefecture, municipality, latitude, and longitude (Meta-data) where the observations were collected. If latitude and longitude were not available, we used Google Map to identify them. The soil group at each site was retrieved if available in the literature, and if not, we extracted it referring to the Japan Soil Map by the soil-inventory project website (NARO, https://soil-inventory.rad.naro.go.jp/).

4.3.2. *Crop information*

In addition to the CG values and geographical information, the dataset contains sieve size for grain screening and CG measurement methods, such as "manual visual inspection" and "mechanical grain discriminator". The standard errors and numbers of replicates were not available in the selected studies and could thus not be extracted. In this study, the variable “CG” was defined as the total percentage of milky-white, basal-white, belly-white, and back-white grains. Wherever available, CG of these four different types of chalkiness were also recorded separately. The number of data with type-specific CG was 253, i.e. about 20% of all the records.

Of the 48 cultivars with known HTRs, 33 were listed in the MAFF guideline, 10 were rated in reference to the standard cultivars, and their HTRs were reported in the RCC database. HTRs of the other five cultivars were obtained from the literature [5–8] (Table 2). The 48 cultivars registered in our dataset belonged to HTRs ranging from 3 (susceptible) to 7 (tolerant) (Table 2). Currently, cultivars with HTRs higher than 7 or lower than 3 have not been registered.

4.3.3. Weather data

NARO’s gridded daily meteorological dataset with a 1-km resolution [9] was used to extract weather data. For 20 days after heading, we averaged daily mean temperature, solar radiation (SR), and relative humidity (RH), a critical period impacting the prevalence of CG [10]. The incident SR was corrected using the shading ratio reported in each trial where shading treatments were enforced. Following previous research, we developed TaHD as a heat stress measure for rice quality, defined as the cumulative mean air temperature over the threshold temperature (Tb) for 20 days after heading. [9,11,12] as follows:

$$\text{TaHD} = \sum_{i=1}^{20} \max(Ta_i - Tb,\ 0)$$

Tai is the daily mean temperature on the i-th day from the heading date (Table 1). The value of Tb was set at 26°C in the analysis presented in the companion paper [1]. However, in agreement with previous studies [9,11,12], the database provides TaHD with different Tb from 24°C (TaHD24) to 28°C (TaHD28) (https://data.mendeley.com/datasets/xwv7bpp5rn/2).

Limitations

- The standard errors and numbers of replicates for the CG data were not available in the selected studies and could thus not be included in the dataset.
- CG data by different types, such as milky-white, basal-white, belly-white, and back-white grains, were available only for 20% of the observations.
- Most data came from cultivar trials conducted in experimental stations, where crops were grown under sufficient water and nutrients, as well as proper control over pests and diseases, but specific agronomic management data were not available.

Ethics Statement

The work does not involve any human subjects, animal experiments, or data collected from social media platforms.

Data Availability

A dataset for determining the dependence of rice grain quality of 48 Japanese cultivars with varying heat tolerance on weather conditions during grain filling (Original data) (Mendeley Data).

CRediT Author Statement

Hitomi Wakatsuki: Methodology, Formal analysis, Writing – review & editing; **Takahiro Takimoto:** Software, Data curation; **Yasushi Ishigooka:** Data curation; **Motoki Nishimori:** Validation; **Mototaka Sakata:** Resources; **Naoya Saida:** Resources; **Kosuke Akagi:** Resources; **David Makowski:** Formal analysis, Writing – review & editing; **Toshihiro Hasegawa:** Formal analysis, Writing – review & editing.

Acknowledgements

This study was partly supported by the Environment Research and Technology Development Fund (JPMEERF20S11820) of the Environmental Restoration and Conservation Agency of Japan; JST Grant Number JPMJPF2013 supported this work; the Joint Linkage Call supported by NARO and INRAE; and the project CLIMAE of INRAE.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] H. Wakatsuki, T. Takimoto, Y. Ishigooka, M. Nishimori, M. Sakata, N. Saida, K. Akagi, D. Makowski, T. Hasegawa, Effectiveness of heat tolerance rice cultivars in preserving grain appearance quality under high temperatures in Japan – A meta-analysis, Field Crops Res. (2024), doi:10.1016/j.fcr.2024.109303.

[2] R. Kaji, H. Ohta, A. Fukushima, N. Tsuda, S. Moriyama, C. Kon, T. Endo, Y. Nakagomi, H. Sato, T. Kawamoto, K. Kato, H. Goto, Y. Abe, S. Sasaki, N. Yoshida, M. Otera, Selection of standard rice varieties for evaluating grain quality under high temperature during ripening stage for tohoku region, Bull. Tohoku Agric. Res. Cent. 118 (2016) 49–55, doi:10.24514/00001292.

[3] K. Tamura, T. Kataoka, A. Nakanishi, H. Sato, Y. Tamura, M. Sakai, O. Yamaguchi, T. Wada, M. Tsubone, I. Tatara, S. Tokuda, K. Yoshida, J. Koga, M. Nakayama, Y. Fujii, M. Mitsukawa, Y. Shimizu, W. Hasegawa, M. Shiraishi, Y. Nagayoshi, S. Matsuura, K.I. Wakamatsu, M. Sato, J. Sonoda, Y. Takeuchi, Standard rice varieties with high temperature tolerance at the ripening stage in the warm region of Japan, Jpn. J. Crop Sci. 87 (2018) 209–214, doi:10.1626/jcs.87.209.

[4] MAFF, 1998. The guideline for variety registration, "Rice". In: MAFF (Ed.), The plant variety protection and seed act

[5] NARO, A new rice cultivar "Koisomeshi", NARO, 2018 https://www.naro.go.jp/publicity_report/press/laboratory/warc/082662.html, last accessed on August 25, 2022.

[6] NARO, A new rice cultivar "Harumoni", NARO, 2011 https://www.naro.go.jp/publicity_report/press/files/20111028konarc_press.pdf, last accessed on August 25, 2022.

[7] T. Wada, M. Tsubone, T. Inoue, T. Ogata, Y. Hamachi, Y. Matsue, K.F. Oosato, T. Yasunaga, Y. Kawamura, A. Ishizuka, "Genkitsukushi," a new rice cultivar with tolerance to high temperature during maturing period and high eating quality, Bull. Fukuoka Agric. Res. Cent. 29 (2010) 1–9.

[8] M. Mizobuchi, S. Takata, M. Sakata, M. Kameshima, Y. Yoshida, "Kouiku 76 gou," A new extremerly early rice line with superior eating quality and grain appearance under high temperatures during ripening, Bull. Kochi Agric. Res. Cent. 27 (2018) 55–64.

[9] Y. Ishigooka, S. Fukui, T. Hasegawa, T. Kuwagata, M. Nishimori, M. Kondo, Large-scale evaluation of the effects of adaptation to climate change by shifting transplanting date on rice production and quality in Japan, J. Agric. Meteorol. 73 (2017) 156–173, doi:10.2480/agrmet.D-16-00024.

[10] S. Morita, Prospect for developing measures to prevent high-temperature damage to rice grain ripening, Jpn. J. Crop Sci. 77 (2008) 1–12, doi:10.1626/jcs.77.1.

[11] Y. Usui, H. Sakai, T. Tokida, H. Nakamura, H. Nakagawa, T. Hasegawa, Rice grain yield and quality responses to free-air CO_2 enrichment combined with soil and water warming, Glob. Chang. Biol. 22 (2016) 1256–1270, doi:10.1111/gcb.13128.

[12] M. Nishimori, Y. Ishigooka, H. Wakatsuki, T. Kuwagata, T. Hasegawa, H. Yoshida, T. Takimoto, M. Kondo, Rice quality analysis using the Crop Survey database of Japan for climate impact assessment, Clim. Biosph. 20 (2020) 1–8, doi:10.2480/cib.J-20-054.