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GENETIC POTENTIAL OF LENTIL AND COMMON BEAN GENOTYPES FOR BREEDING IMPROVED CULTIVARS

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SUMMARY

Leguminous plants belong to the family Fabaceae and play a crucial role in human nutrition and agriculture due to their high-protein content and nitrogen-fixing ability. This study aimed to evaluate the amino acid composition of lentil (*Lens culinaris* L.) and common bean (*Phaseolus vulgaris* L.) genotypes grown under standard agronomic conditions. The analysis of variance revealed significant ($P \leq 0.01$) differences among the 46 lentil and 15 common bean genotypes for yield-related traits. The results disclosed that 21.7% of the lentil genotypes were high-yielding, 45.7% were medium-yielding, and 32.6% were low-yielding. In common beans, 33.3% of the genotypes were high-yielding, 26.7% were medium-yielding, and 40% were low-yielding. The results provided a tangible basis for forming core and trait collections from the national gene fund, supporting breeding programs aimed at improving protein quality and essential amino acid profiles in lentils and common beans.

Keywords: Lentil (*L. culinaris* L.), common bean (*P. vulgaris* L.), yield potential, yield-related traits, breeding

Key findings: Significant genetic diversity was evident among the lentil (*L. culinaris* L.) and common bean (*P. vulgaris* L.) genotypes for both quantitative and qualitative traits. This diversity represents an important resource for plant breeders, offering opportunities to enhance the protein content and nutritional quality through targeted breeding strategies.

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INTRODUCTION

Leguminous plants constitute a major portion of important crops due to their nitrogen-fixing ability and play a crucial role in meeting the population's demand for food and other products (Khazaei *et al*., 2019; Baxevanos *et al*., 2024; Vilakazi *et al*., 2025). At present, high-quality plant-based protein production is one of the pressing global issues. In this regard, legumes entail intensive cultivation on a larger area, and their cultivation area exceeds 130 million hectares worldwide. Lentil represents a key cool-season legume crop, cultivated across more than 52 countries globally (Choukri *et al*., 2020; Sarkar *et al.,* 2025). Legumes can be distinct from other crop plants due to their higher protein content (25–45%). The nutritional value of legume seeds can be comparable to that of meat products. The protein in legumes has a high solubility and ensures better digestibility. In legumes, the essential amino acid (lysine, methionine, cystine, and tryptophan) contents are 2–4 times higher than in cereals. Legume seeds also serve as a highly nutritious and concentrated feed for animals.

Lentils (*Lens culinaris* L.) and common beans (*Phaseolus vulgaris* L.) contain higher levels of protein (20%–30%) than cereals (10%–12%) and, therefore, are widely favorable as non-allergenic protein sources in combating protein deficiency (Salaria and Thavarajah, 2022; Dhull *et al*., 2023; Preiti *et al*., 2024) (Fıgure 1). Among the legumes, lentil ranks special with its flavor, high-protein content, abundance of essential amino acids, and better digestibility by the human body (Salaria and Thavarajah, 2022). Renowned for their nutritional richness, lentils often received the name 'poor man's meat,' as these contain 20%–36% protein, 60%–67% carbohydrates, 2%–3% ash, and fats (<4%). Their low glycemic index makes them a beneficial dietary choice for individuals managing diabetes, obesity, and cardiovascular diseases (Kumar *et al*., 2015). Lentils contain low amounts of fats, and therefore, their cholesterol content is virtually negligible. In lentils, the proteins comprise basic alkaline and amphoteric amino acids (Semba *et al*., 2021; Silva-Perez *et al*., 2022; Sánchez-García *et al*., 2022). With all these qualities, lentils emerged as an essential alternative for addressing global food insecurity, improving nutrition, and combating non-communicable diseases (NCDs). In lentil proteins, the amino acid composition can influence human health in a much better way by preventing protein-energy deficiency and NCDs through its support of physiological functions.

The genetic biofortification of protein, that of enhancing its quality through conventional cultivation methods and the application of molecular technologies, is greatly important for improving the nutritional quality of lentils worldwide (Wright *et al*., 2025). The limited content of specific amino acids in cereals and the high cost of animal-based foods have recognized legumes as an essential alternative for meeting protein needs. One ton of legume stems contains 137.4 kg of protein, while one ton of cereal stems contains 70.5 kg. With the highest contents of protein, carbohydrates, fibers, vitamins, minerals, and biochemical compounds in their vegetative and generative organs, legumes emerged as the most crucial food sources in various countries. In previous years, the study on using the high protein and fiber content of legumes as a beneficial dietary supplement owes it to their functional properties in improving the digestive system and lowering cholesterol and blood sugar. This has also become increasingly vital in the food industry (Adak, 2014).

The common bean is capable of fixing more than 160 kg of atmospheric nitrogen per hectare into the soil through its symbiotic relationship with *Rhizobium* bacteria (Beshir *et al.*, 2015). Recently, however, the nutritional importance of beans—particularly their richness in protein, essential minerals, dietary fiber, and certain vitamins—has reached an increasing recognition, resulting in a growing consumption trend even in developed nations (Lucier et al., 2000). In the common bean, several water-soluble vitamins, such as thiamine, riboflavin, niacin, vitamin B6, and folic acid, as well as minerals including potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), copper (Cu), and iron (Fe), had successful identification (Celmeli *et al.*, 2018).

Figure 1. Lentil (A) and common bean (B) genotypes grown under field conditions.

The common bean, a valuable food crop, ranks first among the legumes for cultivated area and production. Its bean pods are rich in minerals and vitamins, while the dry seeds are richer in protein (Foyer *et al*., 2016). At present, plant-based proteins account for 22% of the global human diet and carbohydrates for 7%, whereas in animal feed, legumes contribute 38% of proteins and 5% of carbohydrates (Adak, 2014). Therefore, the presented research aimed to evaluate the yield and biochemical characteristics of 46 lentil and 15 bean genotypes preserved in the National Genebank, as well as to group those landraces based on yield traits and select the high-yielding genotypes.

MATERIALS AND METHODS

Genetic material

The research materials comprised 46 lentil and 15 common bean landraces introduced from the International Center for Agricultural Research in the Dry Areas (ICARDA), originating from Azerbaijan. Among the lentil accessions, 45 were from ICARDA, and one genotype was of Azerbaijani origin. During the study, 46 lentil and 15 bean landraces succeeded in their cultivation for three years (2023–2025) under irrigated conditions at the Absheron Experimental Base of the Genetic Resources Institute, Ministry of Science and Education, Azerbaijan.

Climate and crop husbandry

In the study area, the average temperature for January during 2023–2025 was 3.8 °C, and for July, it was 22.6 °C. Annual precipitation in Absheron ranged between 180 and 260 mm, and most rainfall occurred during the colder periods. Humidity levels did not change throughout the year. No significant deviations from the long-term climate indicators appeared during the study years. Lentil seeds incurred sowing at a depth of 5–7 cm into moist soil. Sowing the seeds of common beans had a depth of 3–6 cm, depending on their size. Under field conditions, the distance between rows was 45 cm, each row length was 2 m, and the spacing between plants was 5 cm. Throughout the vegetation period, morphological (such as the number and color of flowers) and phenological (such as first sprout and 50% flowering) observations proceeded, with agronomic care practices also performed.

Traits measurement

In both the lentil and common bean crops, after full maturity, 10 plants entailed uprooting from each genotype, with the data recorded on seven key yield components. These are plant height, the number of productive stems, pods per plant, pod width and length, seeds per pod, seeds per plant, and 100-seed weight. Plant height (cm) determination involved measuring the distance from the soil surface to the highest point of 10 randomly selected plants. Detecting the number of pods and seeds employed counting pods and seeds on 10 randomly selected plants and calculating the average. In determining the 100-seed weight (g), seeds collected from samples underwent groupings into four with 100 seeds in each group before calculating their average weight.

Statistical analysis

The obtained data based on various traits underwent statistical analysis using the SPSS software package. The variability of yield components among the lentil and common bean genotypes and the statistical significance of this variability reached evaluation using the analysis of variance (ANOVA) method. The data comprising all these traits bore comparative analysis. Phenotypic correlations among traits achieved calculations.

RESULTS

For 46 lentil genotypes, the calculations of average values over the three years and the analysis of structural elements appear in Table 1. These traits can serve as a basis for characterizing lentil genotypes and selecting initial promising material in breeding programs. The height of the studied genotypes showed high variation in both years, ranging between 35 and 121 cm. The maximum recorded plant height resulted in the lentil genotype Aze PHA-t/18 (121 cm), while the lowest and at-par plant height emerged in the genotypes Aze PHA-18 and Aze PHA-t/37 (35 cm). For comparison, one should note that in past studies, in common beans, the plant height ranged from 61.48 to 130.22 cm (Ekincialp and Şensoy, 2013), 50.7 to 113.5 cm (Babagil *et al*., 2011), 53.3 to 110.5 cm (Aydogan, 2017), and 38.80 to 59.16 cm (Baran, 2018).

The most effective method for analyzing yield-related traits is the variance analysis. In the presented study, the highest variation was notable in lentil genotypes (27.0–44.7 cm) for plant height (Table 2). The 100-seed weight also varied between 2.5 and 5.2 g in lentil genotypes. For the 100-seed weight, the highest value was evident in the lentil genotype Jasmin (5.2 g), while the lowest value occurred in the genotype Flip 2011-42 (2.5 g). Research has indicated the 100-seed weight received relatively less influence from environmental conditions, ranging from 1.9 to 4.5 g across different cultivars, whereas the seed weight per plant varies between 1.40 and 3.5 g (Babagil *et al*., 2011; Ekincialp and Şensoy, 2013; Aydogan, 2017; Baran, 2018).

The study performed the correlation analysis to determine the relationship among different yield-related traits, using the three-year mean values (Table 3). A significant ($P \leq$

Table 1. Mean performance of lentil genotypes for yield traits.

No.	Lentil genotypes	Plant height (cm)	First pod height (cm)	Number of branches	Seeds plant^{-1}	Seeds pod^{-1}	Pod length (cm)	Pods plant^{-1}	Number of sprouts	100-seed weight (g)
1	Flip2010-19	31.7	11.3	2	50.0	1-2	1.0	109.3	91	3.7
2	Flip2010-26	31.3	15.0	2	78.7	1-2	1.0	79	81	3.6
3	Flip2010-81	28.0	12.7	2	76.0	1.0	1.0	50	62	3.0
4	Flip2010-91	30.7	13.3	2	108.7	2.0	1.0	102.7	86	3.1
5	Flip2010-94	30.3	13.3	2	91.0	2.0	1.3	91.3	84	4.2
6	Flip2010-95	31.3	11.7	2	105.7	2.0	1.3	103.7	80	3.8
7	Flip2010-96	27.0	11.0	2	135.0	1-2	1.0	103.0	87	3.2
8	Flip2010-97	33.3	14.7	4	132.7	1-2	1.3	114.7	90	4.7
9	Flip2010-101	29.7	9.0	2	81.7	1-2	1.3	74.7	87	3.6
10	Flip2011-13	31.0	12.7	2	89.0	2.0	1.3	87.7	93	3.0
11	Flip2011-14	31.0	16.7	2	74.7	2.0	1.1	79.0	80	2.6
12	Flip2011-17	35.0	12.7	2	141.7	1-2	1.3	100.7	82	3.5
13	Flip2011-18	32.7	10.3	2	74.3	1.0	1.1	88.7	86	3.6
14	Flip2011-19	31.3	14.3	2	106.7	1-2	1.3	85.7	78	3.4
15	Flip2011-20	35.0	15.3	2	101.3	1-2	1.3	86.3	90	3.6
16	Flip2011-26	35.3	14.7	2	80.3	2.0	1.2	116.7	88	4.2
17	Flip2011-35	33.7	12.3	2	70.0	1.0	2.0	78.0	83	2.5
18	Flip2011-37	38.7	13.7	2	86.0	1-2	1.3	105.0	75	4.0
19	Flip2011-41	32.7	12.3	2	137.7	1.0	1.2	167.0	73	2.6
20	Flip2011-42	32.0	11.3	2	121.3	1-2	1.2	121.3	80	2.5
21	Flip2011-43	31.0	10.0	2	137.7	1-2	1.4	99.3	75	3.3
22	Flip2011-51	30.0	14.0	2	114.7	1.0	1.0	81.7	80	2.7
23	Flip2011-57	40.3	14.0	2	137.0	1-2	1.2	119	84	3.1
24	Flip2011-59	37.7	14.0	2	109.0	2.0	1.0	118	75	2.9
25	Flip2011-61	32.7	11.3	2	153.0	1-2	1.1	114.7	78	3.1
26	Flip2011-64	36.7	15.3	2	149.7	3.0	1.3	116	82	3.3
27	10932	43.3	18.7	2	114.7	2.0	1.4	87.7	78	3.8
28	10946	42.3	17.7	3	117.3	2.0	1.2	115.3	81	4.6
29	10939	41.0	16.3	2	133.3	1-2	122	81.3	92	3.4
30	10943	38.7	14.0	2	225.7	1-2	1.1	165.0	81	3.3
31	Flip2011-32	39.0	17.0	3	129.7	1-2	1.2	126.7	82	4.7
32	Flip2011-31	39.6	17.3	3	126.0	1-2	1.2	138	74	3.8
33	10928	35.0	13.7	2	86.3	1-2	1.3	78	67	4.1
34	Flip2011-40	36.3	13.0	2	99.7	1-2	1.3	100.3	68	3.7
35	10937	40.3	17.0	3	109.3	1-3	1.4	110	100	2.9
36	10940	31.7	11.0	3	110.3	2.0	1.3	53.3	85	3.3
37	10926	34.7	12.7	2	130.3	1-2	1.1	115.3	80	4.5
38	10925	36.3	13.0	2	220.7	1-2	1.2	95.0	85	3.9
39	Flip2011-384	37.3	13.3	3	109.3	1-2	1.0	111.3	84	3.6
40	10942	36.3	13.3	2	124.3	1-2	1.3	108.7	77	2.9
41	10934	37.7	14.3	3	137.7	1-2	1.3	117.3	72	3.9
42	10929	39.0	17.0	3	151.3	1-2	1.4	149.3	73	4.5
43	10930	35.0	13.0	2	100.7	1-2	1.2	87.7	88	3.7
44	Flip2011-29	38.0	18.3	2	131.3	1-2	1.1	100.3	89	4.0
45	Flip2011-36	36.0	17.0	3	121.7	1-2	1.4	118	78	4.0
46	Jasmin	44.7	14.3	3	129.3	1.0	1.2	149	81	5.2

Table 2. Degree of variation in yield traits of the lentil and common bean genotypes.

Biometric traits	Min.	Max.	Mean value	Mean square deviation	Significance
Lentil					
First pod height (cm)	9.0	18.7	12.8±0.11	2.2	**
Plant height (cm)	27.00	44.7	35.8±0.21	1.1	***
Seeds per plant	50.0	225.7	137.5±0.25	41.1	**
Pods per plant	50.3	167.0	133.5±0.41	14.6	**
100-seed weight (g)	2.5	5.2	4.0±0.05	0.6	***
Number of sprouts	62.00	100.0	81.4±0.19	7.2	*
Common bean					
Plant height (cm)	35	121	59.6	24.7	**
First pod height (cm)	6.5	18	10.97	3.34	***
Number of branches	2	4	2.4	0.63	**
Seeds per plant	33.0	114.0	56.7	2.50	**
Seeds per pod	4	6	4.6	0.34	**
Pod length	7.2	13.1	8.5	0.33	
100-seed weight (g)	23	44	34.7	0.65	***
Pods per plant	8.0	28.0	13.7	0.65	*
Yield	75.0	240.0	150.0	0.51	***

Note:The error indicator does not exceed 3%.

Table 3. Correlation among yield components of the lentil and common bean genotypes.

Biometric traits	First pod height	Plant height	Seeds per plant	Pods per plant	100-seed weight	Number of sprouts
Lentil						
First pod height (cm)	1	0.650**	0.119	0.250	0.318*	0.020
Plant height (cm)		1	0.572**	0.471*	0.435*	0.140
Seeds per plant			1	0.598**	-0.093	0.080
Pods per plant				1	0.247	0.089
100-seed weight (g)					1	0.05
Number of sprouts						1
Common bean						
Plant height (cm)	0.357	1	0.565*	0.19	0.202	0.352
First pod height (cm)	1		0.336	-0.313	0.656**	0.183
Seeds per plant			1	0.285	0.230	0.514
Seeds per pod			11		-0.257	-0.129
Pod length			1		0.646*	0.042
100-seed weight (g)					1	0.238
Pods per plant						1
Yield						

Note: *, **, *** = $P \leq 0.05$, $P \leq 0.01$, and $P \leq 0.001$, respectively.

0.05 and $P \leq 0.01$) positive correlation was remarkable between plant height and the number of pods per plant, as well as the number and weight of seeds per plant. The significance of these correlations varied. The correlation between the first pod height and both pods per plant and the number of seeds per plant was nonsignificant. Meanwhile, a moderately significant ($P \leq 0.01$) positive correlation appeared between the first pod height and plant height. These results further revealed a noteworthy positive correlation between the number of seeds and the number of pods per plant, with a negative correlation (r = -0.093) recorded between the number of seeds per plant and 100-seed weight. The results enunciated that an increase in seed number led to a decrease in 100-seed weight. Negative correlations between seed number and 100-seed weight have also surfaced in past studies on leguminous crops.

According to correlation values, the number of sprouts and the yield-related traits revealed nonsignificant correlation. Thus, based on the results, the highest correlations materialized between plant height and first pod height (r = 0.650), seeds per plant and plant height (r = 0.572), and pods per plant and seeds per plant (r = 0.598). These findings are consistent with past observations (Sözen *et al.*, 2012.) Most genotypic variations were ascribable to the pods per plant (50.0–167.0) and seeds per plant (50.0–225.7). However, the lowest genotypic variation recorded prevailed for the traits of plant height and first pod height (9.0–18.7). The analysis of variance detailed moderate significant (*P* ≤ 0.01) variations in 46 lentil genotypes for yield-related traits. The study found that 21.7% of the lentil genotypes were high-yielding, 45.7% were medium-yielding, and 32.6% were low-yielding. Among the lentil genotypes, Flip 2011-61, Flip 2011-41, Flip 2011-43, 10943, 10940, 10939, 10929, and Jasmin were recognizably highly promising genotypes.

In the latest study, 15 common bean genotypes also underwent cultivation for two years under irrigated conditions at the same location, with the genotypes evaluated for various yield-related traits (Table 4). In bean genotypes, the yield per m² ranged from 75 to 240.0 g. The highest yield per plant resulted in the genotype K-13038 (240.0 g). In contrast, the genotype Aze PHA-18 had the lowest yield in both years of study. For comparison, one should note that in a study conducted in Samsun, the reported yield per plant occurred to be 4.61–4.90 g.

The results revealed a significant positive correlation among the traits, such as plant height, leaves per plant, pods per plant, seeds per pod, seeds per plant, 1000-seed weight, and biological yield. Previous studies using path analysis on yield components in common beans stated that the number of seeds per plant had an indirect effect on biological yield, while pod weight and pod number had the highest direct effects (Bıyıklı *et al*., 2021). Thus, the path analysis conducted on yield components, in agreement with previous studies, showed a considerable direct positive relationship between the seeds per plant and the number of pods and the 100-seed weight. The study findings also disclosed

Table 4. Mean performance of common bean genotypes for yield traits.

No.	Bean genotypes	Plant height (cm)	First pod height (cm)	Number of branches	Seeds plant^{-1}	Seeds pod^{-1}	Pod length (cm)	Pods plant^{-1}	Number of sprouts	100-seed weight (g)
1	Aze PHA- t/6	51	6.5	2	34	5	8.0	35	8	180
2	Aze PHA- t/15	56	10.0	3	40	5	11.2	40	10	200
3	Aze PHA-t/17	68	12.0	3	46	5	11.2	37	11	115
4	Aze PHA- t/18	121	15.0	4	42	4	12.5	39	10	160
5	Aze PHA- t/16	105	17.2	3	114	5	10.5	40	28	230
6	Afqo-2027	56	10.5	2	95	4	8.1	38	28	140
7	K-13038	72	10.8	3	52	5	9.1	28	12	240
8	Saksa	70	10 .0	3	51	5	8.5	30	12	190
9	K-3493	78	18.0	3	95	6	13.1	44	24	130
10	Galibiyat	61	7.0	2	71	5	9.5	28	17	150
11	Aze PHA-18	35	10.0	2	37	4	9.3	23	9	75
12	K-15274	45	11.0	2	38	4	7.2	30	11	130
13	Aze PHA-14	39	13.0	3	33	5	11.3	40	8	125
14	Aze PHA-t/37	35	7.0	3	40	4	7.5	38	11	130
15	St. yerlipiyada	50	11.0	3	51	4	8.3	40	13	120

that the most important yield-contributing traits in common beans were the plant height, the number of pods, seeds per pod, and 100-seed weight. This research determined the relationship among the yield-related traits using a correlation analysis based on the two-year mean values of these traits.

During the study in common beans, significant positive correlations were evident for various traits, i.e., between pod height and the first pod height (r ~ 0.670**) and between 100-seed weight and the first pod height (r ~ 0.656**). This is also true between the seeds per plant and plant height (r ~ 0.565*) and between the pod length and 100-seed weight (r ~ 0.646**) (Table 3). Thus, a highly significant ($P \leq 0.001$) genetic diversity appeared from 15 common bean genotypes based on morphological and yield-related traits. The study further determined that 33.3% of the studied bean genotypes were high-yielding, 26.7% were medium-yielding, and 40% were low-yielding. Among the bean genotypes, the Aze PHA-t/16, Aze PHA-t/6, K-13038, Saksa, Aze PHA-t/15, K-3493, Afqo-2027, and Aze PHA-t/18 were recognizably highly promising genotypes.

DISCUSSION

Among the lentil genotypes, the maximum plant height recorded was in Jasmin and 10932, while the minimum height resulted in Flip 2010-81 and Flip 2010-96. Based on past studies in lentil cultivars, the genotypes examined in the presented study can generally have a classification as tall (Kahraman, 2016; Babayeva *et al*., 2018). The considerable variation was visible among the genotypes for the number of pods and seeds. The pods per plant ranged from 50.3 to 167.0, while the seeds per plant ranged from 50.0 to 225.7. The highest pod counts emerged in the lentil genotypes Flip 2011-41 (167.0) and 10943 (165.0), while the lowest appeared in genotype Flip 2010-81 (50.0). The highest seed count was notable in the genotype 10943 (225.7), with the lowest in Flip 2010-19 (50.0). In a previous study, the pods per plant had reports of 5.5–38.5, and the number of seeds was 6.0–37.5 in lentil genotypes, indicating the lentil genotypes examined in the presented study have a comparatively higher productivity (Karadavut and Sözen, 2018).

The first pod height showed the lowest variation, ranging from 6.5 to 18 cm among the bean genotypes. For the first pod height, the lowest value was noticeable in the genotype Aze PHA-t/6, and the highest was in K-3493. The height to the first pod ranged from 12.9 to 25.1 cm during the crop year 2023, while in the 2025 study, it ranged from 8.48 to 12.83 cm. In past studies, the height to the first pod varied between 12.9 and 19.7 cm in common beans (*P. vulgaris* L.) (Elkoca and Çınar, 2015; Baran, 2016). Among the bean genotypes, the lowest variation was also evident for the number of productive branches. In previous studies, the genotypes' variation for branch number was lower than in this concerned study, varying between 1.53 and 4.80 in bean genotypes (Baran, 2016; Aydogan, 2017; Girgel *et al*., 2018). In our study, for seeds per plant, the bean genotypes showed the highest variation (33–114), with a mean of 56.7 seeds. The ultimate seed count resulted in the bean genotype Aze PHA-t/16 (114 seeds), while the lowest seed counts were visible in the genotypes Aze PHA-14 and Aze PHA-t/6 (33 and 34 seeds, respectively).

The bean genotypes revealed the highest variation for the number of pods per plant. The said trait ranged from 8 to 28 pods, and the topmost values appeared in Aze PHA-t/16 and Afqo-2027, while the lowest were in Aze PHA-t/6 and Aze PHA-14. According to past studies, 46 pods (Ceyhan *et al*., 2009), 4.26–6.82 pods (Baran, 2018), and 3.5–5.5 pods (Girgel *et al*., 2018) surfaced in the bean genotypes. The bean plant development largely depends on the length of the vegetation period, and the effect of the growth period on productivity is particularly important and considerable during the flowering stage. Environmental factors can also influence the relationship between the growing period and plant height. Especially, the dry matter in the plant increases significantly until seed formation (Aydogan, 2017).

Climatic factors, including temperature, humidity, photoperiod, and light intensity, play a crucial role in regulating dry-matter accumulation across different stages of plant growth and development. Consequently, identifying genotypes that exhibit differential sensitivity or tolerance to temperature and day length is essential for enhancing crop productivity and stability across environments. Previous research has demonstrated that common bean plants are particularly sensitive to temperature during the 6–8 days following the onset of flowering, with optimal pod development and higher pod weight observed at soil temperatures ranging from 24 °C to 26 °C (Fırtına, 2006). The studied lentil and common bean genotypes exhibited substantial genetic diversity in phenological and morphological characteristics within the core collection, which requires further exploration to develop cultivars with greater biomass and seed productivity. Therefore, additional investigations are necessary on the top-performing accessions identified during this initial evaluation, considering genotype-by-environment interactions.

CONCLUSIONS

This investigation demonstrated substantial genetic variability among the lentil and common bean genotypes for both quantitative and qualitative traits. Such diversity constitutes a critical resource for targeted breeding initiatives aimed at enhancing agronomic performance and nutritional attributes. The pronounced variation in protein and amino acid composition highlighted the potential for improving the dietary quality of these species. Collectively, the results provided a robust scientific basis for the development of high-protein cultivars to address global micronutrient deficiencies and hidden hunger.

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