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RESEARCH PAPER

Gilaneh, an improved rice cultivar with high grain quality through backcrossing

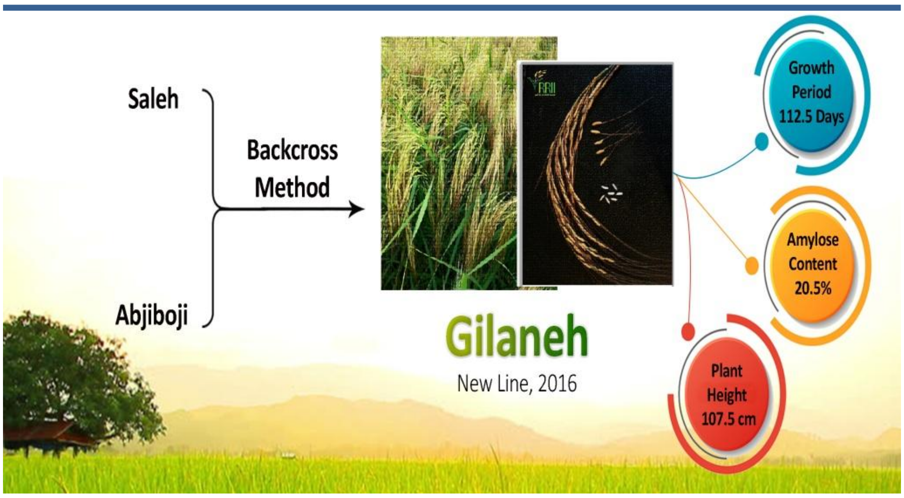
Mehrzad Allahgholipour [1]*, Alireza Haghighi Hasanalideh [2]

Rice Research Institute of Iran, Agricultural Research, Education and Extension Organization (AREEO), Rasht, Iran

Highlights

- Research priorities of rice breeding programs changed due to decreasing cultivation area of newly released varieties.
- Targeted mating design performed aimed to improve a variety with high yielding and high grain quality.
- The BC4 line, as a result of 12 years of breeding is considered one of the early and dwarf varieties and has the same cooking quality as local Iranian varieties.
- This new line was introduced to the Iranian agricultural community in 2016 under the name of Gilaneh.

Graphical Abstract



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Abstract

Newly introduced high-yielding rice varieties were not accepted by farmers, who preferred to use the common local varieties. The decline in acreage of newly introduced varieties has changed research priorities to match improved rice varieties with consumer preferences for rice breeding programs. The first generation and its parents, gene action, and combining ability of various traits were evaluated in 2005. Simultaneously with the cleaning of lines in each breeding population, three backcrosses (with abbreviations BC4, BC9 and BC25) were selected from the 38 original crosses and simulated with the returning parent with 4 crosses. By testing the selected lines in 2012 in a preliminary yield trial, 8 lines were selected. The multisite trial was conducted in the form of randomized complete block experiment with 3 replications at three locations including Rasht, Abkenar and Chaparsar in two cropping years (2013-2014). The GGE biplot results showed that the first two components explained 65% and 27% of the data changes. The stability or two dimensional axis plot of average tester coordinates showed that BC9, BC25, RI18436-46 and Saleh genotypes had high yield and high stability, BC4 had high yield and medium stability. BC4 was selected as superior genotype having medium stability and high grain yield (5.25 tons per hectare), suitable growing period (112.5 days), medium amylose content (20.5%) and optimum plant height (107.5 cm). Line BC4 is considered one of the early and dwarf varieties and has the same cooking quality as local Iranian varieties. This new line was introduced in Iranian agriculture in 2016 under the name Gilaneh. The cultivated area of this variety increased from 10 hectares in 2016 to 2029 hectares in 2019.

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* Corresponding author: mehrzadallahgholipour@yahoo.com (M. Allahgholipour)

1. Introduction

Rice (*Oryza sativa* L.) is now the staple food, providing 21% of the energy needs and 15% of the protein intake of more than 3 billion people, about half of the world's population (Fu et al., 2019; Yang et al., 2019). Ninety percent of rice is produced and consumed in the rice-growing area of developing countries, particularly in Asia and Africa. According to FAOSTAT statistics, more than 720 million tons of rice paddy (equal to 494.4 million tons of white rice) is produced across the world on about 175 million hectares of rice paddy fields, averagely around 4410 tons per hectares. Moreover, according to FAO's statistical prediction, to the sustainable feed of the increasing world population, a constant increase of rice production per unit of the paddy field area is needed (760 million tones paddy at 2025) (Ivanov and Burnaev, 2018). To cope with the food crisis in upcoming decades to feed more than 5 billion people by 2025, a higher yield and more sustainable rice varieties are needed (Khush, 2005).

Next to wheat, rice is the most important agricultural crop in Iran. Rice has shaped the cultures, dietary habits, and economies of around five million Iranian farmers and their families. Rice has a great influence on the food security programs of the country, particularly in the Northern provinces, Gilan and Mazandaran. By country average yield of 4354 kg ha-1 irrigated rice, the Iranian farmers produced 2347290 tons of rice during the current Iranian rice cultivation calendar year (started on March 20), in around 540000 hectares across the country. In 2020, the rice consumption per capita was 38 kg per person per year and it would mean a domestic demand of nearly three million tons for a country of 83 million people. Therefore, to feed the current country population 0.7 to 1 million tons of rice needs to import (Bruinsma, 2017).

In Gilan province, rice is grown on more than 150000 hectares (31.6% of the country's rice fields), with a total yield of about 580000 tons, and it is the second largest rice-growing province in Iran. The most widely grown local rice variety, Hashemi, is cultivated in more than 90% of rice fields in Gilan province and is unrivaled. Despite low grain yield (less than 4 tons' ha-1), susceptibility to pests, diseases and lodging, Iranian local rice varieties with excellent cooking and eating quality, lower water requirement, strong aroma and flavor, marketability and consumer preferences have the highest priority for cultivation in the rice fields of the northern region and other rice growing provinces of Iran. Despite the above advantages of local rice varieties, continuous cultivation of the same variety or/and genetic origin leads to increasing genetic damage to local rice varieties. Moreover, some socio-economic aspects have negative impacts on the newly introduced high-yielding rice varieties throughout the country: most of them are related to cooking quality and marketability of rice. Although almost all of them have performed the higher total and fertile tiller, higher yield, blast-resistant, and lodging tolerant. But, their prize steadily declined on the local and country rice market, and the farmer prefers back to common local varieties (Allahgholipour, 2016). The statistics of rice production at country scale indicated that the local rice varieties of the northern province of Iran such as Hashemi, Domsiah, Binam, Sangtarom, and Alikazemi can cultivate at different climatic conditions of Iran due to their high adaptability (Allahgholipour et al., 2012). The emerged reports of declining cultivation area of newly released varieties by the rice research institute of Iran open the new window of research priorities for rice breeding program to provide the improved rice cultivars with the customer and consumer preferences such as shorter growth stages, lower water requirement, suitable cooking quality, higher yield and resistance to lodging. Therefore, in recent years the tendency to prefer local rice cultivation has become more prevalent among the rice farmer around the country, although, the local rice production costs tremendously increase year by year. Late maturity, low cooking quality, and marketability of the introduced improved rice are some effective aspects that may have an important influence on their development in farmer fields in the last decades.

Moreover, in recent years, the scarcity of global and country water resources for rice cultivation and their impacts both reduced the expanding paddy fields, and also declined the current paddy fields of the rice-growing area. Compared to local early mature rice cultivars, the higher irrigation water requirements of the newly released improved lately mature and high yielding rice varieties led to ignoring them by the farmer, and therefore, they lost their high yield advantages and cultivated land percentage. The analytical reports indicated that the most common improved rice cultivar (Shiroodi, Nemat, Neda) in Mazandaran and Khazar and Gohar in Gilan province considerably reduced their cultivation area from 100 to 50, and 40 to 4 thousand hectares, respectively due to irrigation water limitation and reduction in annual rainfall. Therefore, earliness, storage tolerance, cooking characteristics and marketability are important criteria that form the priorities of rice farmers in adopting new improved rice varieties. Higher yield and resistance to blast are the next priorities. To overcome all the above constraints, limitations and objectives, a new rice variety, Gilaneh, was introduced in 2016 to meet the demands of both farmers and customers.

2. Materials and Methods

In 2004, eight local rice cultivars including Hashemi, Mohammadi, Hassani, Abjiboji, Salari, Ahlamitarom, Hasansaraei and Gharib with low yield, high plant height and susceptibility to blast disease and acceptable in terms of cooking quality are accepted as male parents were crossed with two improved rice cultivars namely Saleh and Sepidrood with slightly suitable and desirable characteristics (high yield, suitable plant height, resistance to blast disease and lodging as a female parents, which are not suitable in terms of cooking quality and have not been accepted by farmers through Line × Tester method. In 2005, simultaneously with the evaluation of the first generation and their parents, additive and dominance variances, and general and specific combinations abilities of different traits were estimated. From 2006 to 2010, selection of desirable genotypes from simple crosses in the research farm of the Rice Research Institute (Rasht) based on characteristics such as suitable plant type, small plant height, early maturity, resistance to diseases and shattering, type of leaves and a number of traits related to yield and seeds such as number of fertile panicles, number of seeds per panicles, seed shape was done using pedigree breeding method. Simultaneously with the process of purifying the lines in each breeding population, three backcrosses (numbered with BC4, BC9, and BC25 codes) were selected from the 38 initial crosses and the simulation with recurrent parent in each cross was performed with 4 backcrosses according to Fig. 1.

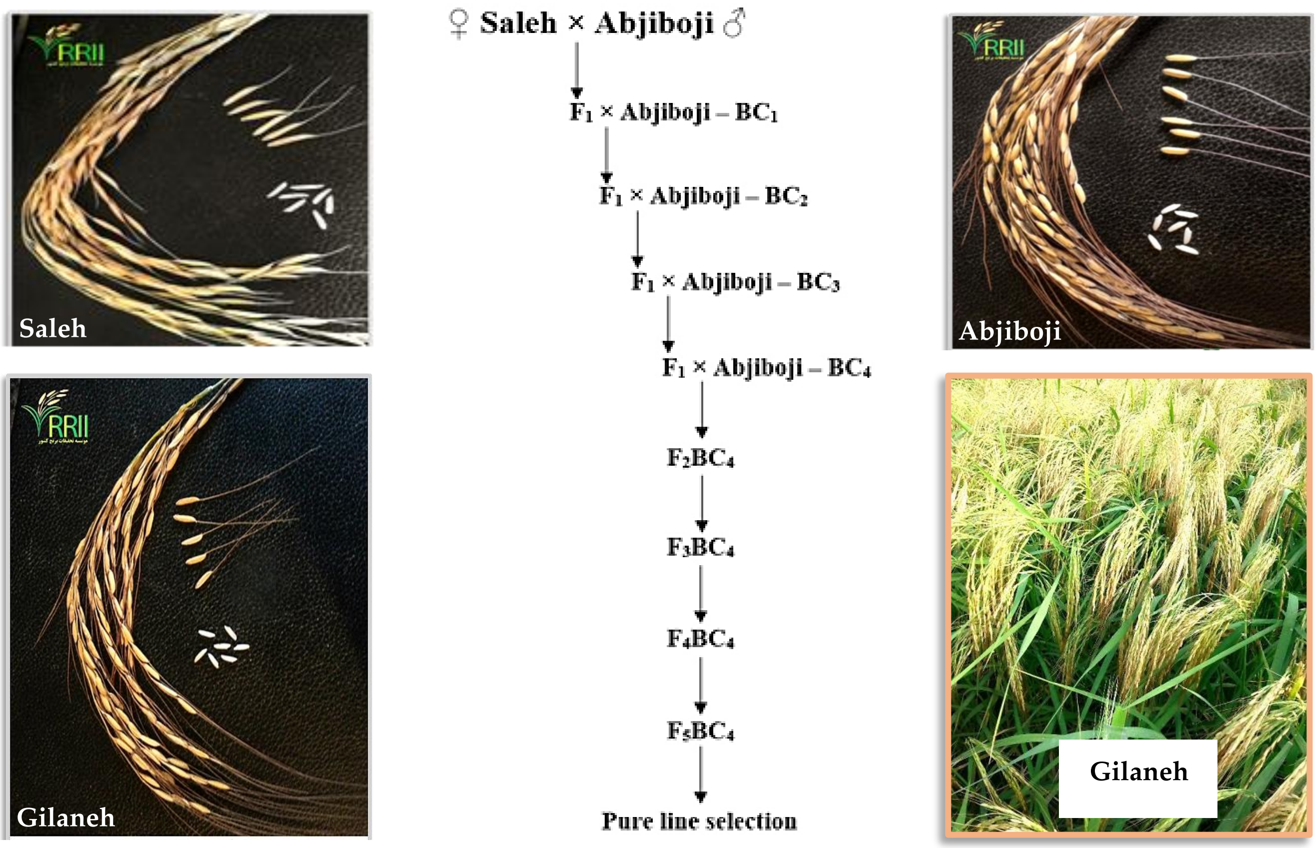

Figure 1. Breeding chart of new rice line using backcross method.

Selected lines with parents were evaluated in the form of an observational experiment through augmented design in 2011 and finally 61 pure lines were selected from different crosses. By examining the selected lines in 2012 in a preliminary yield trial experiment based on a randomized complete block design with 3 replications along with two cultivars Saleh and Abjiboji as controls, 8 lines with desirable quantitative and qualitative characteristics and suitable growth period (Table 1) were selected. In order to evaluate the compatibility and stability of these promising lines a multi-location experiment carried out in the form of randomized complete block design with 3 replications in three locations including Rasht, Abkenar Anzali (Gilan province) and Chaparsar (Rice research station of Tonekabon in Mazandaran province) during two cropping years (2013-2014). The stability of the studied lines in different environments was evaluated using GGE biplot method.

In this experiment, the area of each plot was 18 m^2 and the distance between seedlings was 25 cm in the row and 25 cm between rows, and the number of seedlings in each stake was 3-4. Seeding and transplanting were carried out every year in April and May, respectively, at the 4-5 leaf stage. All field operations and cultural practices such as irrigation, fertilization, weed and pest control were carried out as per the existing technical recommendations. During the growing period and after harvesting, the necessary evaluations for traits such as grain yield (tons per hectare with respect to moisture 14%), number of panicles per plant, weight of 100 seeds (gr and with respect to moisture 13%), number of whole seeds, plant height (cm), panicle length (cm), flag leaf length and width (cm) and days to full maturity were measured on 10 randomly selected plants in each plot. Also, traits related to grain cooking quality including amylose content, gelatinization temperature and grain physical properties such as kernel length, kernel breadth and total rice recovery and total head rice (milled rice) were evaluated. The product of the treatments was harvested from ten square meters from each plot after removing the borders at full maturity and was calculated with 14% moisture. Analysis of variance and mean comparison by Tukey method (using MSTATC ver 1.42 and SPSS ver 9 software) were performed separately for each year and at the end of 2 years of experiment, after ensuring uniformity of experimental error variance using Bartlett test, combined analysis of variance was done assuming the year and locations were random and genotypes were fix. With the significant interaction of genotype × environment for the studied traits, stability analysis was performed by GGE biplot analysis using GenStat software (Yan et al., 2001; Yan and Kang, 2002).

Table 1. Selected genotypes to determine compatibility and stability.

No.	Promising lines	Parents
1	RI18430-74	Saleh× Hashemi
2	Abjiboji× RI18431	Abjiboji) × Abjiboji (BC4) × (Saleh
3	Saleh× RI18434	Hassani) × Saleh (BC9) × (Saleh
4	Sepidrood× RI18443	(Sepidrood × Mohammadi)× (Sepidrood (BC25))
5	RI18435-13	Ahlamitarom× Saleh
6	RI18436-46	Hasansaraei× Saleh
7	RI18446-13	Salari× Sepidrood
8	Selected Hassani	Pure line selection from Hassani
9	Saleh	Improved cultivar
10	Abjiboji	Local variety

3. Results and Discussion

Observational evaluation of pure and selected lines in 2011 led to the selection of 61 top lines including 58 lines with desirable characteristics in terms of plant height (67.34-93.13 cm), day to 50% flowering (78-98 days), grain yield (3.3-3.8 tons per hectare) and amylose content (5.7-18.24%) and three backcross item including {(Abjiboji × (Abjiboji × Saleh)}, {(Saleh × (Hassani × Saleh)} and {(Sepidrood × Mohammadi × Sepidrood)} with an average grain yield of 5.5-6 tons per hectare, plant height 110-115 cm, amylose content was 20-21% and the number of days to 50% flowering was 80-85 days.

Selected lines (58 lines) which were selected based on yield, plant height, days to maturity and amylose content include 13 genotypes from Hashemi × Saleh cross, 5 genotypes from Abjiboji × Saleh cross, 6 genotypes from Mohammadi × Saleh cross, 6 genotypes from Hassani × Saleh cross, 7 genotypes from Ahlamitarom × Saleh, 3 cross from Hasansaraei × Saleh and 9 genotypes from Salari × Saleh cross. Also, from Hashemi × Sepidrood, Hasansaraei × Sepidrood, Ahlamitarom × Sepidrood and Salari × Sepidrood crosses, 2, 2, 2 and 3 pure lines were selected, respectively. By evaluating the selected lines in the preliminary repeated experiment in 2012, 8 superior genotypes were selected and evaluated in advanced experiments.

Mean comparison of grain yield for the studied genotypes in the compatibility experiment using Tukey test showed that the line resulting from the backcross Sepidrood (recurrent) and Mohammadi (donor) {Sepidrood × (Mohammadi × Sepidrood)} had highest grain yield and local variety Abjiboji had the lowest grain yield in all three locations during the two years of experiment. The grain yield of the genotypes studied was higher in the first year of the experiment than in the second year at all three locations. This may be attributed to the favorable weather conditions in the first year.

Only the line resulting from the backcross between Saleh and Abjiboji {Abjiboji × (Abjiboji × Saleh)} with a grain yield range between 5.35 – 5.66 tons per hectare and the line resulting from Hashemi × Saleh cross with a range 3.10-4.91 tons per hectare showed the lowest variation among the evaluated genotypes during two years. Unlike other genotypes, the line obtained from the backcross between Saleh and Abjiboji {Abjiboji × (Abjiboji × Saleh)} showed the highest grain yield (5.66 tons per hectare) in the second year in Abkenar location. The different grain yield of the studied genotypes in different environments clearly shows the role of the environment and the importance of studying the interaction of genotype × environment in rice breeding programs.

The results of GGE biplot method showed that the first two components (representing the main effect of genotype) and the second (representing the interaction of genotype × environment) explained 65, 27, and 92% of the total data changes, respectively (Fig. 2). Therefore, the first two components can be used to justify the grain yield of genotypes. Numerous studies have shown that in most stability analysis experiments the main effect of the environment is high, while the changes justified by the main effect of genotype and the interaction of genotype × environment are small, which can be recommended and interpreted. Since the environment is not a controllable factor, the GGE biplot graphical analysis method uses sources of genotype variation and genotype × environment interaction to obtain reliable results (Yan et al., 2000; Yan et al., 2007). In the other study by studying the upland genotypes of rice in different environments using GGE biplot method reported that the first two main components accounted for 33.9, 25.8, and 59.7% of the total data changes, respectively (Lakew et al., 2014). Justifies the adjective grain yield. To identify large environments and superior genotypes, the GGE biplot diagram was plotted using a two-year average of the data in three regions.

In this form, the genotypes that are the greatest distance from the origin of the biplot are connected by straight lines to form a polygon. Then, lines perpendicular to the sides of the polygon are drawn from the coordinate origin to define large circles. The genotypes at the vertex of each environment are the superior genotypes of that environment (Yan et al., 2000). Accordingly, six genotypes, including BC25, BC4, line RI18446-13, Hassani, Abjiboji, and RI18435-13, were located at the vertex of the polygon. These genotypes are the best or the weakest in terms of grain yield in some or all environments, because they are the farthest from the center of the biplot. In the tested environments, two large and separate environments were identified with superior genotypes RI18446-13, BC25, and BC4, respectively. The first large real environment included the Rasht region with the superior genotype RI18446-13 and the second real large environment included the two watersheds and Chaparsar regions with the superior genotypes BC25 and BC4. In other words, the Rasht region bore no resemblance to the two places of Abkenar and Chaparsar. In the other research, in order to select a high-yield and stable genotype using GGE biplot method identified three large real environments and introduced genotype number 12 as the superior and ideal genotype (Mostafavi et al., 2011).

In addition to the above, the genotypes in each section were very similar to each other. For example, BC9, Saleh, and line RI18436-46 were similar to the superior genotypes BC25 and BC4 and were well adapted to their larger environment, although they were not as large as the superior genotypes at the apex of the polygon. In contrast, although Hassani, Abjiboji, and RI18435-13 genotypes were the genotypes at the apex of the polygon, they did not have good grain yield in any of the environments and are considered as weak genotypes in this study. In addition, line RI18430-74 is one of the genotypes with poor grain yield by being located in the section related to the local variety Abjiboji (Fig. 2).

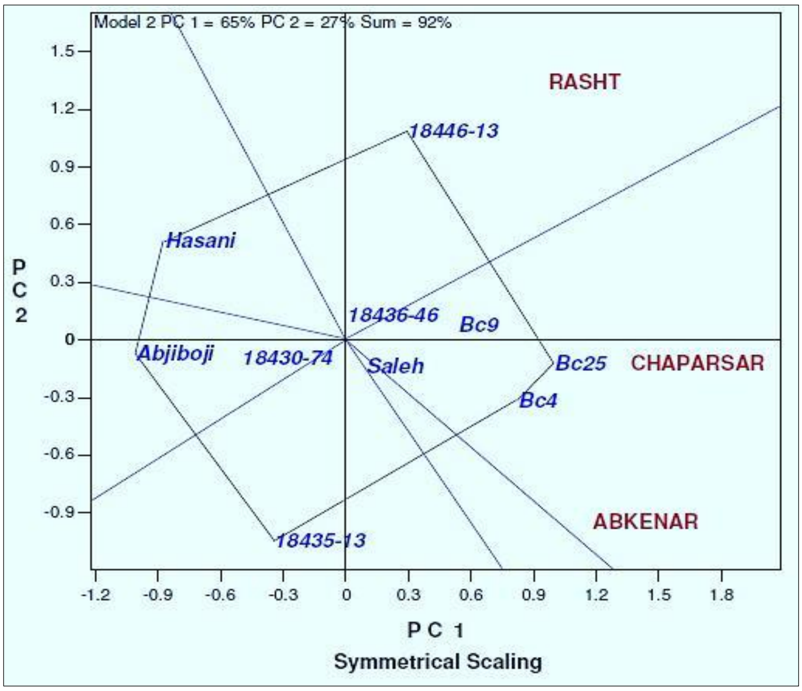

Figure 2. Biplot polygon diagram to identify large environments and superior genotypes.

The stability or two-dimensional axis diagram of the average tester coordinates is used to simultaneously evaluate the stability and performance of the genotypes. A horizontal line with a circle and an arrow indicates stability, and any genotype close to this axis is more stable (Yan et al., 2000). At the same time, the vertical line indicates the average yield of genotypes and the genotypes on the right and left of this line have higher and lower yields than the total average, respectively. Accordingly, genotypes BC9, BC25, RI18436-46 and Saleh had high yield and stability, the resulting line of backcross between Saleh and Abjiboji {Abjiboji × (Abjiboji × Saleh)} (BC4) had high yield and medium stability, genotype RI18446-13 had high yield and Low stability, RI18435-13 genotype had low yield and low stability, Hassani variety had low yield and medium stability and Abjiboji, and RI18430-74 genotypes had low yield and high stability (Fig. 3).

The use of mean tester coordinate diagrams in GGE biplot method is one of the useful and effective methods of stability analysis and provides good information about the appearance of the studied genotypes (Samonte et al., 2005; Kaya et al., 2006). Since both yield and stability factors should be considered in the selection of genotype for different environments, among the genotypes with high stability and grain yield above the overall average, the line (BC4) resulting from backcrossing was selected as the superior genotype having moderate stability and high grain yield (5.25 tons per hectare), suitable growing period (112.5 days), moderate amylose content (20.5%) and optimum plant height (107.5 cm). The top genotypes BC9 and BC25 have high yield and stability, but due to their high amylose content (more than 25%), they do not have good cooking quality and their seeds dry and harden after cooking. On the other hand, the BC4 line, which has acceptable performance and stability, has a good growing period, plant height and cooking quality.

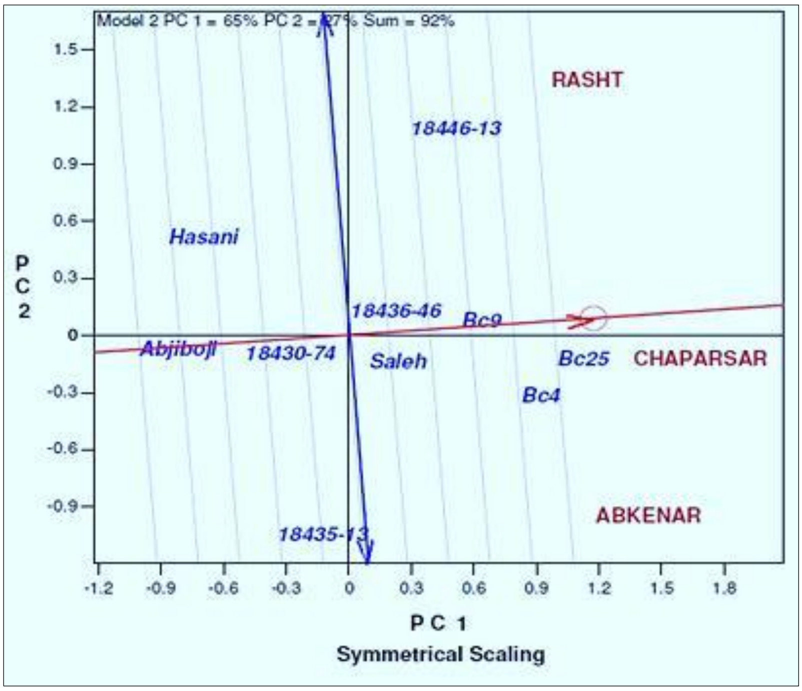

Figure 3. Views of average tester coordination (ATC) of GGE biplot for mean performance and stability of genotypes.

The ideal genotype diagram is hypothetical and based on determining the distance of genotypes from the ideal genotype. This hypothetical ideal genotype is defined based on the most stable and productive genotype. Such a genotype is defined based on the maximum length on the mean vector of high-yielding genotypes with the least role in genotype × environment interaction, so that the hypothetical ideal genotype is represented in the diagram as a small circle on the axis of mean yields of genotypes, and any genotype that is closest to this hypothetical genotype is considered to be a superior genotype (Yan and Kang, 2002). To use the ideal genotype as an evaluation center, concentric circles are created in the biplot to graphically determine the distance between the studied genotypes and the ideal genotype (Fig. 4). Any genotype that is in the center of the circles or has the closest distance from this hypothetical genotype is considered as a superior genotype with high yield and stability. In Fig. 4, the genotype BC9 had the shortest distance from the hypothetical ideal genotype, so it is the highest genotype, followed by the genotypes BC25 and BC4. In contrast, the genotypes RI18446-13, Hassani, Abjiboji, RI18435-13 and RI18430-74 have the highest distance from this hypothetical genotype and were considered as the most inappropriate genotypes in this study. Among the top genotypes of BC9 and BC25, although they have high yield and high stability, but due to high amylose content, they do not have good cooking quality and their seeds dry and harden after cooking. While BC4 line, while having acceptable performance and stability, has a good growth maturity duration, plant height and cooking quality.

Line BC4 is the result of backcross Saleh (modified variety) as the mother and donor parent and the local variety Abjiboji or Domsorkh as the father and recurrent parent (Abjiboji × (Abjiboji × Saleh)). The modified Saleh variety is the result of crossing between the variety imported from IRRI and the Khazar variety. The presence of short and white awns, suitable plant height and resistance to dormancy, blast disease resistance, early maturity, long grain length and medium yield are the prominent characteristics of this variety and have high general combining ability (GCA) for these traits. The variety has high amylose content and does not have the desired cooking quality. For this reason, it was not very welcomed by farmers and consumer market after its introduction (Allahgholipour et al., 2012). This is in contrast to the local variety Abjiboji, an Iranian rice variety of good quality, which was withdrawn from the cultivation cycle due to its high susceptibility to fungal attack. This variety, like other local varieties, has a low yield and is considered as one of the early to middle varieties with its high milling efficiency and moderate amylose content. Long, white to red awns is a prominent feature of this variety and is considered as a morphological marker. The comparison of important agronomic and physicochemical traits of grain in two parent varieties (Saleh and Abjiboji) is shown in Fig. 5. In this diagram, the horizontal axis (X) corresponds to the local variety Abjiboji and the vertical axis (Y) represents the Saleh variety. As shown in Fig. 5, the local variety Abjiboji has the highest value in terms of plant height and white rice, while Saleh variety has the highest in terms of grain length and amylose content. The two varieties are similar in terms of 100-seed weight, but the grain yield, number of spikes and number of full seeds in Saleh variety are higher than Abjiboji variety. The two varieties were selected as backcrossing parents due to their complementary characteristics (Fig. 5).

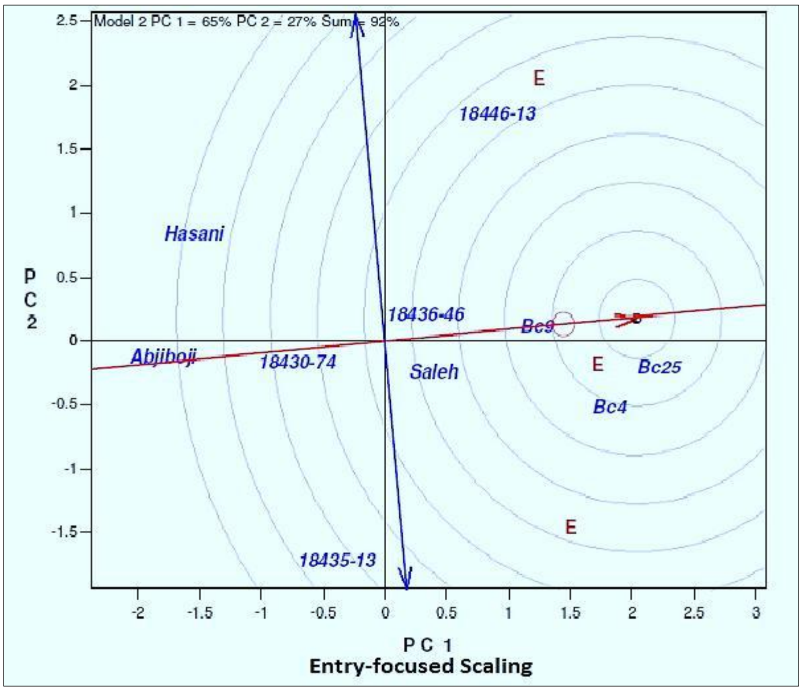

Figure 4. Ideal biplot genotype diagram for comparison of genotypes based on stability and grain yield.

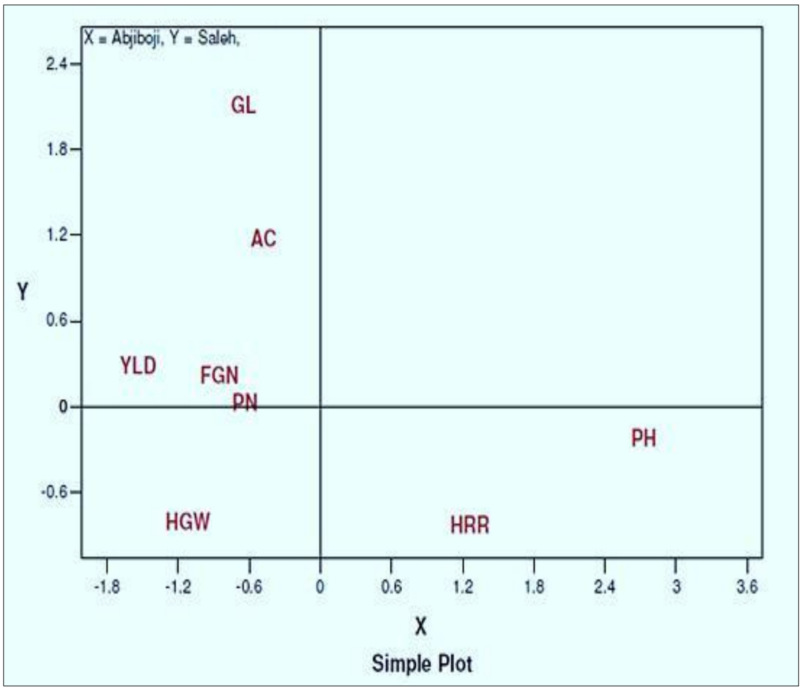

Figure 5. Comparison of important agronomic and physicochemical characteristics of grain in two parent varieties Saleh and Abjiboji.

YLD = Grain yield, AC = Amylose content, FGN = Filled grain number, PN = Panicle number, GL = Grain length, HGW = 100-grains weight, HRR = Head rice recovery, PH = Plant height.

Line from BC4 reciprocal cross with grain yield of 5.6-6 tons per hectare, 100 seed weight 2.5-2.6 grams, number of filled grains 125-130, plant height 105-115 cm and amylose content 20-21%, while being superior to its parents, is considered one of the early and dwarf varieties and has the same cooking quality as local Iranian varieties (Table 2). This variety resembles its parent plant (variety Abjiboji) in structure and morphology and has long awns like the latter. The awns are white at the time of emergence, yellow at the time of seed filling and red at the time of ripening. The presence of awns in this line prevents damage from sparrows and, in some cases, wild boar, and gives the plant a special beauty when it arrives. The germination of the mentioned seed line in the nursery has a high speed like other local varieties and after transplanting in the main ground, due to its long leaves, it creates good shading in the distances between the plants and therefore prevents the growth of weeds.

Table 2. Morphological and physicochemical properties of grain in parent varieties and Gilaneh

Traits	Abjiboji	Saleh	Gilaneh
Grain yield (t/ha)	4 –3.5	5.5 -5	6 –5.5
100-grain weight (g)	2.5-2.4	2.5-2.4	2.6-2.5
Filled grain number (per panicle)	110-100	125-120	130-125
Unfilled grain number (per panicle)	15-12	19-16	20-17
Panicle number	15-12	18-15	15-12
panicle fertility (%)	90-85	90-85	90-85
Plant height (cm)	160-155	110 -100	115-105
Grain length (mm)	11-9	12-10	11-9
Grain width (mm)	2.7-2.2	2.4-2	2.5-2.2
Panicle length (cm)	30-25	30 -25	35-30
Growth period (days)	120-115	120-115	115-110
Flag leaf length (cm)	28-23	27-22	30-25
Flag leaf width (cm)	1.1-1	1.1-1	1.3-1
Amylose content (%)	20-19	26-25	21-20
Gelatinization score	5-4.5	7-6.5	5-4.5

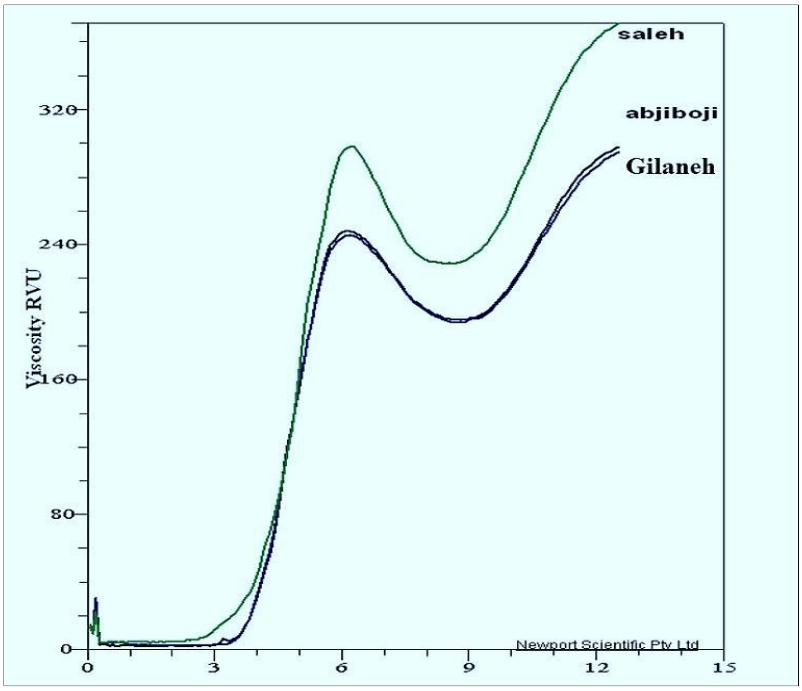

Figure 6. Viscosity parameters of grain starch in Gilaneh, Abjiboji and Saleh.

All farmers in the areas studied agreed on the early maturity of the new line and considered this characteristic, together with resistance to lodging, as one of the outstanding features of this variety. In addition, the new line is soft after cooking and has the same taste as the local varieties. To ensure the desired cooking quality of the new line, the viscosity parameters of the starch were measured with a fast viscoanalyzer and compared and evaluated with the parameters of the parent varieties. The results showed that the above parameters of the new line exactly matched those of the local parent variety, Abjiboji (Fig. 6). The curve for the viscosity parameters of the new BC4 line is similar to the curve for the Abjiboji variety, while it is very different from the curve for the Saleh variety (Fig. 6). Baking of the new white rice confirmed the obtained result. Moreover, the new line is soft after cooking and has the same taste as the local varieties. Almost all farmers and experts involved in this study agreed to introduce the line as a new variety in Gilan province. This new line was introduced in Iranian agriculture in 2016 under the name Gilaneh. The area of this variety increased from 10 hectares in 2016 to 2029 hectares in 2019. In 2020, the area of Gilaneh decreased to 1241 hectares due to the decrease in millers' acceptance due to the presence of awns (Fig. 7). It is necessary to explain that breeding processes to eliminate awns have started in this variety and have achieved very acceptable results.

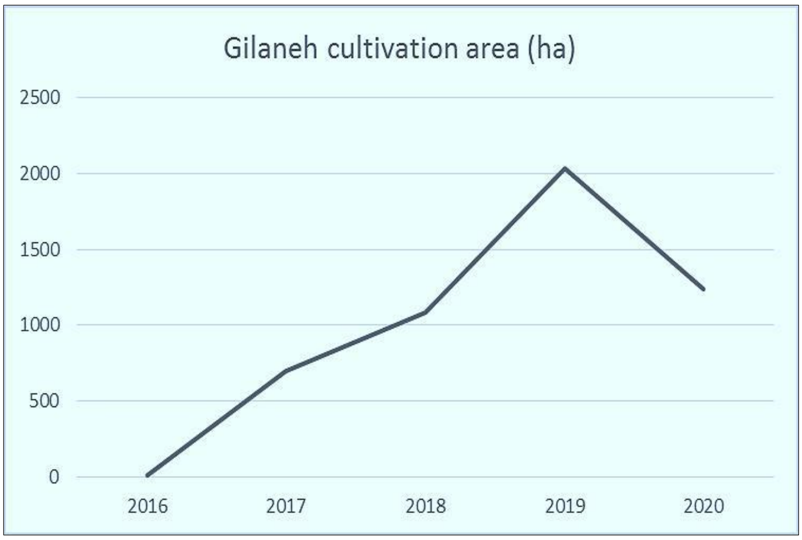

Figure 7. Area under cultivation of Gilaneh cultivar during 2016-20.

4. Conclusion

Local cultivars, while having wide adaptation to different environmental conditions, are considered as a valuable resource in creating breeding populations. High cooking quality and marketability of local cultivars is one of the important reasons for cultivating these cultivars. High-yielding improved varieties that have been introduced so far have not been very successful in competing with local cultivars due to their late ripeness and poor grain quality characteristics (especially cooking quality). Therefore, obtaining relatively high yielding early cultivars and similar to local cultivars with suitable cooking characteristics is a priority of research programs.

In the process of introducing Gilaneh cultivar, different breeding populations were performed by simple and reciprocal crosses using local cultivars and two improved varieties. After selection from each population, the selected lines along with the three lines resulting from the backcrossing were examined for agronomic characteristics and quality traits such as amylose content. The results of adaptability and stability tests led to the selection of the line resulting from the backcrossing between Saleh and Abjiboji cultivars. This line, which has been introduced to the farming community as Gilaneh cultivar, is exactly similar to the local cultivar Abjiboji and differs significantly from the local cultivar only in terms of plant height and ripening time. Also, the results of qualitative traits showed that Gilaneh cultivar is similar to local cultivar in terms of cooking quality. In other words, the targeted selection of parents for crossing and the improvement of the local cultivar have been done correctly.

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