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Original Paper

Conservation of Crop Landraces and Crop Wild Relatives in Hyogo Prefecture in 2021

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Summary

This paper reports on the conservation of crop landraces and crop wild relatives in Hyogo Prefecture in 2021. With the cooperation of the Hyogo-no-zairaishu-hozonkai, a society conserving crop landraces in Hyogo Prefecture, we received seeds of crop landraces from farmers and surveyed natural or artificially disturbed environments to collect seeds of crop wild relatives. We collected the seeds of 2 Mizuna landraces (*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt), 3 accessions of turnip (*Brassica rapa* L. em. Metzg. subsp. *rapa*), 4 of mustard (*Brassica juncea* (L.) Czern. et Coss.), 2 of wild radish (*Raphanus sativus* L. var. r*aphanistroides* Makino), 1 of soybean (*Glycine max* (L.) Merr.), and 1 of okra (*Abelmoschus esculentus* (L.) Moench) from 21 cultivation sites or habitats. The novelty of this report is the discovery of "Banshu-Takana," a landrace of leaf mustard and "Banshu-Shiro-Mizuna," a landrace of Mizuna as well as the introduction of naturally growing turnips and radishes into the National Agriculture and Food Research Organization (NARO) Genebank for the first time. After the seeds had multiplied, the NARO Genebank will preserve them for research and educational purposes (https://www.gene.affrc.go.jp/index_en.php).

KEY WORDS: Conservation, Crop wild relatives, Genebank, Genetic resources, Crop landraces

Introduction

The Research Center of Genetic Resources of the National Agriculture and Food Research Organization (NARO) Genebank is paying renewed attention to the conservation of crop landraces and crop wild relatives in Japan. Such an initiative was prompted by (1) the provision "promoting the conservation of crop landraces by public research institutions" (excerpts and translations by the authors) in the supplementary resolution of the Plant Variety Protection and Seed Act, Japan (House of Councillors 2020) and (2) the aim to "maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species" of "Goal 2: Zero Hunger" of the Sustainable Development Goals (United Nations Department of Economic and Social Affairs, https://sdgs.un.org/goals/goal2). Indeed, conserving crop landraces and crop wild relatives is a challenge that Japan and the rest of the world face.

Hyogo Prefecture—located at 35°N and 135°E, which defines Japan standard time—is classified as "Cfa" in the Köppen climate classification (Beck *et al.* 2018). Hyogo Prefecture covers an area of approximately 8,401 km^2 (Hyogo Prefectural Government, https://web.pref.hyogo.lg.jp/ac02/kids_style.html). Its climate and topography are roughly divided into southern and northern areas by mountains approximately 1,000 m high. For example, Mt. Hyonosen is 1,510 m high (Geospatial Information Authority of Japan, https://www.gsi.go.jp/kihonjohochousa/kihonjohochousa41168.

html). The southern area is characterized by sunny weather and average precipitation of approximately 1,000 mm per year; its temperature may rise above 30 °C even at night during summer, and snow depth during winter is approximately 10 cm (Kobe Local Meteorological Office, https://www.data.jma.go.jp/kobe-c/climate/kiko/kiko.html). In contrast, the northern area is characterized by fair weather and average precipitation of approximately 2,000 mm per year; its maximum temperature exceeds 37 °C during summer due to the Foehn phenomenon, and snow depth in Toyooka City and Kami Town is more than 1 m due to Siberian monsoon during winter (Kobe Local Meteorological Office, https://www.data.jma.go.jp/kobe-c/climate/kiko/kiko.html). The northern area topography is generally steep, except for the basin near Toyooka City, and its coast is characterized by submerged coasts where mountainous areas meet the sea directly (Suzuki 1925).

Under the Japanese government, the NARO Genebank has been conducting *ex situ* conservation of plant genetic resources for food and agriculture and third-party distribution for research and educational purposes. As of 2022, The NARO Genebank has conserved 93 landraces, mainly of cereals and legumes, in Hyogo Prefecture. On the other hand, the Japanese book Hyogo no zairai sakumotsu described 90 landraces, mainly vegetables, in Hyogo Prefecture (Hyogo-no-zairaishu-hozonkai 2016). The landraces described in the book include those that are not preserved in the NARO Genebank; therefore, these landraces must be conserved considering the supplementary resolution of the Plant Variety Protection and Seed Act, Japan.

This paper reports on the efforts in conserving crop landraces and crop wild relatives in Hyogo Prefecture in 2021. We conducted a field survey in the northern area of Hyogo Prefecture in June and early summer, when rice planting was almost complete.

Methods

The field survey was conducted in Hyogo Prefecture from June 3 until June 6 (Fig. 1, Table 1). We obtained information on crop landraces through Mr. Takashi Kosaka, a Hyogo Prefecture official and manager of Hyogo-no-zairaishu-hozonkai—a society conserving crop landraces in Hyogo Prefecture. We visited farmers who were cultivating crop landraces in their fields, interviewed them about the conservation status of their crops, recorded their passport data, and obtained seeds from farmers who agreed to the NARO Genebank policy. We recorded the passport data of crop wild relatives

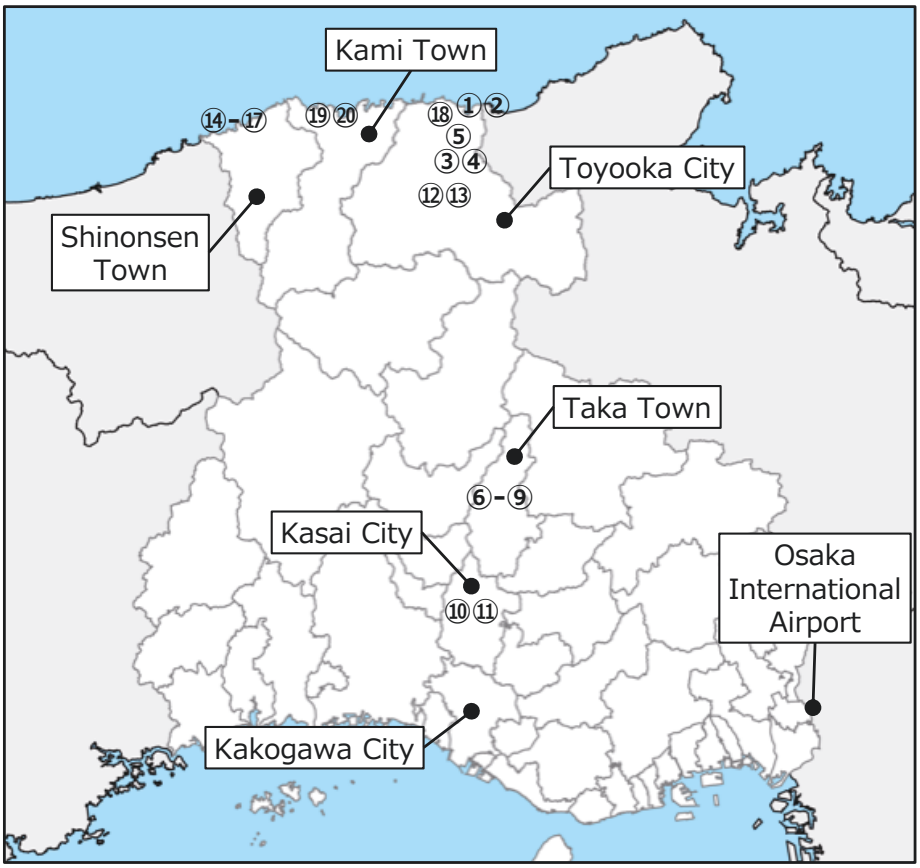

Fig. 1. Collection sites. The numbers in the circles correspond to the IDs in Table 3.

Table 1. Itinerary of the field survey

Date	Itinerary	Stay
2021/6/3	Haneda Airport - JAL111 - Osaka International Airport - Kakogawa City - Kinosaki Town*	Kinosaki Town*
2021/6/4	Kinosaki Town* - Taka Town - Kasai City - Kinosaki Town*	Kinosaki Town*
2021/6/5	Kinosaki Town* - Hidaka Town* - Shinonsen Town - Kinosaki Town*	Kinosaki Town*
2021/6/6	Kinosaki Town* - Kami Town - Osaka International Airport - JL130 - Haneda Airport	-

*Toyooka City

and collected seeds from the habitats after obtaining permission from landowners. We used Google Maps and Google Earth to determine the latitude, longitude, and altitude of the cultivation sites, which are useful information included in the passport data. Target crops with immature seeds at the time of the survey were mailed to us after they were harvested. We assigned the collected plants to taxonomic families based on the Angiosperm Phylogeny Group III (The Angiosperm Phylogeny Group 2009) and reassigned those in the genus *Brassica* to subspecies as an intraspecific classification based on Hammer *et al.* (2013).

For characterization, we used a soil and plant analyzer development meter (SPAD-502, KONICA MINOLTA OPTICS, INC., Japan) to evaluate the chlorophyll content index in the leaves of plants grown at 25 °C for 49 days in pots filled with 0.2 L culture soil. There were five biological replicates.

Results and Discussion

We recorded 21 genetic resources, including 2 Mizuna landraces (*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt), 3 accessions of turnip (*Brassica rapa* L. em. Metzg. subsp. *rapa*), 4 of mustard (*Brassica juncea* (L.) Czern. et Coss.), 6 of wild radish (*Raphanus sativus* L. var. *raphanistroides* Makino), 1 of wasabi (*Eutrema japonicum* (Miq.) Koidz.), 2 of long-stamen chive (*Allium macrostemon* Bunge), 1 of garlic (*Allium sativum* L.), 1 of soybean (*Glycine max* (L.) Merr.), and 1 of okra (*Abelmoschus esculentus* (L.) Moench) (Table 2). Because *ex situ* conservation of wasabi with recalcitrant seeds and vegetative propagation of long-stamen chive and garlic proved difficult, we only recorded the information about them in this study (Table 2). We were also unable to collect seeds from four immature radish populations. The passport data for each accession are shown in Table 3, and the characteristics of each species are described below. These landraces are listed in the Japanese book Hyogo no zairai sakumotsu (Hyogo-no-zairaishu-hozonkai 2016), except for HY07 "Banshu-Takana" and HY09 "Banshu-Shiro-Mizuna."

Brassicaceae

Mizuna (*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt)

Mizuna is a leafy vegetable with deeply lobed leaves and a large number of branches. Historically, it has been used as a winter leaf vegetable for cooking and pickling in salt; however, recently, it has grown year-round and eaten raw as a salad. In the NARO Genebank, Mizuna is registered as "*Brassica rapa* L. Japonica Group."

Table 2. Summary of the collections

Family	Species name	Statas		Collections		Total
		Cultigen	Growing naturally	No. of seed samples collected	Cultivation or habitat recorded (No seed collected)	
Brassicaceae	*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt	2	-	2	-	2
	Brassica rapa L. em. Metzg. subsp. *rapa*	-	3	3	-	3
	Brassica juncea (L.) Czern. et Coss.	2	2	4	-	4
	Raphanus sativus L.	-	6	2	4	6
	Eutrema japonicum (Miq.) Koidz.	1	-	-	1	1
Amaryllidaceae	*Allium macrostemon* Bunge	-	2	-	2	2
	Allium sativum L.	1	-	-	1	1
Fabaceae	*Glycine max* (L.) Merr.	1	-	1	-	1
Malvaceae	*Abelmoschus esculentus* (L.) Moench	1	-	1	-	1
	Total	8	13	13	8	21

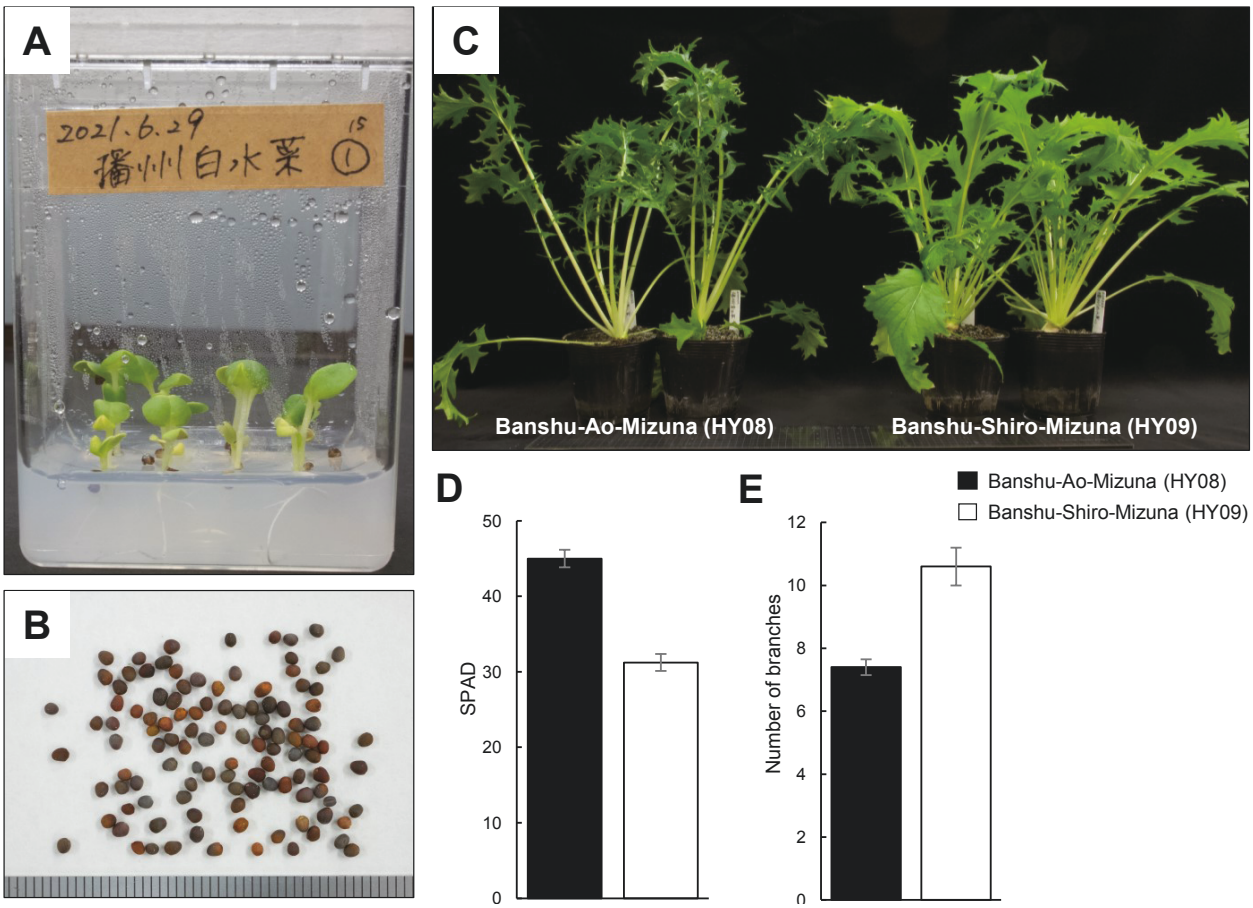

Fig. 2. Characteristics of "Banshu-Shiro-Mizuna." (A) Germinated "Banshu-Shiro-Mizuna" (HY09) seeds on MS solid medium. (B) Seeds of "Banshu-Shiro-Mizuna" (HY09) harvested from the plants of photograph A after flowering. Scale indicates 1 mm order. (C) Comparison of "Banshu-Ao-Mizuna" (HY08) and "Banshu-Shiro-Mizuna" (HY09) grown in a growth chamber. Photograph was taken 1 month after sowing. (D) Leaf color intensity of the plants shown in photograph C. Bar indicates standard error of the mean (SEM) (n = 5). Values were quantified by SPAD Chlorophyll Meter. (E) Branch number of the plants shown in photograph C. Bar indicates SEM (n = 5).

HY08 "Banshu-Ao-Mizuna" is a Mizuna landrace that has been cultivated in Taka Town for more than 60 years, and its seeds were in the process of drying at the time of the survey (Photo 1). Meanwhile, HY09 "Banshu-Shiro-Mizuna," another Mizuna landrace, was introduced more than 60 years ago but has not been cultivated recently. When Farmers Factory, an agricultural enterprise (Representative: Mr. Keisuke Okano), directly sowed HY09 seeds in their fields in 2018, they did not germinate. We received HY09 seeds and sowed them aseptically on agar medium in our laboratory and successfully germinated them (Fig. 2A). We transplanted the seedlings into culture soil and induced flowering by vernalization at 6 °C for 60 days, and then obtained approximately 20,000 seeds through sibling crosses among 49 individuals (Fig. 2B). HY09 had light green leaves and more branches than HY08 (Fig. 2C, D, and E).

Turnip (*Brassica rapa* L. em. Metzg. subsp. *rapa*)

Turnip is a root vegetable and fodder with swollen roots and hypocotyls. In the NARO Genebank, turnip is registered as "*Brassica rapa* L. Rapifera Group."

HY19 "Heike-Kabu" is a turnip growing naturally on the cliffs facing the Sea of Japan in Kami Town (Photo 2). In this area, HY19 grows as a pioneer plant after a landslide had occurred. In the past, HY19 was valued as a winter vegetable and grew naturally in spring, covering the cliffs with yellow flowers (Photo 3). Recently, however, it has been eradicated as a weed in Japanese pepper (*Zanthoxylum piperitum* (L.) DC.) cultivation (Photo 4). In addition, "Heike-Kabu" population has been rapidly declining due to feeding damage by deer (Photo 5). In this survey, HY19 seeds were collected from 27 individuals that survived in a vacant lot adjacent to a field with a deer-proof net to protect against prickly ash (Photos 6−8). This survey elucidates the significant impact of animal damage not only on agriculture in mountainous areas but also on genetic resources growing

naturally. These genetic resources must be conserved as soon as possible (Photo 9). To date, there are no records of naturally growing turnips in Hyogo Prefecture other than "Heike-Kabu" in Kami Town; however, we found HY17, a turnip growing naturally on the riverbed of the Kishida River in Shin-onsen Town (Photos 10 and 11). Since HY17 may be another habitat of "Heike-Kabu" or a novel genotype, we plan to evaluate its genetic distinctiveness from HY19 in the future.

Mustard (*Brassica juncea* (L.) Czern. et Coss.)

Mustard is an amphidiploid species that arose in western Asia 8,000–14,000 years ago through interspecific hybridization between *B. rapa* and *Brassica nigra* (L.) W.D.J. Koch (Kang *et al*. 2021). Mustard in Japan is divided into two taxa: Indian mustard (*Brassica juncea* (L.) Czern. et Coss. subsp. *juncea*) and leaf mustard (*Brassica juncea* (L.) Czern. et Coss. subsp. *integrifolia* (H. West) Thell.). Leaf mustard has been cultivated in Japan for more than 1,000 years, as described in a 9th century Japanese book Saibai syokubutsu no kigen to denpa (Hoshikawa 1987). Meanwhile, Indian mustard exhibits vigorous growth and high tolerance to drought and high temperatures, and it grows naturally on riverbanks, asphalt roadsides, and railway tracksides (Khatikarn *et al*. 1991; Nishizawa *et al.* 2010).

HY05 and HY18 are Indian mustards growing naturally in Toyooka City and were found on riverbanks and roadside crevices, respectively (Photos 12 and 13). HY06 "Banshu-Kobuna" and HY07 "Banshu-Takana" are leaf mustard landraces that were introduced in Taka Town more than 60 years ago (Photos 14 and 15). The Okano family, who was cultivating HY06 and HY07, said "these can be grown year-round for leafy vegetables and require less fertilizer."

Wild radish (*Raphanus sativus* L. var. *raphanistroides* Makino)

Wild radish "Hama-Daikon" is an annual allogamous plant closely related to the domesticated radish (*Raphanus sativus* L. var. *sativus*) and is found along the coasts of Japan through seed dispersal by ocean currents (Han *et al*. 2015). Wild radish is recognized as a potential genetic resource because it can easily hybridize with domesticated radishes and exhibits salt tolerance, allowing it to inhabit sandy beaches. We found HY03 podded on the riverbank near the sluice gate of the Maruyama River in Toyooka City (Photo 16). HY16 population was abundant on the riverbank approximately 600 m upstream from the coast of Shin-onsen Town (Photos 17 and 18). HY03 and HY16 were the first accessions in the NARO Genebank as *R. sativus* var. *raphanistroides*. Only the passport data was recorded for HY01, HY02, HY14, and HY15 because of their low abundance (Photo 19). Because wild radish in mainland Japan, including Hyogo Prefecture and the Okinawa Archipelago, are genetically different (Han *et al*. 2015), collecting wild radish from the Okinawa Archipelago should be prioritized in the future because they exhibit high-temperature tolerance.

Wasabi (*Eutrema japonicum* (Miq.) Koidz.)

Wasabi is a perennial allogamous plant endemic to Japan. It forms enlarged underground stems in clear streams and is domesticated as a spice in Japan (Yamane *et al*. 2016). In Hidaka-Cho (Toyooka City), it was recorded that wasabi was offered to the feudal lord roughly 300 years ago (Hyogo-no-zairaishu-hozonkai 2016). In the past, wild wasabi collected from the surrounding mountains were cultivated in the fields; however, in 1957, the Kitamura family received 10 seedlings of the "Daruma" variety from Shizuoka Prefecture. HY12 is a farmer's variety based on the wild wasabi and "Daruma" variety, which has continued to be self-seeded through open pollination (Photo 20). Because wasabi possess recalcitrant seeds that lose their germination ability when dried, seeds are collected in pods and preserved in running water during generation renewal (Photo 21). Since the NARO Genebank is not equipped to preserve wasabi seeds, only information recording was conducted for HY12. Wasabi, which prefers a cooler environment, has become difficult to cultivate due to global warming. An extremely high temperature causes leaf yellowing and poor underground stem enlargement (Right of Photo 22). The Kitamura family has continued experimenting on the cultivation of mericlone seedlings of several F_1 varieties, and one of them showed less leaf yellowing at the time of this survey when the temperature was not extremely high (Left of Photo 22). Because wasabi is an allogamous plant that takes several years for its enlarged underground stems to be harvested, it is difficult to genetically maintain HY12 in a field where F_1 varieties are grown. To conserve wasabi landraces, there is an urgent need to develop techniques, such as cryopreservation, for seed and/or meristem preservation.

Amaryllidaceae

Long-stamen chive (*Allium macrostemon* Bunge)

Long-stamen chives are perennial plants of the genus *Allium* in East Asia. Although long-stamen chives

are not domesticated, the Japanese have used their bulbs for food for a long time. Long-stamen chive reproduces not by seed but by the dispersal of bulbils that form on the inflorescence and are found throughout Japan. Saga University selected an accession with bulbs weighing 6 g or more from approximately 350 accessions collected all over Japan, with a prospect to commercialization (Ishimaru *et al*. 2018). In this survey, a long-stamen chive was found on the riverbanks but not on the riverbed (Photo 23). HY04 was found with flowering individuals and those that had shed their bulbils (Photo 24) on a riverbank near the sluice gate of the Maruyama River in Toyooka City. HY16.5 was found with bulbil individuals germinating on the inflorescence (Photo 23) on a riverbank near the mouth of the Kishida River in Shin-onsen Town. Because HY04 and HY16.5 do not form seeds, only the passport data was recorded.

Garlic (*Allium sativum* L.)

HY10 "Harima-Oh" is a garlic landrace cultivated in Kasai City, by Kitamoto Farm, a company headed by Kiyoshi Kitamoto (Photo 25). The Kitamoto family has been growing garlic for more than 100 years; however, during the Second World War, Kitamoto's great-grandfather disposed their garlic crops in a nearby bamboo grove. Fortunately, Kitamoto's grandfather discovered the garlic crops thriving in the bamboo grove in the 1950s. Kitamoto's father named it "Harima-Oh" and registered it as a trademark in Japan in 2008. HY10 formed bulbils but not seeds; hence, only the passport data was recorded (Photo 26). Kitamoto Farm focused on the rich flavor of bulbils in their product development.

Fabaceae

Soybean (*Glycine max* (L.) Merr.)

HY11 "Hokke-Shiro-Daizu" is a soybean landrace characterized by its large seed size, and it is being cultivated in Kasai City. HY11, multiplied by a farmer in Kasai City, produced 100 seeds that weigh 43.39 g (Photo 27). HY11 is valuable as a genetic resource of large yellow (white) soybean accession, although its seed weight was inferior to "Tanbaguro," black soybean landrace in Hyogo Prefecture.

Malvaceae

Okra (*Abelmoschus esculentus* (L.) Moench)

Okra originated in northeastern Africa; therefore, it is an important vegetable as a source of vitamins in tropical regions owing to its high-temperature tolerance. Okra is generally a perennial plant in the tropics; however, it is cultivated as an annual plant in Japan because it cannot overwinter. Okra was introduced to Japan in 1873, but it did not become widespread until 1965 (Inomata 2012).

HY13 "Yashiro-Okra" is an okra landrace that has been cultivated for more than 60 years in the Yashiro region of Toyooka City. At the time of this survey, the seedlings were collected only a few days after being sown (Photos 28 and 29). Although common okra cultivated in Japan can be classified into pentagonal and round types based on pod cross sections, the HY13 pod displays octagonal or decagonal cross sections (Photo 30). The collected dry pods contained more than 150 seeds. In addition, the HY13 pod is characterized by having short, thick, and few hairs (Photo 29).

Future Prospects

The novelty of this report is the discovery of "Banshu-Takana," a leaf mustard landrace and "Banshu-Shiro-Mizuna," a mizuna landrace as well as the introduction of naturally growing turnips and radishes into the NARO Genebank for the first time. Furthermore, it is a notable achievement that through *in vitro* culture of seeds, we prevented the loss of "Banshu Shiro-Mizuna," whose seed activity had declined to the point that it would not germinate when sown in the field. The NARO Genebank will preserve these seeds after they had multiplied and distribute them for research and educational purposes (https://www.gene.affrc.go.jp/index_en.php).

Acknowledgments

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兵庫県おける在来作物および作物近縁野生種の生息域外保存（2021 年）

有賀 裕剛・高橋 有

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和文摘要

本報告は，兵庫県における在来作物および作物近縁野生種の保存に関する報告書である．我々は「ひょうごの在来種保存会」の協力を得て，生産者から在来作物の種子の分譲を受けると共に，作物近縁野生種を収集するために自然環境または人為攪乱環境を調査した．その結果，21 点の生産地または生息地を記録し，そのうち，ミズナ 2 点，カブ 3 点，カラシナ 4 点，ハマダイコン 2 点，ダイズ 1 点，オクラ 1 点の種子を収集した．本報告の新規性は，新たな在来作物として「播州高菜」と「播州白水菜」を見出したことに加え，自生するカブとハマダイコンを初めて農研機構ジーンバンクに導入したことである．さらに，圃場に播種しても発芽しないほど種子の活性が低下していた「播州白水菜」の無菌培養による復活は特筆すべき成果である．農研機構のジーンバンクは，これらの種子を増殖後，研究または教育を目的とする利用のために配布する（https://www.gene.affrc.go.jp/index_en.php）．

Table 3. Passport data of the collections

ID	Accession No.	Coll. Date	Scientific name	Local name	Statas	Latitude	Longitude	Altitude (m)	Collection site	Topography	Soil type	Remarks
HY01	-	6/4/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.6424758	134.8399405	4	Kehi, Toyooka City, Hyogo Prefecture	Plain	Sand	No seed collected, purple flowers, on the mouth of the Kehi River
HY02	-	6/4/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.6416301	134.8401551	3	Kehi, Toyooka City, Hyogo Prefecture	Plain	Sand	No seed collected, white flowers, on the Kibi-No-Hama beach
HY03	JP274398	6/4/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.5012041	134.8075232	10	Nishishiba, Hidaka Town, Toyooka City, Hyogo Prefecture	Plain	Clay	Enlarged taproot, on the riverbank near the sluice gate of the Maruyama River
HY04	-	6/4/2021	*Allium macrostemon* Bunge	Nobiru	Growing naturally	35.5018952	134.8076023	11	Higashishiba, Hidaka Town, Toyooka City, Hyogo Prefecture	Plain	Clay	No seed collected, on the riverbank near the sluice gate of the Maruyama River
HY05	JP274396	6/4/2021	*Brassica juncea* (L.) Czern. et Coss. subsp. *juncea*	Karashina	Growing naturally	35.4802756	134.8067969	11	Kamigoh, Hidaka Town, Toyooka City, Hyogo Prefecture	Mountains	Organic soil	on a bank of the irrigation canal
HY06	JP274394	6/4/2021	*Brassica juncea* (L.) Czern. et Coss. subsp. *integrifolia* (West) Thell.	Banshu-Kobuna	Cultigen	35.0611990	134.9159728	108	Nakaku-Takagishi, Taka Town, Taka County, Hyogo Prefecture	Mountains	Organic soil	in a field for seeding
HY07	JP274395	6/4/2021	*Brassica juncea* (L.) Czern. et Coss. subsp. *integrifolia* (West) Thell.	Banshu-Takana	Cultigen	35.0611990	134.9159728	108	Nakaku-Takagishi, Taka Town, Taka County, Hyogo Prefecture	Mountains	Organic soil	in a field for seeding
HY08	JP274392	6/4/2021	*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt.	Banshu-Ao-Mizuna	Cultigen	35.0610373	134.9160775	108	Nakaku-Takagishi, Taka Town, Taka County, Hyogo Prefecture	Mountains	Organic soil	in a field for seeding
HY09	JP274393	6/4/2021	*Brassica rapa* L. em. Metzg. subsp. *nipposinica* (L. H. Bailey) Hanelt.	Banshu-Shiro-Mizuna	Cultigen	35.0610373	134.9160775	108	Nakaku-Takagishi, Taka Town, Taka County, Hyogo Prefecture	Mountains	Organic soil	No germination in the field
HY10	-	6/4/2021	*Allium sativum* L.	Harima-Oh	Cultigen	34.8973219	134.8143963	56	Higashikenzaka Town, Kasai City, Hyogo Prefecture	Mountains	Organic soil	No seed collected
HY11	JP274401	6/4/2021	*Glycine max* (L.) Merr.	Hokke-Shiro-Daizu	Cultigen	34.8973219	134.8143963	56	Higashikenzaka Town, Kasai City, Hyogo Prefecture	Mountains	Organic soil	Large seeds, late flowering
HY12	-	6/5/2021	*Eutrema japonicum* (Miq.) Koidz.	Kitamura-Wasabi	Cultigen	35.4749853	134.7149820	105	Jugo, Hidaka Town, Toyooka City, Hyogo Prefecture	Mountains	Lava stone	No seed collected, farmers' variety
HY13	JP274400	6/5/2021	*Abelmoschus esculentus* (L.) Moench	Yashiro-Okra	Cultigen	35.4749853	134.7149820	105	Jugo, Hidaka Town, Toyooka City, Hyogo Prefecture	Mountains	Organic soil	Pod with eight corners or more
HY14	-	6/5/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.6256211	134.4498844	11	Hamasaka, Shinonsen Town, Hyogo Prefecture	Plain	Sand	No seed collected, cultivation of wild radish harvested from the natural environment
HY15	-	6/5/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.6286630	134.4517907	6	Hamasaka, Shinonsen Town, Hyogo Prefecture	Plain	Sand	No seed collected
HY16	JP274399	6/5/2021	*Raphanus sativus* L. var. *raphanistroides* Makino	Hama-Daikon	Growing naturally	35.6275475	134.4573293	4	Kiyotomi, Shinonsen Town, Mikata County, Hyogo Prefecture	Plain	Organic soil	growing on a bank of the Kishida River
HY16.5	-	6/5/2021	*Allium macrostemon* Bunge	Nobiru	Growing naturally	35.6276826	134.4571683	5	Kiyotomi, Shinonsen Town, Mikata County, Hyogo Prefecture	Plain	Organic soil	No seed collected
HY17	JP274390	6/5/2021	*Brassica rapa* L. em. Metzg. subsp. *rapa*	Kabu	Growing naturally	35.6212504	134.4652759	7	Kiyotomi, Shinonsen Town, Mikata County, Hyogo Prefecture	Plain	Organic soil	Seeds collected from about 10 individuals
HY18	JP274397	6/5/2021	*Brassica juncea* (L.) Czern. et Coss. subsp. *juncea*	Karashina	Growing naturally	35.6143307	134.8081996	4	Imazu, Kinosaki Town, Toyooka City, Hyogo Prefecture	Mountains	Unknown	Seeds collected from about 10 individuals, growing along a railway track

Table 3. (Continued).

ID	Accession No.	Coll. Date	Scientific name	Local name	Statas	Latitude	Longitude	Altitude (m)	Collection site	Topography	Soil type	Remarks
HY19	JP274389	6/6/2021	*Brassica rapa* L. em. Metzg. subsp. *rapa*	Heike-Kabu	Growing naturally	35.6639883	134.5438376	175	Kasumiku-Amarube, Kami Town, Mikata County, Hyogo Prefecture	Mountains	Organic soil	Seeds collected from 27 individuals.
HY20	JP274391	6/6/2021	*Brassica rapa* L. em. Metzg. subsp. *rapa*	Kabu	Growing naturally	35.6493565	134.6068731	12	Kasumiku-Shimonohama, Kami Town, Mikata County, Hyogo Prefecture	Mountains	Organic soil	Seeds collected from about 5 individuals.

Photo 1. Drying plants of “Banshu-Ao-Mizuna” (HY08).

Photo 2. “Heike-Kabu”(HY19) blooming yellow flowers on a submerged coast on April 5, 2015. Photo by Kosaka T.

Photo 3. Habitat of “Heike-Kabu” (HY19) on April 5, 2015. Photo by Kosaka T.

Photo 4. “Heike-Kabu” (HY19) has been eradicated as a weed in prickly ash cultivation on April 5, 2015. Photo by Kosaka T.

Photo 5. Habitat of “Heike-Kabu” (HY19) in 2021. Same location as Photo 3.

Photo 6. Plants of “Heike-Kabu” (HY19).


Photo 7. Taproot of “Heike-Kabu” (HY19).


Photo 8. Dried plants of “Heike-Kabu” (HY19) were mowed down as weeds.


Photo 9. Wild deer appeared at the hotel where we stayed in Toyooka City.


Photo 10. Habitat of turnip growing naturally on riverbeds (HY17).


Photo 11. Taproot of turnip growing naturally on riverbeds (HY17).


Photo 12. Habitat of naturally growing Indian mustard (HY05).

Photo 13. Habitat of naturally growing Indian mustard (HY18).

Photo 14. Plants with mature seeds of “Banshu-Kobuna,” a leaf mustard landrace (HY06).

Photo 15. Pods and flowers of “Banshu-Takana,” a leaf mustard landrace (HY07).

Photo 16. Habitat of naturally growing radish (HY03).

Photo 17. Flowers and pods of naturally growing radish (HY16).

Photo 18. Taproot of naturally growing radish (HY16).

Photo 19. Radish plants growing naturally on sandy beaches (HY15).

Photo 20. Plants and inflorescences of wasabi in the water-filled field (HY12).

Photo 21. Preservation of wasabi seeds in spring water (HY12).

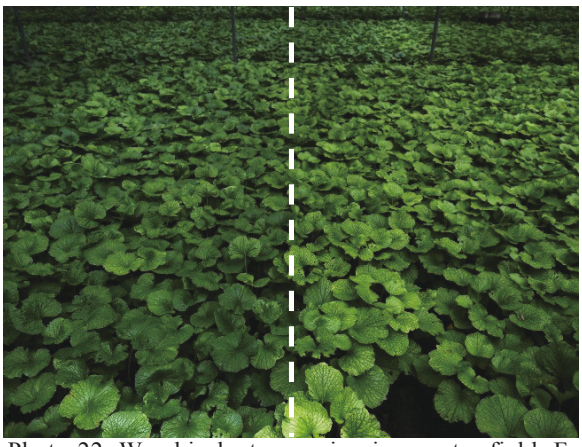

Photo 22. Wasabi plants growing in a water field. F_1 variety (left), and HY12 (right).

Photo 23. Habitat and sprouting bulbils of long-stamen chives (HY16.5).

Photo 24. Inflorescence and bulbils of long-stamen chive (HY04).


Photo 25. Bulbs of “Harima-Oh” garlic (HY10).


Photo 26. Scape containing bulbils of “Harima-Oh” garlic (HY10).


Photo 27. Seeds of “Hokke-Shiro-Daizu” soybean (HY11).


Photo 28. Young plants of “Yashiro-Okra” (HY13).


Photo 29. Dried pod of “Yashiro-Okra” (HY13).


Photo 30. Cross-sections of “Yashiro-Okra” pod (HY13).