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Alternative Crops for Adaptation to Climate Change: The Importance of Conserving the Diversity of *Lathyrus cicera L.* Landraces Adapted to the Morocco Mountains †

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Abstract: A Global climate change has raised serious concerns about food security and the sustainability of agriculture, particularly in developing regions of the world. In response to these concerns, attention should be called to the global importance of conservation of some neglected and underutilized crops, like *Lathyrus* species, which are nutrient-rich and already adapted to harsh environments and low-input agriculture. *L. cicera* L., known in Morocco as '*ikiker*', '*kiker*' or '*ichicher*', is marginally cultivated in the region. Landraces of this crop species, which are maintained locally by traditional agricultural practices, correspond to ecotypes adapted to local agroclimatic conditions. We have surveyed the traditional cultivation sites of this crop to identify specific associated agroecosystems the Middle and High Atlas Mountains of Morocco. We have evaluated the diversity of ecotypes of *Lathyrus cicera* L. by a set of characters associated with the socioeconomic and agromorphological aspects of their cultivation. The results confirmed that their cultivation is very old in the area, and that its maintenance until today is important as the local farmers have started to master the uses for human and animal food. In addition, from a biology point of view, we have demonstrated the existence of variability depending on the trait considered but which demonstrates a differentiation between the ecotypes. From adaptive potential of these ecotypes with respect to tolerance to aridity and increased temperatures, the ecotypes studied showed promising prospects for selection. Thus, in spite of the limitation of the territory and the regression of the culture, the studied ecotypes have a very interesting germinative and productive capacity. This result can be explained by cultural practices. These ecotypes are maintained in traditional agroecosystems which play the role of conservatory of neglected resources. The conservation of these genetic resources therefore depends on the conservation of the traditional agroecosystem and local knowledge.

Keywords: *Lathyrus cicera L.*, phenotypic diversity; alternative culture

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1. Introduction

At the global level, variations in climatic events have influenced all regions, and even, this trend is likely to continue or even accelerate in the future, with probably serious but variable consequences on quality and agricultural productivity in the world [1–5]. Indeed, the impacts of climate change can strongly claim the agricultural sector, especially the component of production and food supply, either directly or indirectly [6], thus threatening global food security [7–9]. In addition, the situation is more alarming if we take into account the importance of modern monoculture systems, which are more ecologically homogeneous than polyculture systems [10–12]. As a result, the drastic reduction in crop diversity has threatened global food production, including three food crops (wheat (Triticum spp.), Rice (Oryza spp.) And maize (*Zea mays* L.) which provide more than half of the food energy consumed by humans [13]. Faced with such a situation, minimizing the loss of plant genetic resources, increasing the sustainability and resilience of agricultural systems have been identified as major pillars [14,15]. Traditional agro-ecosystems are a good example of conservation of agro-biodiversity and livelihood to environmental and economic constraints, ie, the ability to maintain the operation and productivity when subjected to stress and shock [16–18]. The present study falls within this framework through the identification and characterization of the cultures which are practiced there. *L. cicera* L. is an example of a marginalized crop considered neglected and underutilized. It is an ancient legume native to the western Mediterranean [19,20]. In Morocco, the extent of its cultivation is very limited to the geographical area of the Middle and High Atlas, representing its last refuge. However, there is renewed interest in this species with adaptation and introduction trials in different regions of the world. This interest coincides with the context of climate change and the search for alternative crops adapted to the difficult conditions predicted by different climate scenarios and models, hence the importance that we attach to this crop through this study.

2. Material and Methods

2.1. Study Area

The plant material was collected during prospecting missions during the harvest period. These missions were carried out at the level of the area of practice of this culture, of which 13 ecotypes were collected within the traditional mountain agroecosystems of the High and Middle Atlas. (Figure 1).

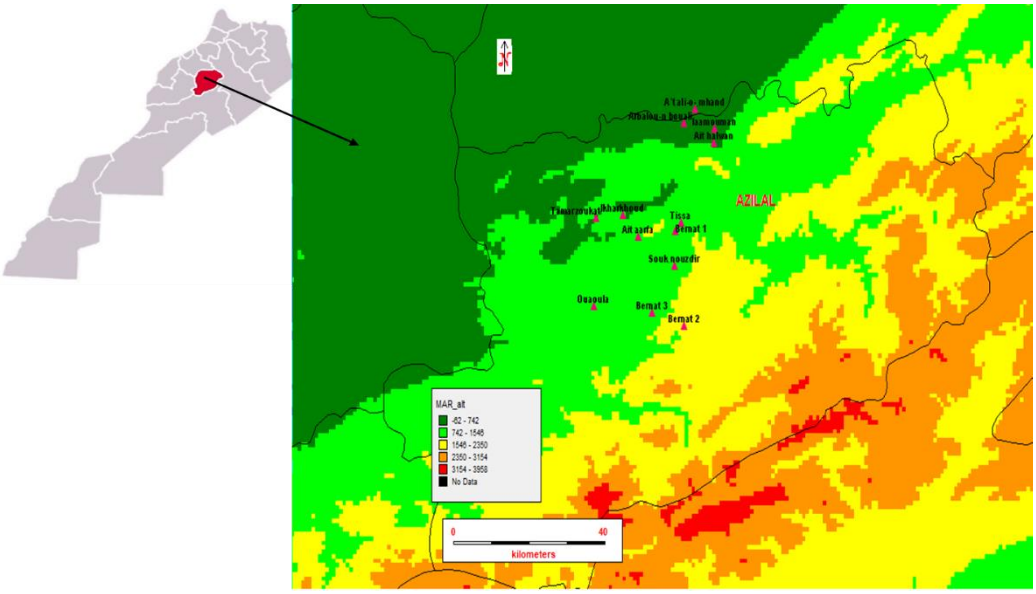

Figure 1. Location map of sampling sites for the different ecotypes of *L. cicera*.

2.2. The Capacity of Germination

The sampled ecotypes were the subject of a comparative study of germination capacity, carried out with a repeat of 30 individuals per ecotype. The seeds used were disinfected before being distributed among the Petri dishes, then they were soaked in distilled water and placed in the dark. Daily monitoring was adopted in order to assess the germination capacity (% of germinated seeds), the earliness (speed of the onset of germination) and the duration of germination (time necessary to reach the maximum germination capacity).

2.3. Seed and Pod Biometry

The morphological parameters of the seed and pod are used as traits for the assessment of the diversity and polymorphism of *L. cicera* ecotypes. Thus, 12 characters were measured: 4 at seed level (Seed length (SL), Seed width (SWD); Seed length/Seed width (SL/SWD); Seed weight (SWG)) and 8 at pod level (Pod length Total (PLT); Pod length Basal (PLB); Pod length Total/Pod length Basal (PLT/PLB); Pod length Total-Pod length Basal (PLT-PLB); Pod width (PWD); Pod length Total/Pod width (PLT/PWD); Pod weight (PWG); Number of seeds per pod (NSP)).

2.4. Data Processing

Descriptive statistics and analysis of variance (ANOVA) were performed with the XLSTAT software (version 2010). The hierarchical classification (Euclidean distance and UPGMA clustering method) was carried out using the NTSYSpc software (1.05).

3. Results

3.1. Precocity, Duration and Germination Capacity

Regarding the precocity, the ecotypes of L. cicera are revealed early, they all germinated from the second day (Figure 2). For this, the germination time varied between 72 and 96 h, however, all the ecotypes showed a short germination time of 72 h with the exception of the Iaamouman ecotype which required a germination time of 96 h. Hours. From the point of view of germination capacity, after 48 h, the germination percentage varied between 43% (Souk nouzdir) and 10% (Tamarzoukat, Ouaoura, Ikharkhoud and Iaamouman), however, after 72 h, it varied between 90% and 100%; 3 ecotypes had a germination percentage of 100% (Ouaoura, Ikharkhoud and Ait ali-o-mhand) and 7 ecotypes which achieved 96% germination (Tissa, Souk nouzdir, Bernat 1, Ait aarfa, Arbalou-n bouali, Ait halwan and Iaamouman), one ecotype reached 93% (Bernat 3) and two ecotypes resulted in 90% germination (Bernat 2 and Tamarzoukat). Nonobostant, Iaamouman did not reach 100% germination until after 96 h.

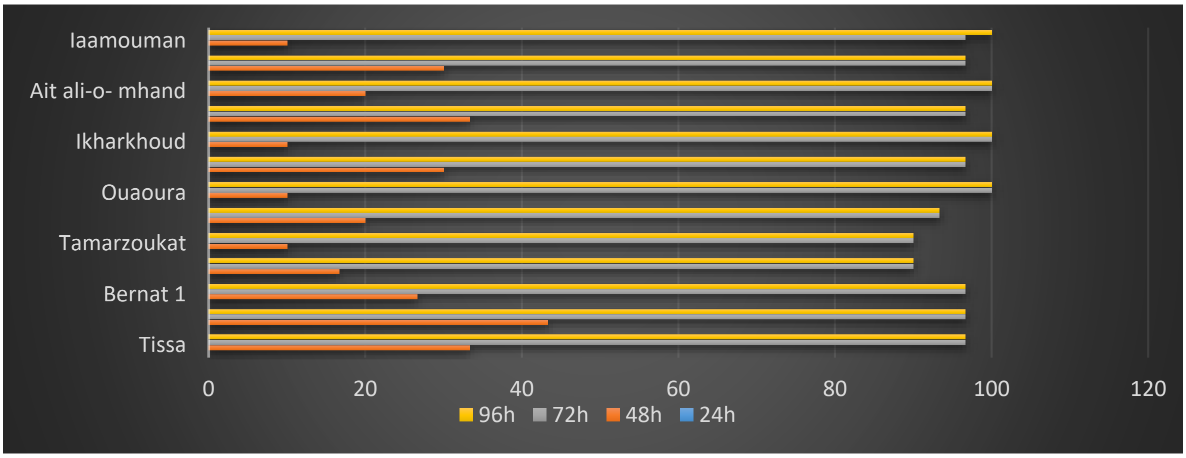

Figure 2. The germination capacity of the 13 ecotypes of *L. cicera.*

3.2. The Biometrics of the Seed

The results relating to the data collected from measurements carried out on the seeds of the various ecotypes collected showed significant variations within and between the various ecotypes (Table 1). The analysis of variance for the different traits measured showed a very highly significant difference ($p < 0.0001$) and which is the result of morphological diversity between the individuals who make up these ecotypes. This difference is expressed more with very high F for the characteristics relating to the size than for the weight and the shape of the seeds.

The SL mean is 5.62 mm; the smallest seeds (5.08 mm) are from Souk nouzdir and the larger seeds (6.08 mm) are from Aït halwan. For SWD, the values per ecotype vary between 5.85 mm (Aït halwan) and 4.75 mm (Souk nouzdir) with an average of 5.34 mm. Thus, the seeds of large size are those of Aït halwan and smaller sizes are that of Souk nouzdir, while the seeds of other ecotypes are included in the interval between the sizes of these two populations. The SL/SWD ratio expressed somewhat the general shape of the seed and showed poor differentiation at this level with a low coefficient of variation (5.54%) compared to SL and SWD. Indeed, the values recorded by the SL/SWD ratio varied between 1.04 (Ait aarfa, Ikharkhoud, Arbalou-n bouali, Ait ali-o-mhand, Ait halwan and Iaamouman) and 1.08 (Tissa and Souk nouzdir) with an average of 1.05. Regarding SWG, a significant variation was noted with a coefficient of variation of around 44.06%. It varied between 0.1 mg (Ait halwan) and 0.01 mg (Arbalou n bouali) with an average of 0.08 mg. Thus, the seed characters showed a certain level of polymorphism in which the seeds differed more in size and weight than in shape

Table 1. Results of the one-way analysis of variance of the various parameters of seeds of L. cicera.

Ecotype	SL (mm) Mean ± SD (CV)	SWD (mm) Mean ± SD (CV)	SL/SWD Mean ± SD (CV)	SWG (g) Mean ± SD (CV)
Tissa	5.23 ± 0.44 (8.48)	4.85 ± 0.55 (11.26)	1.08 ± 0.07 (6.77)	0.06 ± 0.01 (23.91)
Souk nouzdir	5.08 ± 0.70 (13.83)	4.75 ± 0.77 (16.28)	1.08 ± 0.07 (6.81)	0.07 ± 0.02 (22.94)
Bernat 1	5.48 ± 0.40 (7.33)	5.18 ± 0.38 (7.33)	1.06 ± 0.05 (4.46)	0.07 ± 0.01 (17.68)
Bernat 2	5.39 ± 0.43 (8.13)	5.12 ± 0.48 (9.47)	1.06 ± 0.06 (6.03)	0.07 ± 0.02 (23.16)
Tamarzoukat	5.63 ± 0.63 (11.22)	5.30 ± 0.63 (11.88)	1.07 ± 0.07 (6.43)	0.08 ± 0.06 (72.43)
Bernat 3	5.36 ± 0.45 (8.35)	5.07 ± 0.53 (10.48)	1.06 ± 0.08 (7.11)	0.07 ± 0.01 (22.22)
Ouaoura	5.63 ± 0.36 (6.41)	5.31 ± 0.37 (6.99)	1.06 ± 0.06 (5.67)	0.08 ± 0.01 (15.71)
Ait aarfa	5.71 ± 0.35 (6.16)	5.48 ± 0.36 (6.57)	1.04 ± 0.05 (4.32)	0.08 ± 0.01 (15.77)
Ikharkhoud	5.97 ± 0.40 (6.78)	5.75 ± 0.39 (6.80)	1.04 ± 0.04 (4.15)	0.09 ± 0.02 (18.41)
Arbalou-n bouali	5.91 ± 0.42 (7.13)	5.67 ± 0.42 (7.32)	1.04 ± 0.05 (5.03)	0.01 ± 0.09 (93.76)
Ait ali-o-mhand	5.76 ± 0.47 (8.19)	5.56 ± 0.39 (7.02)	1.04 ± 0.04 (4.26)	0.08 ± 0.02 (19.12)
Ait halwan	6.08 ± 0.41 (6.68)	5.85 ± 0.38 (6.50)	1.04 ± 0.03 (3.25)	0.1 ± 0.02 (16.53)
Iaamouman	5.77 ± 0.31 (5.34)	5.57 ± 0.3 (5.40)	1.04 ± 0.03 (3.31)	0.08 ± 0.01 (12.65)
Mean ± SD	5.62 ± 0.54	5.34 ± 0.57	1.05 ± 0.06	0.08 ± 0.03
CV	9.56	10.75	5.54	44.06
F	37,805	46,190	6755	10,608
P	<0.0001	<0.0001	<0.0001	<0.0001

3.3. The Biometrics of the Pod

The data collected from the measurements carried out on the pods of each ecotype showed very highly significant to significant differences depending on the trait studied. (Table 2). Thus, we noted that the characters can be classified in decreasing order of differentiation according to the value of: PLB = 29.78, PWG = 27.11, PLT = 25.72, PWD = 22.1, PLT/PWD = 7.53, PLT/PLB = 4.97, NSP = 2.27, PLT-PLB = 1.77. It therefore clearly appears that the pods of the ecotypes differ mainly in size and weight than in shape and number of seeds per pod.

The mean of PLT is 36.08 mm, it is longer (40.09 mm) in Ait halwan, and smaller (31.57 mm) in Tissa. However, the average PLB recorded is 29.16 mm, varying between 33.22 mm; the longest at Aït Halwan; and 24.90 mm; the smallest in Tissa. The mean values of the ratio (PLT/PLB) and the difference (PLT-PLB) are respectively 1.24 and 6.92 corresponding to more or less slivered shape. The average PWD of the fruit was 8.18 mm, the variation limits of which were 7.28 mm and 9.1 mm. For PWG, the average is of the order of 0.42 mg, it showed a significant level of differentiation with a coefficient of variation of 23.46%; the lightest pods are those of Tissa (0.32 mg) and the heaviest are those of Aït halwan (0.57 mg). However, the NSP showed very little variation, with an average of 4.55 and a coefficient of variation of 13.8%.

Table 2. Results of the analysis of variance with a classification criterion of the different parameters of the pods of L. cicera.

Ecotype	PLT (mm) Mean ± SD (CV)	PLB (mm) Mean ± SD (CV)	PLT/PLB Mean ± SD (CV)	PLT-PLB Mean ± SD (CV)	PWD(mm) Mean ± SD (CV)	PLT/PWD Mean ± SD (CV)	PWG (g) Mean ± SD (CV)	NSP Mean ± SD (CV)
Tissa	31.57 ± 2.58 (8.17)	24.90 ± 2.53 (10.17)	1.27 ± 0.06 (5.21)	6.67 ± 1.34 (20.13)	7.81 ± 0.50 (6.51)	4.05 ± 0.32 (8.09)	0.32 ± 0.06 (18.76)	4.23 ± 0.62 (14.78)
Souk nouzdir	33.83 ± 3.49 (10.31)	26.54 ± 3.23 (12.17)	1.27 ± 0.05 (4.50)	7.28 ± 1.28 (17.59)	7.28 ± 0.93 (12.84)	4.67 ± 0.46 (9.94)	0.38 ± 0.10 (26.83)	4.5 ± 0.62 (13.99)
Bernat 1	34.73 ± 2.94 (8.46)	27.97 ± 2.39 (8.57)	1.24 ± 0.04 (3.31)	6.76 ± 1.15 (17.09)	7.86 ± 0.64 (8.17)	4.42 ± 0.33 (7.48)	0.39 ± 0.07 (18.26)	4.56 ± 0.50 (11.03)
Bernat 2	34.90 ± 1.74 (4.98)	28.37 ± 1.68 (5.93)	1.23 ± 0.03 (2.96)	6.53 ± 0.88 (13.47)	7.91 ± 0.45 (5.70)	4.42 ± 0.27 (6.18)	0.36 ± 0.05 (16.04)	4.53 ± 0.68 (15.03)
Tamarzoukat	37.09 ± 3.69 (9.96)	30.05 ± 2.74 (9.13)	1.23 ± 0.08 (6.59)	7.03 ± 2.33 (33.22)	8.31 ± 0.80 (9.69)	4.47 ± 0.36 (8.16)	0.41 ± 0.08 (19.69)	4.4 ± 0.72 (16.45)
Bernat 3	33.83 ± 2.44 (7.22)	26.84 ± 2.28 (8.51)	1.26 ± 0.04 (3.45)	6.99 ± 1.01 (14.58)	7.78 ± 0.49 (6.31)	4.35 ± 0.28 (6.45)	0.35 ± 0.06 (19.20)	4.53 ± 0.50 (11.19)
Ouaoura	33.45 ± 1.97 (5.90)	27.01 ± 1.68 (6.23)	1.23 ± 0.04 (3.47)	6.44 ± 1.10 (17.11)	7.76 ± 0.40 (5.18)	4.31 ± 0.29 (6.75)	0.41 ± 0.04 (11.31)	4.56 ± 0.56 (12.44)
Ait aarfa	37.46 ± 2.41 (6.44)	30.18 ± 2.37 (7.87)	1.24 ± 0.04 (3.80)	7.28 ± 1.14 (15.65)	8.27 ± 0.43 (5.22)	4.53 ± 0.27 (5.96)	0.44 ± 0.07 (16.54)	4.5 ± 0.57 (12.71)
Ikharkhoud	38.86 ± 3.01 (7.75)	31.88 ± 2.90 (9.11)	1.22 ± 0.06 (5.36)	6.98 ± 2.06 (29.56)	8.43 ± 0.57 (6.82)	4.62 ± 0.37 (8.14)	0.53 ± 0.08 (15.21)	4.76 ± 0.67 (14.24)
Arbalou-n bouali	36.90 ± 3.03 (8.23)	30.15 ± 2.78 (9.22)	1.22 ± 0.03 (2.98)	6.74 ± 0.99 (14.70)	8.38 ± 0.51 (6.12)	4.40 ± 0.27 (6.21)	0.46 ± 0.07 (16.96)	4.55 ± 0.64 (14.06)
Ait ali-o- mhand	38.65 ± 2.62 (6.78)	31.05 ± 2.09 (6.74)	1.24 ± 0.02 (1.96)	7.60 ± 0.86 (11.40)	8.68 ± 0.45 (5.24)	4.45 ± 0.26 (5.93)	0.46 ± 0.08 (17.71)	4.73 ± 0.78 (16.58)
Ait halwan	40.09 ± 2.60 (6.49)	33.22 ± 2.43 (7.32)	1.20 ± 0.03 (3.07)	6.87 ± 1.05 (15.35)	9.10 ± 0.52 (5.74)	4.41 ± 0.26 (6.03)	0.57 ± 0.08 (14.80)	4.9 ± 0.54 (11.17)
Iaamouman	37.37 ± 2.24 (6.00)	30.72 ± 1.90 (6.20)	1.21 ± 0.04 (3.90)	6.64 ± 1.33 (20.02)	8.77 ± 0.63 (7.25)	4.26 ± 0.22 (5.36)	0.43 ± 0.05 (13.55)	4.43 ± 0.50 (11.36)
Mean ± SD	36.08 ± 3.62	29.16 ± 3.33	1.24 ± 0.05	6.92 ± 1.36	8.18 ± 0.75	4.41 ± 0.34	0.42 ± 0.10	4.55 ± 0.62
CV	10.05	11.43	4.32	19.69	9.19	7.8	23.46	13.8
F	25.72	29.78	4.97	1.77	22.1	7.53	27.11	2.27
P	<0.0001	<0.0001	<0.0001	0.05	<0.0001	<0.0001	<0.0001	0.008

3.4. Hierarchical Classification

A hierarchical classification of 13 ecotypes was performed using all the measured traits of the seed and pod (Figure 3). It represents the similarities between the different ecotypes of L. cicera as a function of Euclidean distance. Four groups are distinguished according to a size gradient. Group 1 includes ecotypes which have heavy and large seeds and pods (Iaamouman. Ait halwan, Ait ali-o-mhand, Arbalou-n bouali, Ikharkhoud and Tamarzoukat), group 2 and 3 include forms intermediates (Bernat 1, Bernat 2, Bernat 3, Ouaoura and Ait aarfa), while group 4 includes ecotypes with light and small seeds and pods (Tissa and Souk nouzdir).

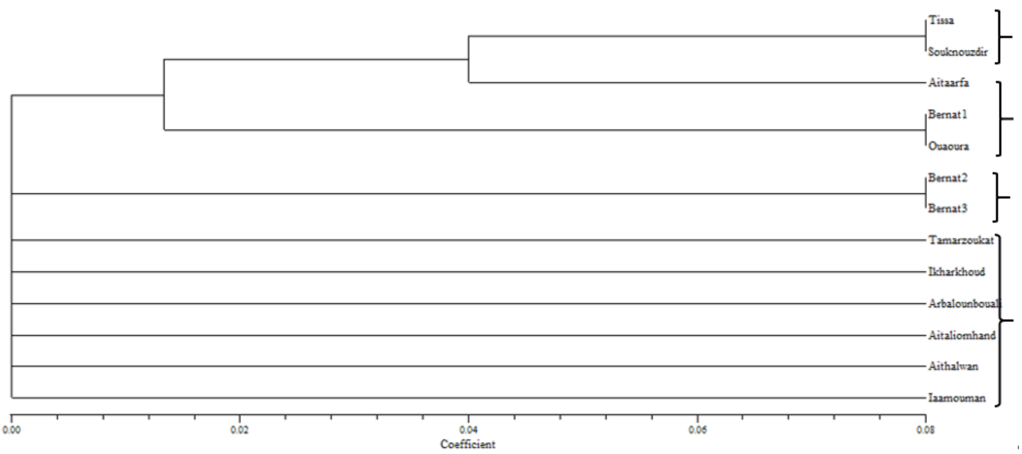

Figure 3. Distance dendrogram between 13 ecotypes of L. cicera L. obtained by the method of unweighted pair groups with arithmetic means (UPGMA) based on a paired Euclidean distance matrix calculated on morphological markers.

4. Discussion

Despite the small number of agromorphological characters used in this study and which relate only to 3 aspects, seed, pod and germination, there is a significant variability in the ecotypes of L. cicera. The interest and importance of this variability are particularly interesting insofar as they have been demonstrated over a small and relatively delimited territory.From a socio-economic point of view, the observations made in the field and the discussions with the farmers confirmed the autochthonous origin of the ecotypes cultivated and maintained locally, from a stock of seeds traditionally renewed by the peasants, whose explanation of this variability. Indeed, the presence of a significant morphological variability between fields can be related to the mode of seed conservation. In addition, the almost total absence of seed exchanges between the different growing regions helps maintain variability between fields. Each ecotype evolves in isolation from the others, which accentuates the differences observed over generations. However, further study for other agromorphological characters affecting the adult plant and its productivity could then provide a better insight into the extent and importance of this morphological variability.

5. Conclusions

The study showed the existence of a significant diversity between the ecotypes of L. cicera in Morocco. This phenotypic diversity has been demonstrated by a small number of morphological markers (seed and pod). This evaluation must be extended first by other agromorphological characters and which concerns the whole plant and its productivity and secondly by genetic markers for a more efficient estimation of genetic diversity. These studies are essential in the current context of this culture. Characterization is a first step towards conservation. Subsequently, in a region where culture continues to decline, we must highlight the urgency of putting in place strategies to encourage the conservation of this heritage. The best strategy seems to us to be in situ conservation in a peasant environment by encouraging the maintenance of traditional cultures.

Institutional Review Board Statement:

Informed Consent Statement:

Data Availability Statement:

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References

1. Challinor, A.J.; Wheeler, T.R. Crop yield reduction in the tropics under climate change: Processes and uncertainties. *Agric. Meteorol.* **2008**, *148*, 343–356.
2. Challinor, A.J.; Ewert, F.; Arnold, S.; Simelton, E.; Fraser, E. Crops and climate change: Progress, trends, and challenges in simulating impacts and informing adaptation. *J. Exp. Bot*. **2009**, *60*, 2775–2789.
3. Boote, K.J.; Allen, L.H., Jr.; Prasad, P.V.V.; Jones, J.W. Testing effects of climate change in crop models. In *Handbook of Climate Change and Agroecosystems*; Hillel, D., Rosenzweig, C., Eds.; Imperial College Press: London, UK, 2010; pp. 109–129.
4. Palm, C.A.; Smukler, S.M.; Sullivan, C.C.; Mutuo, P.K.; Nyadzi, G.I.; Walsh, M.G. Identifying potential synergies and trade-offs for meeting food security and climate change objectives in sub-Saharan Africa. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 19661–19666.
5. Reynolds, M. *Climate Change and Crop Production*; CAB International: Wallingford, UK. 2010.
6. FAO. The State of Food Insecurity in the World. In *How does International Price Volatility Affect Domestic Economies and Food Security?*; FAO: Rome, Italy, 2011.
7. Hanjra, M.A.; Qureshi, M.E. Global water crisis and future food security in an era of climate change. *Food Policy* **2010**, *35*, 365–377.
8. Poppy, G.M.; Chiotha, S.; Eigenbrod, F.; Harvey, C.A.; Honzák, M.; Hudson, M.D.; Jarvis, A.; Madise, N.J.; Schreckenberg, K.; Shackleton, C.M.; et al. Food security in a perfect storm: Using the ecosystem services framework to increase understanding. *Philos. Trans. R. Soc. B: Biol. Sci*. **2014**, *369*, 20120288.

9. Fanzo, J.; Davis, C.; McLaren, R.; Choufani, J. The effect of climate change across food systems: Implications for nutrition outcomes. *Glob. Food Secur.* **2018**, *18*, 12–19.
10. Adams, M.W.; Ellingboe, AH.; Rossman, E.C. Biological uniformity and disease epidemics. *Bioscience* **1971**, *21*, 1067–1070.
11. Altieri, M.A.; Nicholls, C.I. Biodiversity and pest management in agroecosystems, 2nd edn. Haworth Press, New York. 2004.
12. Heinemann, J.A.; Massaro, M.; Coray, D.S.; Agapito-Tenfen, S.Z.; Wen, J.D. Sustainability and innovation in staple crop production in the US Midwest. *Int. J. Agric. Sustain.* **2013**, *12*, 71–88.
13. FAO. *The State of the World's Plant Genetic Resources for Food and Agriculture*; Food and Agriculture Organization of the United Nations: Rome, Italy, 1998; p. 510.
14. IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development). *Agriculture at a Crossroads, International Assessment of Agricultural Knowledge, Science and Technology for Development Global Report*; Island Press: Washington, DC, USA, 2009.
15. Pretly, J.; Sutherland, W.J.; Ashby, J.; Auburn, J.; Baulcombe, D.; Bell, M.; Bentley, J.; Bickersteth, S.; Brown, K.; Burke, J.; et al. The top 100 questions of importance to the future of global agriculture. *Int. J. Agric. Sustain.* **2010**, *8*, 219–236.
16. Saxena, K.G.; Maikhuri, R.K.; Rao, K.S. Changes in agricultural biodiversity: Implications for sustainable livelihood in the Himalaya. *J. Mt. Sci.* **2005**, *2*, 23–31.
17. McNeely, J.A.; Schroth, G. Agroforestry and biodiversity conservation–traditional practices, present dynamics, and lessons for the future. *Biodivers. Conserv.* **2006**, *15*, 549–554.
18. Jackson, L.; Van Noordwijk, M.; Bengtsson, J.; Foster, W.; Lipper, L.; Pulleman, M.; Said, M.; Snaddon, J.; Vodouhe, R. Biodiversity and agricultural sustainability: From assessment to adaptive management. *Curr. Opin. Environ. Sustain.* **2010**, *2*, 80–87.
19. Tscharntke, T. Global food security, biodiversity conservation and the future of agricultural intensification. *Biol. Conserv.* **2012**, *151*, 53–59.
20. Peña-Chocarro, L.; Peña, LZ. History and traditional cultivation of Lathyrus sativus L. and Lathyrus cicera L. in the Iberian Peninsula. *Veg. Hist. Archaeobot.* **1999**, *8*, 49–52.
21. Adak, A.; Cancý, H.; Ertoy Inci, N.; Oncu Ceylan, F.; Sari, D.; Sari, H.; Yildirim, T.; Toker, C. Essential selection criteria for dual uses of red pea (*Lathyrus cicera* L.). *Legume Res. Int. J.* **2018**, *42*, 45–49.