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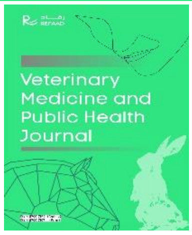

Genetic Stability Analysis of Three Barley Cultivars (*Hordeum vulgare* L.) Grown under the Influence of Different Levels of Nitrogen Fertilizer

Fatimah Ali Jamel[1*], Waleed Abdulredha Jabail[2], Khawla Rashige Hassan[3]

[1,3] Department of Field Crop, College of Agriculture, University of Basrah, Iraq.

[2] Department of Biology, College of Education, Quran, University of Basrah, Basrah, Iraq.

*** Corresponding author:** Fatimah Ali Jamel (fatima.chamel@uobasrah.edu.iq)

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Abstract:

Objectives: to analyze the genetic stability of three barley cultivars under the influence of different levels of nitrogen fertilizer to identify the variety or varieties that have genetic stability.

Methods: At the Agricultural Research Station in Karma Ali, College of Agriculture at the University of Basrah, a field experiment was carried out in the Basrah Governorate during the 2021-2022 winter season The experiment was done using a split-plot design with three replications. The main plots showed the number of harvests (once, twice, or three times), which were shown by (C1, C2, C3). The secondary plots showed the crops (Baraq, Abaa 99, Abaa 265), which were shown by (V1, V2, V3). The sub-plots showed the amounts of fertilizer (300, 200, 100) N ton ha^{-1} and symbolized by (N1, N2, N3).

Results: The results showed that the values of phenotypic variances were highly significant compared to the genetic and environmental variances, the studied traits. Green and dry food yield, protein yield, and inheritance in a broad sense all had high values of 88.86%, 75.28%, and 82.45%, respectively due to the decrease in the values of environmental variance compared to the values of genetic variance. The phenotypic and genetic variation coefficients were low for the trait of fiber yield. The genetic variation coefficient for the trait of green forage yield was low, reaching 9.567%, and average for the rest of the studied traits.

Conclusions: Also can note that the variety V1 is more stable for the trait.

Keywords: *barley; genetic stability; nitrogen fertilizer; yield.*

1 Introduction

It is one of the most important grain and forage plants in the world (*Hordeum vulgare* L.). It's mostly used for two things: to obtain green fodder and grains, as well as for use in various industries. Barley is also characterized by its high nutritional value, as it contains a high percentage of amino acids and protein (13%), high levels of dietary fiber, and vitamins, especially vitamin B (Al-Ghaiashi,2020). In addition, barley is used to reclaim saline soils. The use of phenotypic traits is one of the most important and oldest methods for studying the relationship between genetic structures. Phenotypic indicators have been used for a long time to evaluate genetic structures by describing genetic structures and distinguishing them from each other and the individuals belonging to them (Dialcoune, 2006), The variations are divided into phenotypic variation, which is the sum of genetic variation and environmental variation. However, one of the most important problems that plant breeders face is the degree of inheritance of the trait and its stability in different plants. This has led to the importance of studying genetic-environmental stability. The task of plant breeders is to find genetic structures that are suitable and completely similar to their external appearance (Al-Adhari,1992). This is the challenge that researchers are seeking to find. The concept of stability has been defined in different ways, and scientists have been interested in proposing and developing many methods, including single-factor and multi-factor methods that help to obtain information about the stability of the performance of certain genetic structures of different crops (Lin, *et al*.1986, J.; et al. 2018)The stability trait in a living organism is a multidimensional trait resulting from the interaction of thousands of gene pairs with multiple environmental factors to give different manifestations of the organism's trait depending on that wide interaction.

Another factor is the response of grain crops to nitrogen fertilization, especially in poor soils, as it helps to increase the rate of vegetative growth and improve the nutritional value of forage. It is recommended to be added in the form of payments after each harvest to activate branching and regrowth (Al-Rifaii, 2016), Nitrogen is a macronutrient that plants need in big amounts. It is an essential nutrient for plants. In the absence of it at the required level, it limits plant growth, weakens its performance, and subsequently leads to low yield (Vicente, et al. 2018). This study was conducted to analyze the genetic stability of three barley cultivars under the influence of different levels of nitrogen fertilizer to identify the cultivar or cultivars that have genetic stability.

2 Materials and Methods

In the winter of 2021–2022, an experiment was carried out in the field in Basrah Province, Iraq. It took place at the Karma Ali site of the Agricultural Research Station of the College of Agriculture, University of Basra, in soil that was sandy loam to analyze the genetic stability of three barley cultivars under the influence of different levels of nitrogen fertilizer to identify the cultivar or cultivars that have genetic stability.

The experiment was conducted using a split-split plot design with three replications. The main plots included three harvests (C1, C2, C3), with C1 representing one harvest, C2 representing two harvests, and C3 representing three harvests. The secondary plots included three barley cultivars (Baraq, Abba99, Abba265), each marked with the numbers V1, V2, and V3. There were three levels of nitrogen fertilizer in the sub-plots: 100, 200, and 300 kg N/ha-1. These levels were marked with the letters N1, N2, and N3.

The field was split up into 4 m2 (2 x 2) plots. Each experimental unit contained 10 rows of plants, with a row spacing of 20 cm. Planting was carried out on November 1 with 180 kg ha-1 of seeds for all the test units (Yasser, 2016) It was mixed with triple superphosphate (P2O5 46%) and spread at a rate of 60 kg P2O5 ha-1 before planting (Mahdi, et al., 2011).

The treatments in the experiment were watered right after they were planted. As needed, other types of watering were used. According to the study treatments, the nitrogen fertilizer was spread out in three equal parts as urea fertilizer (46% N). The first increase was made after the plants came up, the second after the first harvest and the third after the second harvest yet again.

The analysis of variance method was used to look at the data statistically for each of the traits that were being studied. We used the least significant difference (LSD) test with a 0.05 chance level to compare the means of the treatments, as explained by (Al-Rawi, 2000).

2.1 Evaluation of genetic, environmental, and phenotypic differences

To evaluate the genetic, environmental, and phenotypic differences, we used the method described by (Walter, 1975) and did the following:

$$G = \frac{Msv - Mse}{r \times a} \; {}^{2}\sigma$$

$$\sigma^2 E = Mse$$

$$\sigma^2 P = \sigma^2 G + \sigma^2 E$$

where:

- $G^2\sigma$ = Genetic Variance
- $E^2\sigma$ = Environmental Variance
- $P^2\sigma$ = Phenotypic Variance
- Msv = Mean squares for varieties
- Mse = Mean squares for experimental error
- r = Number of replications
- a = Levels of factor a

2.2 Degree of heritability

The degree of heritability, including broad-sense heritability (h2b.s.), was estimated according to the method explained by (Hnson, et al., 1956), as follows:

$$h^2_{b.s} = \frac{\delta^2 G}{\delta^2 p} \times 100$$

where:

- h2b.s. represents broad-sense heritability
- δ2G = Genetic variance for the trait
- δ2P = Phenotypic variance for the trait

2.3 Calculation of the coefficient of genetic variation in varieties

$$GCV\% = \frac{\sqrt{\sigma^2{}_g}}{\bar{X}} \times 100$$

where:

- Genetic variance = σ2g
- Mean = X¯

2.4 Calculation of the coefficient of phenotypic variation for varieties

$$PCV\% = \frac{\sqrt{\sigma^2{}_p}}{\bar{X}} \times 100$$

where:

- Phenotypic variance = σ2P
- Mean = X¯

2.5 Homeostasis

H%= 1- S/ X¯ ×100

where:

- S = Standard deviation
- Mean = X¯

2.6 Calculation of the genetic yield of varieties

GR= 1- s/x¯ × 100 × Xi¯ /Xc¯i

where:

- Mean of the trait for the variety = ¯Xi
- Mean of the trait for the varieties included in the study = ¯Xci
- Standard deviation = S
- Mean = X

3 Results and Discussion

3.1 Genetic, environmental, phenotypic variances, broad-sense heritability (%), and phenotypic and genetic variation coefficients

Table 1 indicates that the phenotypic variances are highly significant compared to the genetic and environmental variances, which were 10.339, 1.633, 358.665, and 363.859, respectively, for the studied traits. This is consistent with the findings of (Cleveland, 2010, Grando, *et al*.,2010) who found that high phenotypic variance for a trait gives plant breeder a great opportunity for selection. The genetic variance is higher than the environmental variance in all the studied traits, indicating the importance of genetics in controlling the appearance of traits. We also note that the broad-sense heritability values were high for all the studied traits. According to the boundaries for the values of heritability degree, as indicated by, values (Ali,1999) of broad-sense heritability of less than 40% are considered low, 40-60% are considered medium, and 60% or more are considered high. Overall, 88.86% of the traits for green and dry food yield, 75.28% of the traits for protein yield, and 82.45% of the traits for overall heritability were high. The reason for this is that the environmental variance for these traits is not very high compared to the genetic variation. This gives plant breeders the opportunity for direct selection to improve these traits. This is consistent with this agrees of (Ahmed, 2012, Sadiq, 2010).

As for the values of the phenotypic and genetic variation coefficients, based on the boundaries indicated by (Rashid, 1989), hich are less than 10% are considered low, from 10-30% are considered medium, and more than 30% are considered high. The phenotypic and genetic variation coefficients were low for the trait of fiber yield, at 8.888% and 6.613%, respectively. The genetic variation coefficient for the trait of green forage yield was low, at 9.567%, and medium for the rest of the studied traits. This is consistent with the findings of (Al-Tawel, 2013).

Table 1: Estimates of genetic, environmental and phenotypic variations and broad-sense heritability for the studied traits of barley crop

Studied attributes	δ^2G Genetic variation	δ^2E Environmental variation	δ^2P Phenotypic variation	$h^2_{b.s}$ Broad heritability (%)	Coefficient of phenotypic variation PCV(%)	Coefficient of genetic variation GCV(%)
Green fodder Yield (t ha-1)	9.1876	1.1517	10.3393	88.86	10.149	9.567
Dry fodder yield (t ha-1)	1.2294	0.4036	1.633	75.28	12.888	11.182
Protein yield (t ha-1)	295.725	62.94	358.665	82.451	15.513	14.086
Fiber yield (t ha-1)	201.459	162.4	363.859	55.367	8.888	6.613

3.2 Stability and genetic yield

Stability was calculated for the traits of green forage yield, dry forage yield, protein yield, fiber yield. According to (Al-Aboudi,2019), a stability percentage of less than 85% for a variety is considered low, and the variety is considered unstable and unsuitable for cultivation in that environment or region. The genetic yield was also calculated. The higher the value of this index, the closer it is to 95-99% or more, the higher the yield and the better the stability of the variety. The inverse is also true (Al-Tawel, 2013). By applying the equation for calculating the genetic yield to determine the phenotypic stability of the varieties under different levels of nitrogen fertilization, we will obtain the best variety in terms of yield stability and yield.

Based on (Tables 2, 3, 4, and 5), we note that variety V1 is the most stable for the traits of green forage yield, dry forage yield, and fiber yield, with stability percentages exceeding 85%. These percentages were 91.794, 88.355, and 92.146, respectively. V1 is also the most stable variety, as it has a genetic yield that exceeds 95%. These percentages were 99.450, 97.935, and 97.637, respectively.

Therefore, variety V1 (Baraq) gave the highest stability and genetic yield of all the other varieties. We, therefore, recommend its cultivation under the conditions of the study site, as it gave the highest average for the traits of green forage yield, dry forage yield, protein yield, and fiber yield. This is consistent with the findings of (Al-Ghaiashi, 2020, Al-Aboudi,2019 and Bilgin, *et al*.,2018).

Table 2: Stability and genetic yield of varieties at nitrogen fertilization levels for green fodder yield (t ha^{-1})

Cultivars	Fertilization levels ($t\ ha^{-1}$)			Average Cultivars	S	S/X	Stability H%	Genetic outcome GR
	N1	N2	N3					
V1	31.77	33.88	37.35	34.33	2.817	0.082	91.794	99.450
V2	25.39	28.16	31.57	28.37	3.096	0.109	89.090	79.766
V3	29.74	32.18	35.17	32.36	2.720	0.084	91.597	93.543
Average Fertilization levels	**28.97**	**31.41**	**34.69**	**31.69**				

Table 3: Stability and genetic yield of varieties at nitrogen fertilization levels of dry fodder yield (t ha-1)

Cultivars	Fertilization levels ($t\ ha^{-1}$)			Average Cultivars	S	S/X	Stability H%	Genetic outcome GR
	N1	N2	N3					
V1	9.882	10.698	12.391	10.990	1.280	0.116	88.355	97.935
V2	8.018	8.424	9.848	8.763	0.961	0.110	89.033	78.689
V3	8.569	10.270	11.138	9.992	1.307	0.131	86.922	87.597
Average Fertilization levels	**8.823**	**9.797**	**11.129**	**9.916**				

Table 4: Stability and genetic yield of varieties at nitrogen fertilization levels of total protein yield (t ha-1)

Cultivars	Fertilization levels (t ha^{-1})			Average Cultivars	S	S/X	Stability H%	Genetic outcome GR
	N1	N2	N3					
V1	114.93	136.42	165.11	138.82	25.176	0.181	81.864	93.095
V2	88.67	101.77	122.56	104.34	17.090	0.164	83.620	71.468
V3	96.52	128.83	143.85	123.07	24.186	0.197	80.348	81.001
Average Fertilization levels	**100.04**	**122.34**	**143.84**	**122.07**				

Table 5: Stability and genetic yield of varieties at nitrogen fertilization levels of Fiber yield (t ha-1)

Cultivars	Fertilization levels (t ha^{-1})			Average Cultivars	S	S/X	Stability H%	Genetic outcome GR
	N1	N2	N3					
V1	215.2	219.1	247.9	227.4	17.860	0.079	92.146	97.637
V2	189.6	192.1	215.3	199.0	14.171	0.071	92.879	86.123
V3	206.7	212.2	233.4	217.4	14.098	0.065	93.516	94.746
Average Fertilization levels	**203.8**	**207.8**	**232.2**	**214.6**				

4 Conclusions

That variety V1 is the most stable for the traits of green forage yield, dry forage yield, and fiber yield, with stability percentages exceeding 85%. variety V1 (Baraq) gave the highest stability and genetic yield of all the

Recommendations:

We, therefore, recommend its cultivation under the conditions of the study site, as it gave the highest average for the traits of green forage yield, dry forage yield, protein yield, and fiber yield.

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