International Quinoa Conference 2016:

Quinoa for Future Food and Nutrition Security in Marginal Environments

Dubai, 6-8 December 2016

www.quinoaconference.com

Quinoa Research and Production Prospect in Iran

Dr. **Niaz Ali Sepahvand**[1*]

Seed and Plant Improvement Institute (SPII), Karaj, Iran.

Iranian Genetics Society

niazsepahvand@gmail.com

Introduction

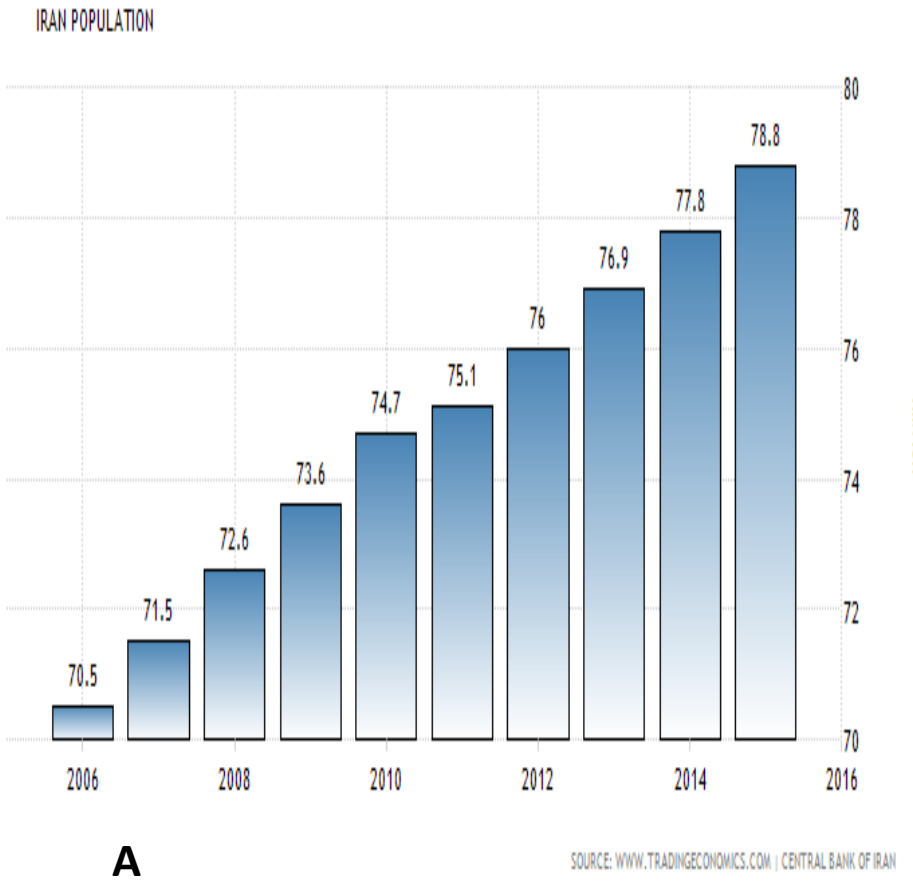
- **The nutritional value of Quinoa is for high protein content and mineral concentrations .**
- **The amino acid is suitable for a balanced human diet.**
- **Quinoa is one of the few crops, if not the only crop, able to grow in the most extreme environmental conditions [1].**
- **Its high tolerance to salinity and drought, together with its excellent nutritional quality, makes it an ideal crop to contribute to food security for the twenty-first century [2].**
- **Quinoa has long and distinguished history in South America and has been cultivated since 3000 BC [3].**
- **However it was unknown in the Middle East and also in Iran till recent years.**

Introduction

- **Iran has great agricultural potentials, the vast area of arable land.**
- **Varied climate condition and suitable human resources.**
- **However, climate change and shortage of water is a serious challenge to Iranian agricultural sector and food production.**
- **The new crops and under utilized crops especially those with higher water productivity and adapted to harsh conditions may be an option to tackle the challenges.**

Introduction

B

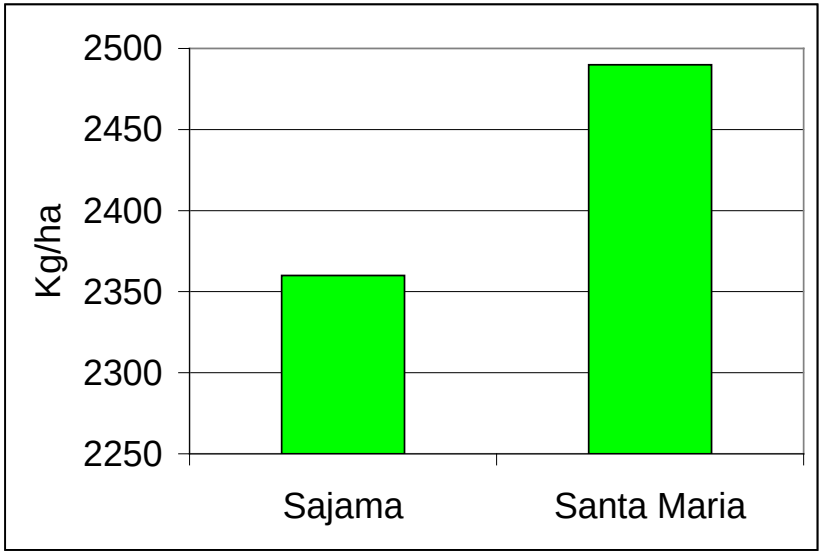


A

Fig. 1. The population of the country is growing (A), Quinoa research and production sites in Iran (green color, (B).

Introduction

- **The first Quinoa trial in Iran initiated by sowing quinoa in the field of SPII in Karaj in 20th April and early August, 2009.**
- **The genotypes of the first sowing date didn't produce any seed.**
- **The genotypes of the second date produced reasonable yield. The yield of Sajama was 2362 $kgha^{-1}$ and that of Santamaria was 2490 $kgha^{-1}$.**



- **The results revealed that quinoa is adapted to the climate condition of Karaj and it could be a novel crop in Iran [4].**
- **Two genotypes showed variation in different traits such as; Plant form, plant height, foliage and stem color, the panicle form and color, seed color and maturity. [4].**

Introduction

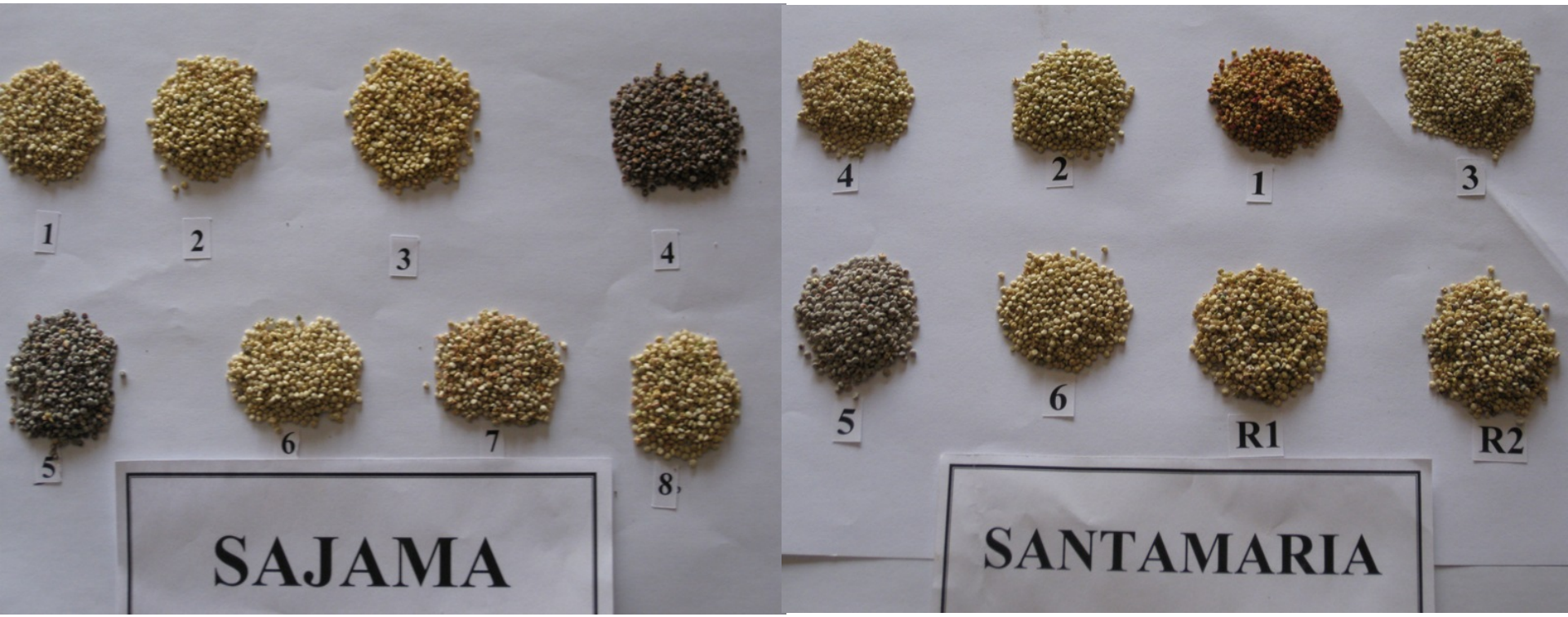


Fig. 2. The variation of seed color of two genotypes, Santamria and Sajama were grown in SPII field in Karaj, Iran 2009.

Introduction

- **The genetic variation of the morphotypes was assessed by using quinoa SSR markers.**
- **The seeds were sown on 3 rows with the length of 3m and the rows spacing 60cm.**

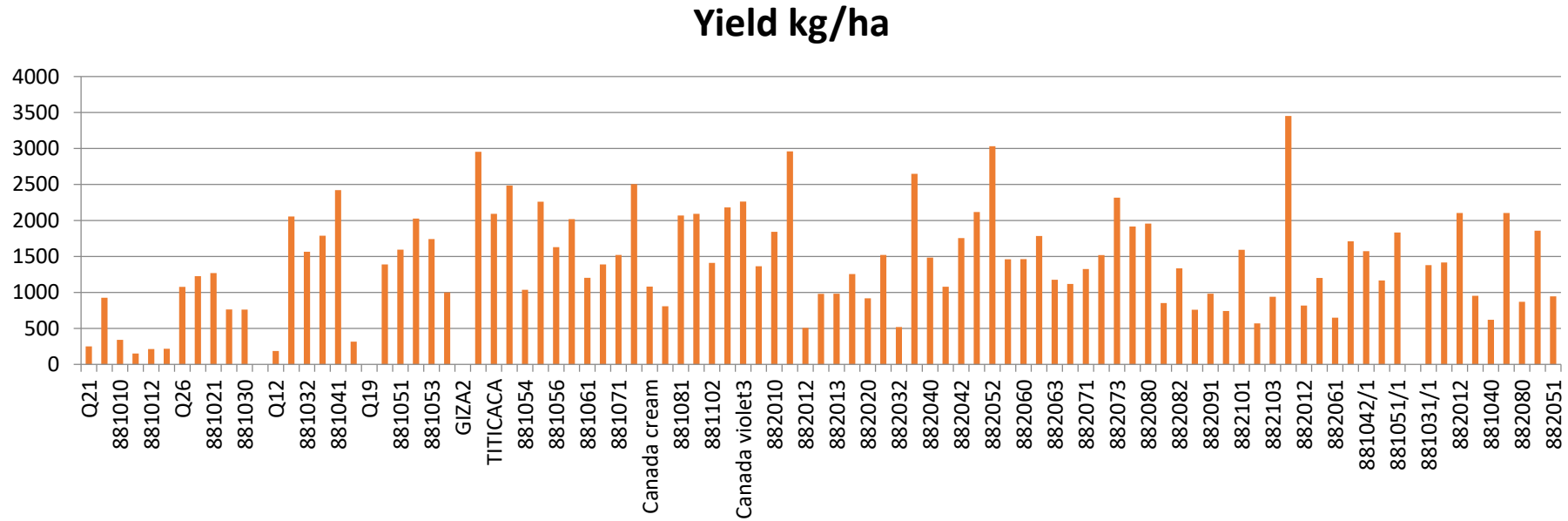


Fig. 3. The cultivars and morphotypes harvested yield in the field trial in SPII, Karaj in 2014.

Introduction

- **Forty five morphotypes were derived from Sajama and Santamaria genotypes.**

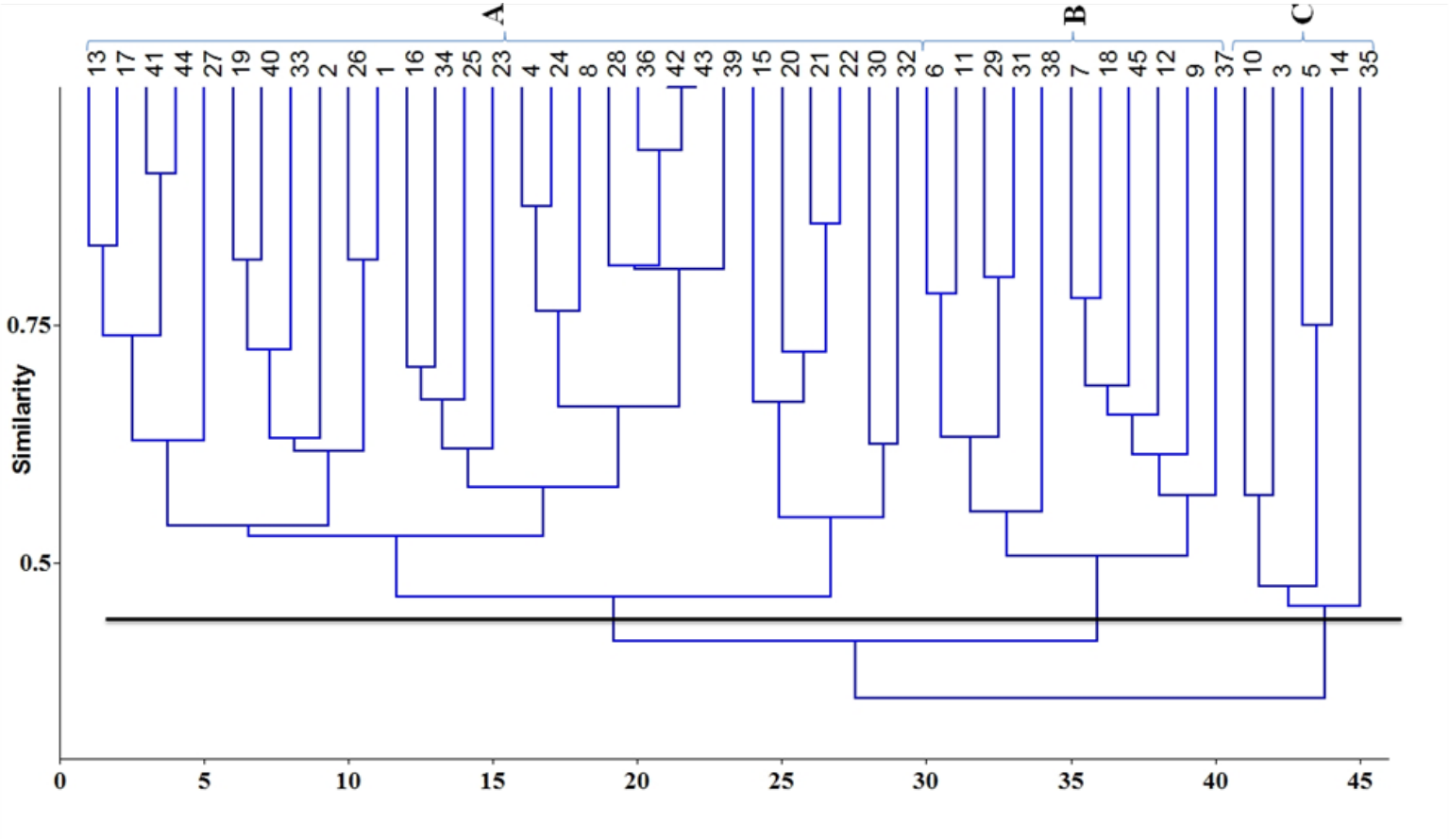


Fig. 2. Cluster analysis based on UPGM of 45 Iranian Morphotypes derived from two genotypes, using data from PCR product of SSR markers.

Materials and Methods

- **To study the adaptability and productivity potential of quinoa, 3 genotypes were sown in a complete block randomized design (RCBD) with 6 replications in Karaj, Ahwaz, Iranshar and Gorgan (Fig. 1) .**
- **The sowing dates were early August in Karaj, late October in Ahwaz, early December in Iranshahr and mid October in Gorgan.**
- **Their traits were scored and analyzed by SPSS and Duncan test used for mean comparison.**
- **Twelve genotypes, 6 from Peru and the rest from various origins (Table 1) were evaluated for their adaptability and yield in high latitude at AR Station in Shahrekord (Fig. 1) in randomized complete block design (RCBD) with 3 replications.**

- **The seeds were sown on 3m rows spacing 60cm on 9th June 2015. Their traits were scored and analyzed by SAS 9.1 and Duncan test used for mean comparison.**

Materials and Methods

- **The seeds were sown on 3m rows spacing 60cm on 9th June 2015. Their traits were scored and analyzed by SAS 9.1 and Duncan test used for mean comparison.**
- **Ten quinoa genotypes from FAO-RNE and Red Carina, Giza1, Titicaca and Sajama were evaluated in Iranshahr in 2015-2016.**
- **The seeds were sown on rows with the length of 3m and the rows spacing 60cm in a RCBD with three replications in early December 2015.**
- **The main traits were recorded and analysis of variance was done by SAS 9.1.**
- **The mean were compared with Duncan test.**

Results

- **The Adaptation of quinoa in different climatic condition of Iran in 2010.**

• The combined ANOVA of the yield revealed significant differences between the stations, but not the genotypes.

• The mean analysis of the yield in the productive stations showed that Ahwaz and Karaj stations had higher yields, 1162 and 1082kgha^{-1} respectively (Table 1).

• However Sajama-Iranshahr had higher mean yield of 1075kgha^{-1} Santamaria and Sajama had 1016 and 973.3kgha^{-1} in all stations respectively (Table 1).

• The protein of the seeds range was 12.2%-13.3%, Santamaria had the highest and Sajama-Iranshahr had the lowest protein content [9].

• However, genotypes didn't produce any grain on the sowing date in Gorgan station despite of proper vegetative growth.

Results

Investigation on adaptation, phonological and agronomical characters and quality of Quinoa in Iran .

Table 1. The mean comparison of 3 quinoa genotypes and 4 stations main traits in Iran of adaptation project in 2010-2011

Genotype/Station	Plant height cm	Flowering period (days)	Seed Protein (%)	Yield ($kgha^{-1}$)
Sajama	87.28b	51.78a	12.8	973.33
Santamaria	93.3a	51.56a	13.3	1016
Sajama-Iranshar	86.48b	51.72a	12.2	1075
Karaj	128.58a	52.11b	13.0	1081a
Ahwaz	89.17b	37.00c	13.3	1162a
Iranshahr	81.39c	65.94a	12.3	822.67b
Gorgan	56.67d	-	-	-

Results

- **Evaluation of Peruvian and some cultivars reaction to long day Period in high latitude of Zagros Mountains at Sharekord**

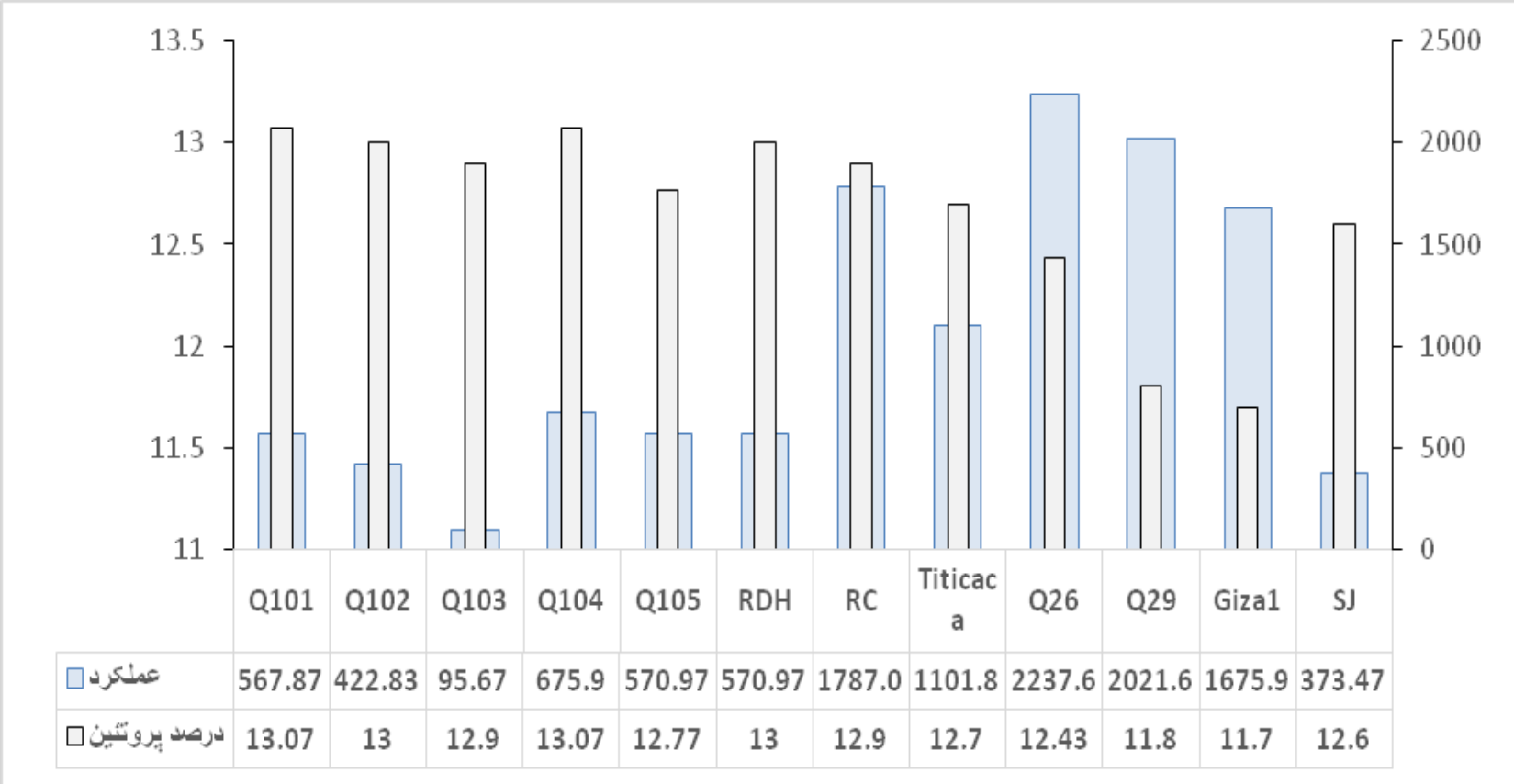
•The ANOVA results of the genotypes showed highly significant differences between traits such as; yield, TKW , plant height, stem diameter, protein, and saponin content of the seeds.

• The mean comparison revealed that genotypes Q26 and Q29 had higher yield, 2237.6kgha^{-1} and 2021.6kgha^{-1} respectively.

• Grain protein content was from 13.07% of Q101 and Q104, to 11.07% of Giza1 that were in group A and E respectively (Table 1, Figure 5).

• The genotype Titicaca was the earliest maturing cultivar having 83 days from cultivation to maturity, four genotypes Giza1, Q29 ،Q26 and RC reached to physiological maturity.

Results



	Q101	Q102	Q103	Q104	Q105	RDH	RC	Titicaca	Q26	Q29	Giza1	SJ
عملکرد	567.87	422.83	95.67	675.9	570.97	570.97	1787.0	1101.8	2237.6	2021.6	1675.9	373.47
درصد پروتئین	13.07	13	12.9	13.07	12.77	13	12.9	12.7	12.43	11.8	11.7	12.6

Fig. 3. The yield and protein (dark columns) mean comparison of the genotypes that were valuated in Zagross Mountains high latitude, climate condition in Sharekord station, Iran. The highest and the lowest yield (blue columns) are genotypes Q26 and Q103 respectively.

Results

Table 2. The mean comparison of some traits of quinoa cultivars from different origins in high latitude climate condition of Zagros Mountains (Shahrekord), Iran using Duncan test

No	Cultivars	origin	1000 Kernel Weight (gr)	Plant height (cm)	Stem Diameter (mm)	Yield (Kg/ha)	Protein (%)	Saponin (mg/gr)
1	Q101	Peru	1.70 E*	154.73A	6.33B	567.87EF	13.07A	1.80A
2	Q102	Peru	2.76 A	153.57A	7.20A	422.83F	13.00AB	1.40ABC
3	Q103	Peru	1.87 DC	132.33AB	4.63CD	95.67G	12.90ABC	1.10ABCD
4	Q104	Peru	2.83 A	136.17AB	4.13DE	675.90E	13.07A	0.93BCD
5	Q105	Peru	2.87 A	125.40BC	3.33F	570.97EF	12.77ABCD	0.63CD
6	RDH	Peru	1.87 DC	134.87AB	7.03A	570.97EF	13.00AB	0.43D
7	RC	Holland	2.93 A	107.93BC	4.77C	1787.03C	12.90ABC	1.30ABC
8	Titicaca	Denmark	1.97 C	85.13D	5.97B	1101.80D	12.70BCD	1.83A
9	Q26	FAO	2.83 A	101.93D	3.57EF	2237.63A	12.43D	1.57AB
10	Q29	FAO	2.83 A	103.93CD	5.10C	2021.60B	11.80D	1.27ABC
11	Giza1	Egypt	2.43 B	105.40CD	5.97B	1675.93C	11.70E	1.11ABC
12	SJ	Iran	1.80 DE	134.47AB	3.63EF	373.47F	12.60CD	0.35D

Results

- **Evaluation of some FAO-RNE genotypes reaction to short day Period in Iranshahr in 2015-2016.**

- **Analysis of variance of 14 genotypes showed that the effect of genotype on yield and the other agronomic characters was highly significant different.**
- **The mean range of genotypes seed yield varied from 1033.3 to 3961.1kgha^{-1}. Among the genotypes, Q29 had the highest seed yield of 3961.1kgha^{-1} (Table 3). The lowest seed yield was recorded for Sajama with 1033.3kgha^{-1}.**
- **The genotypes Q12, Q26, Q18 and Q31 had high yield of 3802.50, 3799.44, 3349.97 and 3386.1kgha^{-1} respectively (Table 3).**
- **The protein content range of the genotypes seeds was 10:9%-12.3%, RC had the highest protein content and Q104 had the lowest.**


Regional Quinoa Awareness and Planning Workshop
Project TCP/RAB/3403 -Technical Assistance for The Introduction of
Quinoa and Appropriation/ Institutionalization of its Production
Seed and Plant Improvement Institute. Karaj-Iran
18-20 October 2014
photo by
spii...eskandarlooali

Results

Table 3. Mean comparison of some traits of quinoa cultivars in autumn short day climate condition in Iranshahr, Iran in 2015-2016 using Duncan test

Cultivar	Spike length cm	TKW[1] gr	Biologic weight	Harvest Index	Yield Kgha^{-1}	Protein[3] Perc. %	Saponin[3] Mggr^{-1}
Q12	30.2c[2]	2.88h	8666.3a	43.96de	3802.50ab	11.6	3.91
Q18	25.7cd	3.46a	6697.0bc	50.02ab	3349.97bc	11.1	5.26
Q21	23.5de	3.06de	6858.3bc	47.97bc	3277.8c	11.4	4.67
Q22	18.9e	3.05de	5966.7cd	39.61f	2363.9d	11.8	4.42
Q26	23.8de	3.35abc	8549.3a	44.38de	3799.44ab	12.0	5.60
Q29	22.1de	3.49a	7797.3ab	50.81a	3961.1a	11.8	5.94
Q31	24.7d	3.09de	6876.7bc	49.24ab	3386.1bc	11.9	6.36
Q104	37.8b	2.6g	5141.7d	31.02g	1587.1f	10.9	3.82
Q105	44.8a	3.12cde	5464.0d	33.36g	1727.4ef	11.7	3.74
Q107	22.8de	2.69fg	6016.7bc	45.70cd	3158.3c	11.8	4.67
Red carina	24.1de	3.22bcd	5208.3d	41.96ef	2188.9de	12.3	4.84
Giza1	22.8de	2.79fg	6952.6bc	44.56de	3091.7c	12.2	4.25
Sajama	23.1de	2.63g	4022.3e	25.71h	1033.3g	11.7	0.86
Titicaca	18.8e	3.08de	5972.3cd	40.68f	2430.6d	11.8	3.99

Results

- **Prospects;**
- **The people's awareness is promising and encouraging for Quinoa production and usage.**
- **However, it needs more capacity building by using public communication facilities such as, TV, radio, newspapers, magazines and advertisement.**
- **The research results publications, IYQ, FAO-TCP activities had effects on officials especially Minister of Agriculture, Deputy Minister on Agronomy and Deputy Minister on Research, Education and Extension (AREEO).**
- **They showed high interest on quinoa production in the country. However, there are a few concerns that must be under consideration for quinoa production and utilization.**
- **The farmers are willing for quinoa production in Iran.**

Results

- **Challenges;**
- **Improved high yield, quality cultivars and classified seed for farmers community.**
- **Agronomy and good practices for quinoa production such as; water and fertilizer requirement, IWM (selective herbicide), mechanized harvesting and threshing.**
- **Suitable market for selling the farmers' product.**

Conclusions

. The limited quinoa genetic material restricted the primary quinoa research to lower yield genotypes and production to the southern regions in Iran.

• The new genotypes were evaluated in high latitude of Zagros Mountains in Shahrekord was a novel finding.

•A few adapted genotypes produced good yield. The genotypes which are productive in spring cultivation as the long-day/day-neutral genotypes are promising achievement.

• The results of evaluation of new genotypes in Iranshahr revealed that a few genotypes higher yield than previous adapted genotypes.

• The results of new genotypes in Shahrekord and Iranshahr revealed the genotypes; Q29, Q26, RC, Giza1 and Titicaca were day-neutral, more productive and adapted to both climate conditions.

Conclusions

- **The quinoa research findings were transferred to the farmers fields in Khuzestan and Baluchistan**
- **However, there is a long way in front for proper quinoa production in Iran.**
- **Quinoa research, production, processing, marketing and utilization need good planning and investment in Iran.**

Acknowledgments

- **I would like to thank my colleagues; G. Najafian, M. , Kh. Miri, A. Molaei, and M. Tavoosi, Abassali, M. Kahbazi, M. Tavazoa, A. Parkasi, B. Fooladi, M. Sarhangi, F. Sheikh, and S. Khoshkam; who worked hard for a successful quinoa project in Iran.**


Thank you for your
kind attenssion.