Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 2, Issue 5, May 2026
Website: usajournals.org

EVALUATION OF YIELD AND AGROBIOLOGICAL TRAITS OF INTRODUCED QUINOA (CHENOPODIUM QUINOA WILLD.) VARIETY SAMPLES

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Abstract
This article presents the evaluation results of major yield-related agronomic traits in introduced quinoa (Chenopodium quinoa Willd.) variety samples under the agroecological conditions of Uzbekistan. The experiment was conducted at the experimental farm of the Tashkent State Agrarian University using a randomized design with three replications. Important agronomic traits including plant height, panicle characteristics, wet and dry panicle weight, 1000-seed weight, and yield performance were analyzed. The obtained results revealed significant genotypic variability among the studied variety samples. Several quinoa samples demonstrated superior productivity, biomass accumulation, and better adaptability to local environmental conditions. The findings provide an important scientific basis for the selection of promising quinoa germplasm and the development of breeding materials for future quinoa improvement programs.

Keywords: Quinoa, Chenopodium quinoa Willd., variety samples, yield traits, breeding, introduction, genotype, agronomic characteristics.

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Quinoa — Chenopodium quinoa Willd. — has gained considerable scientific and practical importance worldwide in recent years as a promising pseudocereal crop with high nutritional value. This crop is distinguished by its high content of proteins, essential amino acids, vitamins, minerals, and biologically active compounds. In particular, the balanced composition of amino acids such as lysine, methionine, and threonine, which are essential for the human body, makes quinoa highly valued as a functional and dietary food source.

Another important biological characteristic of quinoa is its high tolerance to various unfavorable environmental factors, including drought, salinity, high temperatures, and poor soil conditions. Therefore, this crop is recognized as one of the strategic crops for ensuring food security under global climate change conditions. Currently, extensive scientific research is being conducted not only in South America but also in Asian, European, and African countries to introduce quinoa and develop varieties adapted to local agroclimatic conditions.

Under the conditions of Uzbekistan, the introduction of drought-tolerant, low-water-demanding crops with high nutritional value is of great scientific and practical significance. In this regard, the introduction of quinoa, the study of its biological characteristics, and the identification of high-yielding varieties adapted to local agroecological conditions are among the most relevant research priorities.

The objective of this study was to evaluate the yield and agrobiological characteristics of introduced quinoa variety samples, determine the degree of genotypic variation among them, and identify promising materials for breeding purposes. The obtained results will serve as an important scientific basis for developing new breeding materials adapted to local conditions in the future.

The experiment was carried out at the experimental farm of the Tashkent State Agrarian University. The experimental field measured 30 m in length and 20 m in width, and the treatments were arranged in three replications with a 1.5 m protective zone between variants. The study included quinoa lines and varieties such as Ames-654 Check1, Ames-13761 New 14, BO-16 New21, CHEN-298 New 42, PI 433232 New 170, and D-12229 New 141.

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During the experiment, major agronomic indicators such as germination percentage, duration of the vegetation period, plant height, branching level, panicle length, 1000-seed weight, seed mass per plant, and yield per hectare were recorded. Before sowing, seeds were prepared under identical agrotechnical conditions, while soil fertility and moisture levels were maintained uniformly across all treatments. During the vegetation period, weed control, irrigation, and phytosanitary observations were conducted according to the same standards, which allowed a more accurate assessment of differences among genotypes.

The research results demonstrated significant genotypic differences in panicle and seed yield components among quinoa (Chenopodium quinoa Willd.) lines. In general, stable variability among the lines was observed for all studied traits, including wet and dry panicle weight, physiological maturity panicle mass, and 1000-seed weight. The highest agronomic indicators were mainly recorded in the New 141, New 170, and New 42 lines, indicating their high biomass and reproductive potential. The standard variety Check1 showed moderate values and served effectively as a comparative control. The coefficient of variation (V%) values for all traits ranged from low to moderate, indicating stable genetic expression in certain lines.

Panicle Weight of Quinoa Varieties (g)

Line name	**Seed coat color at physiological maturity**	**Panicle weight gr**		
		M±m	**σ**	**V%**
Check1	White	7,7±0,47	0,94	12,32
New 14	White	6,8±0,39	0,78	11,6
New 21	Yellow	8,1±0,43	0,87	10,8
New 42	Yellow	9,1±0,36	0,73	8,1
New 170	White	9±0,40	0,81	9,07
New 141	White	9,7±0,33	0,67	6,95

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Analysis of panicle weight at physiological maturity revealed that the lowest value was observed in the New 14 line (6.8 g), while the highest value was recorded in the New 141 line (9.7 g). The New 42 and New 170 lines also demonstrated high results with 9.1 g and 9.0 g, respectively. The Check1 variety occupied an intermediate position with a value of 7.7 g. The coefficient of variation ranged from 6.95% to 12.32%, with the most stable performance observed in the New 141 line. This indicates that the most stable genotypes for panicle weight were New 141 and New 42.

Dry Panicle Weight of Quinoa (g)

Line name	Seed coat color at physiological maturity	Dry panicle weight, gr		
		M±m	σ	V%
Check1	White	9,9±0,36	0,73	7,45
New 14	White	10,9±0,43	0,87	8,03
New 21	Yellow	13,7±0,57	1,15	8,46
New 42	Yellow	13,4±0,48	0,96	7,2
New 170	White	13,9±0,59	1,19	8,61
New 141	White	11,3±0,47	0,94	8,39

The results for dry panicle weight showed increased values in all lines, reflecting the conversion of vegetative biomass into reproductive biomass. The highest dry weight was recorded in the New 170 line (13.9 g), followed closely by New 21 (13.7 g) and New 42 (13.4 g). The lowest value was observed in the Check1 variety (9.9 g), indicating relatively lower biomass potential compared to the breeding materials. The coefficient of variation ranged from 7.2% to 8.61%, demonstrating relative stability of dry biomass traits. Dry panicle weight is considered one of the important agronomic indicators in quinoa because it reflects the amount of accumulated biomass transferred into the reproductive organs during plant development. Higher dry panicle weight usually indicates better assimilate accumulation, improved grain filling, and greater yield potential. In the present study, significant differences were observed among the quinoa lines for this trait.

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The highest dry panicle weight was recorded in the New 170 line (13.9 g), followed by New 21 (13.7 g) and New 42 (13.4 g), indicating their strong productivity potential under local environmental conditions. In contrast, the Check1 variety showed the lowest value (9.9 g), suggesting relatively lower biomass accumulation capacity. The relatively low coefficient of variation values (7.2–8.61%) demonstrated that dry panicle weight was a stable trait among the studied genotypes and may serve as an important selection criterion in quinoa breeding programs.

Wet Panicle Weight of Quinoa (g)

Line name	Seed coat color at physiological maturity	Wet panicle weight, gr		
		M±m	σ	V%
Check1	Green	2,7±1,45	2,90	8,89
New 14	Yellowish	31,8±0,87	1,75	5,50
New 21	Green	36,8±1,39	2,78	7,55
New 42	Green	38±1,37	2,74	7,23
New 170	Yellowish	30,9±0,76	1,5	4,93
New 141	Green	42,4±1,75	3,5	8,26

The results for wet panicle weight showed significant differences among genotypes. The highest value was recorded in the New 141 line (42.4 g), which considerably exceeded all other lines. The New 42 (38.0 g) and New 21 (36.8 g) lines also exhibited high productivity potential. Although the New 170 line had the lowest value (30.9 g), it showed the lowest coefficient of variation (4.93%), indicating very high stability of this genotype. Overall, the New 141 line was identified as the most promising genotype based on wet panicle weight. Wet panicle weight is an important agronomic trait that characterizes the total fresh biomass accumulated in the panicle during the reproductive stage of plant development. This indicator reflects the intensity of physiological processes,

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nutrient accumulation, and the potential productivity of quinoa genotypes. In the present study, considerable variation in wet panicle weight was observed among the investigated quinoa lines.

Weight of 1000 Seeds of Quinoa (g)

Line name	Seed coat color at physiological maturity	Weight of 1000 seeds, gr		
		M±m	σ	V%
Check 1	White	3,22±0.23	0,47	14,78
New 14	White	3,42±0,24	0,48	14,24
New 21	Yellow	3,4±0,22	0,45	13,5
New 42	Yellow	3,23±0,20	0,40	12,55
New 170	White	3,53±0,18	0,37	10,67
New 141	White	3,54±0,13	0,26	7,5

Analysis of 1000-seed weight demonstrated high genetic stability, which is considered one of the most important agronomic traits in quinoa breeding. The highest values were observed in the New 141 (3.54 g) and New 170 (3.53 g) lines. The New 14, New 21, and Check1 varieties showed relatively lower values ranging from 3.22 to 3.42 g. The coefficient of variation ranged from 7.5% to 14.78%, with the highest stability recorded in the New 141 line. These findings confirm that lines with high genetic stability for 1000-seed weight are particularly important for breeding programs.

The results of the study revealed significant genotypic differences in yield and yield components among the introduced quinoa variety samples. In particular, the New 141, New 170, and New 42 varieties demonstrated superior performance in terms of panicle mass, dry biomass, and 1000-seed weight. The relatively low coefficients of variation confirmed high genetic stability in several variety samples. The obtained results suggest that these lines can be recommended as promising breeding materials for local conditions. Furthermore, panicle mass and 1000-seed weight were identified as important selection indicators in quinoa breeding.

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Overall, the analysis of all traits demonstrated that the New 141, New 170, and New 42 lines showed superior results for complex agronomic characteristics and can therefore be considered promising breeding materials. The Check1 variety represented a moderate standard level. The obtained findings indicate that panicle mass and 1000-seed weight are the main selection indicators for improving quinoa productivity.

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