OPEN ACCESS Freely available online

Journal of Nutrition & Food Sciences

ISSN: 2155-9600

Research Article

# Revival and Coservation of Buck Wheat Endangered species (Fagopyrum esculentum): New Paradigm for Economic, Livelihood and Food Security of Himalian Regions by using Different Breeding Techniques.

**Mushtaq Ahmad[1*], Faizan Ahmad[1], Eajaz Ahmad Dar[2], Mudasir ahmad khan[3],**

*Shabir.HussainWANI[4]., Rizwan Rashid[5], Intikhab Aalum Jehangeer[5], F.A. Bahar[6]*

[1]*Mountain Agriculture Research & Extension-Kargil Ladakh-194103*

[2]*Krishi Vigyan Kendra Kargil Ladakh-194101*

[3]*Saffron Research Station, Pampore, 192301*

[4]*Mountain Research Centre for Field Crops- Khudwani-192101*

[5]*Faculty of Horticulture, Shalimar*

[6]*Faculty of Agriculture, Wadura*

## ABSTRACT

A significant effect of GEI is the differential ranking of the genotypes within the 4 locations and the variation of the test locations. AMMI Biplot allows detection of a uniquely adapted genotype. Biplot recognizes the existence of two mega environments with their successful genotype. MAR & ES-Kargil, Battalic and Thasgam form one sector and G3 form their winning genotype Farmers through PVS in seven locations along with stability experimental sites are G3, G7 and G9. These genotypes must be evaluated in large areas by the Baby Trial Evaluation and grandmother trials System to finalize large plot sizes and actual performance, and eventually recommend varieties for scaling by involving seeds in such ecology Positive feedback has been received from farmers for cultivating this crop in various places in Ladakh this happens after 10 years, we cover more than 100 kanals of land in first year. Buckwheat biodiversity, collection and multiplication in hotspots in partnership with farmers and this complex breeding method is a good sign of its revival and will save this fragile crop on the brink of extinction.

**Keywords:** AMMI, GGE biplot, food security, Revival, participatory breeding

## INTRODUCTION

The Ladakh region is one of the highest (2900 to 5900 mils) and cooler regions of the earth (-30 0 C to -70 0 C) and is located between 310 44 '57' to 320 59 '57' N latitude and 760 '. The longitude ranges from 9 '29' to 0061 '37' 'E. Kargil District is a district in the Indian Union Territory of Ladakh. It extends to Ladakh in the south, Jammu and Kashmir in the west, Leh district in the east, Gilgit-Baltistan in the north of Pakistan and Himachal Pradesh in the south. The district is northwest of the Great Himalayan Range and has a lot of Zanaskar range, including two historic areas called Punig and Zanaskar. Its population includes the river valleys in some parts of Kargil and Leh and almost all villages in the Kargil district, located in the lowlands and near the Line of Control, which closes on land for more than six months a year. Huh. There are villages in the Leh district around the Indus River. Similarly, villages in Kargil district are near Sindhu and Sururiver [1] Of the various crops grown, buckwheat is one of the oldest indigenous crops in Asia, Central and Eastern Europe, and is mainly used as a staple food in southern China [2] Buckwheat (Phagopyrium esculentum) is

*Correspondence to:** Mushtaq Ahmad, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar-India-1940025, Tel: 9797725250, E-mail: drmushtaqdarskuastk@rediffmail.com

**Received:** November 02, 2020; **Accepted:** August 30, 2021; **Published:** September 30, 2021

**Citation:** Ahmad M (2021) Revival and coservation of Buck wheat endangered species (Fagopyrum esculentum): New paradigm for economic, livelihood and food security of Himalian regions by using different breeding techniques. J Nutr Food Sci. 11:p170

one of the important crops grown in the high temperate region of Ladakh and Jammu and Kashmir. Grain was one of the main foods of the Ladakh people a year ago. The most popular ingredient in Kargil made with flour is called saffron or gujiri, which is similar to plain cabbage? But now the status of such a nutritious crop is on the verge of extinction [3], which is unique and has strong and nutritious value. Experiments with animal models have shown that buckwheat flour contains a rich source of nutrients that can reduce diabetes, esophageal hypertension and hypercholesterolemia. Buckwheat seeds and other tissues contain one type of nutrients. They are a great source of trace elements, including carbs, protein, antioxidants and dietary fiber. Goat is used for livestock, livestock and poultry. Essential amino acids, especially lysine, tryptophan, and threonine, improve the quality of bovine protein; Apart from buckwheat there is a high content of albumin and globulin and to some extent prolamins. Vitamin B1 (thiamine), B2 (riboflavin), e (tocopherol) and b3 (niacin and niacin amide) are higher in whole grains [4] than most cereals. The bran fraction obtained by buckwheat milling, especially dietary fiber (139–161 mg / g), [4, 5, 6, 7]. The reason behind its unavailability for the research scientist is the lack of high yields where farmers do not prioritize harvesting, so it is on the brink of extinction [3]. But unfortunately now the state of such nutrient crops is in a state of extinction, although it has high value and nutritional value [8, 3]. The importance of the research scientist is the lack of high yielding varieties and the impact that climate change has on its cultivation. There is also a significant decrease in the area of buckwheat in Ladakh. In view of the nutritional quality of its seeds for human consumption and the suitability of this crop for marginal and degraded lands, it is necessary to restore its cultivation in the cold dry conditions of Ladakh (Jammu and Kashmir). Therefore, there is a need to use new research technologies to increase seed yield.

GEI is very valuable in breeding programs to identify a wide range of genotypes that are widely or specifically adapted to specific environments. [1] Noted the importance of GEI in buckwheat yield performance. When target environments differ from the selected environment, the stability of the cultivation performance is important. Therefore GXE analysis is important for identifying better varieties and for their consistency and stability in different agro-ecology [9]. The two main statistical analyzes used to measure GEI and sustainability are the AMMI and the GGE. GGE captures the main effects of biplot genotypes and genotype x environmental interactions, which are two important sources of genotype evaluation. Environmental factors have a strong influence on the various stages of crop growth [10], so genotypes vary widely in their response to the environment. Most research workers believe that the average high yield genotype is not the only criterion of superiority unless its superiority is verified in the performance of many environmental conditions [11]. The phenotypic function of the genotype may not be the same under different agro-climatic conditions. This variation is caused by the G x E interaction, which reduces the stability of the genotype in different environments. Several models have been developed to measure the stability of various parameters and collisions due to the G x E interaction [11]. The stability of genotype function is of particular importance in Jammu and Kashmir, where environmental conditions vary considerably and ways of modifying the environment are inadequate. Therefore, information on high yielding genotypes and multi-locus function is important in Ladakh, where the environment varies greatly over short distances. Multivariate methods are widely applied in stability analysis to provide more information about the actual multivariate response of the genotype to the environment. In multivariate analysis methods, the AMMI model is a powerful method for assessing the stability / adaptation of G-XE interactions and genotypes from multivariate testing. The advantages of the AMMI model or its variants are that they use a mixed arrangement, impose limits on qualitative terms, and at least squares fit [12]. [14] In scope, any model is expected to [13]. However [14] the AMMI model has a good chance of evaluating new sites and the year ahead, thus contributing to the real uptake. [15] Have shown that AMMI2 is commonly selected with IPCA1 and IPCA2, and that the graphical representation of axes is usually informative against major effects such as IPCA1 or IPCA2 or against IPCA2. Testing and identifying phenotypically stable genotypes is essential for any breeding program that operates more or less uniformly under different environmental conditions. The AMMI model [15] is more effective in determining the most stable and high-yielding genotypes in multi-environment testing than previous approaches [16. Biplot analysis is perhaps the most powerful explanatory tool for the AMMI model. Biplots are graphs where the genotype and the elements of the environment are plotted on the same axis so that correlations are visualized. The AMMI biplot, with the main effect on the X axis (genotype average and environmental average), and IPCA1 scores for both genotype and environment are plotted on the Y axis. The effectiveness of the AMMI process has been clearly demonstrated [12].

Farmers are increasingly involved in agricultural research as scientists and development activists learn more about the philosophy of "farmers first and its effects" [17]. The Farmer Participatory Varietal Selection (PVS) approach is used to address the limited variety of options available to farmers. In plant breeding, farmer participation appears to be important to increase the chance of adopting new varieties, and addresses the issue of selection efficiency in participatory planting by examining the impact of selection climate on the performance of selected rows. The genotypes used for farmer-management evaluation have been tested by participant efforts to identify farmer acceptable growers more effectively. Remember, the nutritional properties of buckwheat, planted for human consumption. The current research program evaluates nine genotypes under different agro-ecological conditions, evaluates GXE interactions in participatory mode to assess their performance, adaptability, utilization and conservation, and the most important goal of this experiment is to identify high yield and stable varieties and reproduce these endangered species. The present research seeks to demonstrate the optimal performance of variables and farmers under the nine genotypes of buckwheat and its ecological zones in different climates of the Ladakh (UT) and cool arid zone of regeneration and conservation, with the choice of participating plant breeder or technologies according to farmer preference.

# MATERIALS AND METHOD

## EXPERIMENTAL DESIGN AND SITES

Ladakh, MAR & ES-Kargil, Batalik, Lanskarchy, Thasgam, Kargil, Drass and G.M. Pora Ladakh during the 2019 major harvest season. At each location, a 3x3 lattice design with three replicates was studied. A total of nine buckwheat genotypes (Table 1) were collected from the NBPGR of Plant Genetic Resources in New Delhi. Plot size was 9.6 m 2, six rows 4 m long and 40 cm row spacing and 10 cm between plants. However, all yield and farm data were collected from four middle rows of 6.4 m2 net plot size. All required maintenance packages and exercises were executed according to the recommendations of each plot at each location. Temperature fluctuations at these experimental sites described in Table 1. In this current research, these nine genotypes were evaluated by mothers / grandmothers (Participatory Plant Breeding) Mother Trial Evaluation System to identify the most appropriate genotypes based on the preferences of the farmers and the specification for breeding. Consultation with the farmers about future strategies how you preferred in this unique crop then descriptive statistics was generated using the $\chi 2$-test. The farmer's field consists of the Kargil Farmers 'Trial, the Battalion Farmers' Trial, the Lanskarchy Farmers 'Trial and the Thasgam Farmers' Trial, and the Three Mother Trials, at Drass Station Trial, MAR & ES Station Trial and Trials at G.M Pora Station and four mother trials at above cited areas. The experiment was performed in a randomized Complete Block Design (RCBD) with three replicas in the year 2019 Test Evaluation System, and ranks and station tests at seven locations, including their own farms, based on farmer skills and knowledge and testing.

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average high °C (°F) | −4.3 (24.3) | 1.6 (34.9) | 4.3 (39.7) | 13.5 (56.3) | 20.9 (69.6) | 25.7 (78.3) | 29.2 (84.6) | 28.6 (83.5) | 24.2 (75.6) | 17.8 (64.0) | 9.8 (49.6) | 0.9 (33.6) | 14.4 (57.8) |
| Average low °C (°F) | −13.2 (8.2) | −11.9 (10.6) | −4.9 (23.2) | 3.3 (37.9) | 9 (48) | 13.3 (55.9) | 17.4 (63.3) | 17 (63) | 12 (54) | 4.9 (40.8) | −1.6 (29.1) | −8.1 (17.4) | 3.1 (37.6) |
| Average precipitation mm (inches) | 46 (1.8) | 51 (2.0) | 82 (3.2) | 35 (1.4) | 26 (1.0) | 11 (0.4) | 7 (0.3) | 10 (0.4) | 10 (0.4) | 8 (0.3) | 6 (0.2) | 26 (1.0) | 318 (12.4) |

**Table 1:** Climatological Information for Kargil, Ladakh", Hong Kong Observatory, 2018

# RESULTS AND DISCUSSION

## Analysis of AMMI Joint Diversity

The advantages of the AMMI model or, therefore, that they use composite alignment, are that there are no restrictions on qualitative terms and that at least squares are sufficient [12]. In scope, any model is expected to match the received data. However, there is a good chance for the AMMI model there is a good chance of predicting new sites and the New Year, thereby contributing to real progress [18] (Gauch. 1988). [15] Have shown that AMMI1 is generally selective with IPCA1 and IPCA2, and graphical representations of axes generally provide information against major effects such as IPCA1 or IPCA2, or against IPCA2. The AMMI method is used for three main purposes. AMMI is more suitable for early statistical analysis of first model diagnostics and yield tests because it provides an analytical tool for determining sub-cases when other data models are better suited to specific datasets [16]. Second, AMMI defines G × E interactions and captures patterns and relationships of genotypes and environments. The third use is to improve the accuracy of yield estimates. Gains with the accuracy of equivalent yield estimates have been obtained to increase the number of replicates by a factor of two to five [19, 20]. Such a goal is to reduce test costs by reducing the number of replicates, adding more treatments to the experiments, or improving the ability to choose the best genotype. Using ANOVA, the whole class of yield was divided into genotype, environment, and GE interactions. GE interactions are further divided by principal components analysis. The combined analysis of variance for seed yield was performed using the GenStat ver.18 software. Differential homogeneity error was tested before concurrent analysis using the Bartlett symmetry test (1937). The analysis results (Table 2) showed that genotype, environment, and interaction effects (GEI) were significantly affected ($P < 0.01$) with the yield of buckwheat seeds. Therefore, beaver genotypes are genetically variable in their seed yield performance and the significant impact of GEI reflects differential ranking of genotypes at test sites. The environment accounts for the largest share of captured variation, accounting for 55.93% of the total variance of squares after GEI and genotype, which is 26.33% and 16.21%, respectively. From the results, the seed yield was largely influenced by the suitability of the study to assess the locations of the environment and the test locations as well as to fully estimate the locations of those variables. The AMMI model divided GECA into IPCAs, and both IPCA1 and IPCA2 were significant ($p < 0.01$), with 71.60% and 22.78% of the total variability related to GEI, respectively. However, IPCA3 was very low, accounting for only 6.83% of the GEI variability. Most of the genotypes and surroundings were observed scattered around the biplot. Genotypes away from the middle of the biplot show specific adaptation. The biplot diagram is used to estimate specific adaptations and to study their stability. In a study on the environmental interaction of genotype in durum wheat, Saleem et al reported that genotypes shifted away from the center of the biplot had higher G × E interactions and that genotypes closer to the biplot center had higher stability. The present study is in line with the results of [21] that assessed nine yellow buckwheat genotypes for seed yield performance and found significant effects of genotype, environment and GEI.

| Genotypes | Genotypes code | Status |
|---|---|---|
| IC-109311 | G1 | Advanced lines |
| IC-24307 | G2 | Advanced lines |
| IC-107988 | G3 | Advanced lines |
| IC-42414 | G4 | Advanced lines |
| EC-18604 | G5 | Advanced lines |

| | | |
|---|---|---|
| IC-42428 | G6 | Advanced lines |
| IC-107984 | G7 | Advanced lines |
| IC-108500 | G8 | Released variety |
| HIMACHAL LOCAL | G9 | Released variety |

**Table 2:** List of experimental materials used in the study and their status

| Experimental sites | Longitude | Latitude | Altitude | Soil type | Annual rainfall |
|---|---|---|---|---|---|
| MAR&ES Kargil | 30 -359N | 75-77E | 9003ft | Sandy loam in texture, poor water holding capacity | Annual precipitation 10cm mainly snow |
| Lanskarchy | 34-35N | 76-78E | 14000ft | Sandy, loamy | 21-24cm |
| Thasgam | 34- 36 N | 76-78 E | 11045ft | Sandy | 20-24cm |
| Battalic | 30-34 N | 76-79E | 10023 ft | Sandy, loamy | 25-30cm |
| DRASS | 32 -369N | 75-78E | 11000ft | Sandy, loamy | Annual precipitation 12cm mainly snow |
| G.M. PORA | 31 -359N | 75.4-77.2 E | 9003ft | Sandy loam in texture, poor water holding capacity | Annual precipitation 10cm mainly snow |
| Kargil | 30 -359N | 75-77E | 9003ft | Sandy loam in texture, poor water holding capacity | Annual precipitation 10cm mainly snow |

**Table 3:** Geographical location of experimental sites of cold arid zone of Ladakh

## AMMI (Additive Main Effects and Multiplicative Interactions)

The AMMI1 biplot represents the relationship between IPCA1 (the first major axis of interaction) and groups and location [22]. According to [23] found that genotypes and positions on the same equilibrium yield identical yields, and a genotype on the right of the midpoint of this axis and positions yield more than those on the left. If a genotype or environment has an IPCA1 score close to zero, then its interaction effect is low and therefore stable [28] (Carbonell et al. 2004). IPCA1 coordinates have genetically identical interactions and have positive interactions in the environment [24] (Yan 2003). Therefore, according to Fig. 1, G6 and G8 and G4 were found on the same line, showed positive interactions and had similar yields, with these genotypes interacting positively in the Thasgam region as well. While the G5, G6, G8, G2 and G4 genotypes were on the left side of the midpoint of the axis, the average yield decreased, whereas G3, G7 and G9, on the contrary, were on the right axis. They are above average yields. Of all the genotypes, G3 is the highest and G5 is the lowest in average seed yield. Furthermore, the G3 is close to IPCA1's zero score, indicating its stability.

Regarding locations (Fig.1), battalion lancets are found in the right quadrant and are considered high yield potential sites. In contrast, MAR & ES-Kargil and Thasgam, since they are found on the left side of the quartile, can be considered as low yield potential sites. AMMI analysis can be used effectively in identifying improved environmental conditions and improved average performance genotypes for agricultural exploitation [30]. The AMMI 2 biplot is visualized by the multiplicative effects of the GEI, which were previously included in two IPCAs [25]. In the AMMI2 biplot, distances from the biplot origin indicate the interaction of the genotype with the environment or genotype. Specific adaptation refers to high average productivity of genotypes in the selected environment. Accordingly, in Figure 2, G2, G5 and G9 are exclusively Lanskarchy, and G3 is converted into MARs & ES-Cargill, G6 and G8 as Thasgam, and the genotypes, G1 and G7, are expressed exclusively for the receiving Batalik. Creatures placed close to the biplot source have less interaction and greater compatibility for all test locations. However, in the case of downstream AMMI2 (Fig. 2), all genotypes indicate positive or negatively high interactions, and thus the generally accepted genotype cannot be extracted.

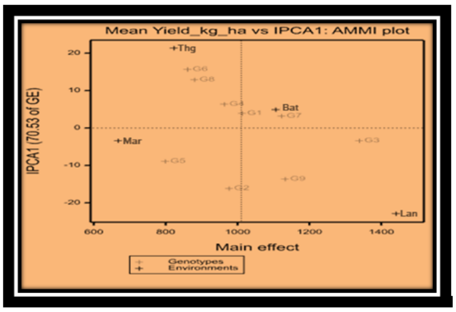


**Figure1:** AMMI1 biplot showing genotypes and environments interaction; Genotype denoted as G1, G2. G3... and environment denoted as Mar=MAR& ES- Kargil, Bat=Battalic, Phg=Thasgam, lan= Lanskarchy

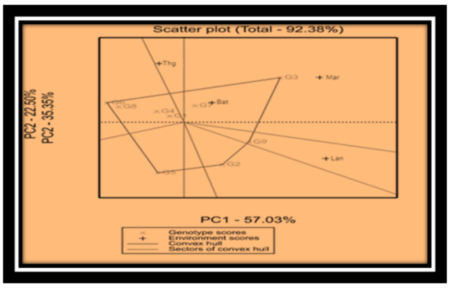


**Figure 2:** AMMI2 biplot showing the interaction between genotypes and test environments Genotype denoted as G1, G2. G3… and environment denoted as Mlk=MAR& ES- Kargil, Mes=Battalic, Paw=Thasgam, Skt= Lanskarchy

## Genotype and genotype by Environment Biplot (GGE)

The polygonal view of the binomial is the best way to visualize interactions between genotypes and environments and to understand bipolar effectively [32]. According to Figure 3, the genotype, G3, G9, G2, G5, and G6 Top or Corner genotype gave the highest seed yield to the region's environment. However, the environment has fallen into just two regions, where MAR & ES-Kargil, Batalik and Thasgam G3 form one region, with the highest seed yield genotype and Lanskarchy G9. , Because it has the highest yielding genotypes. Place. However, the second corner genotypes G2, G5 and G6 are the worst, and the worst-yielding genotypes are far from all test sites. The GGE biplot in Fig. 2 also confirms the formation of two distant mega environments, similar to the result of the polygon view of the GGE biplot. GGE Biplot's "which-won-where' ' model is the most suitable tool for mega-weather analysis in a variety of tests. [26] reported a simple bean to us polygonal view. According to [27] the ideal environment should be representative of genotypes and mega-environment. The ideal genotype is very stable and a high average yield should be placed between the relative circles. In other words, the representation of the ideal genotype on the ATC y-axis is clearly zero (very stable) and its position on the ATC x-axis is equal to the longest vector of all genotypes. Consequently, the shortest distance between the genotype and the virtual ideal genotype represents the ideal genotype.

Accordingly, in Fig.5, G3 is an ideal genotype, followed by G7. G3 is therefore considered to be the most stable and highest yield of buckwheat genotypes tested. In contrast, the G6 and the G8 are the differences for this post. In terms of locations, MAR & ES-Kargil is the ideal location for the buckwheat genotypes, followed by the position of the battalion, in In contrast; Lanskarchy was discriminated at this time and is considered highly unstable despite its high seed yield. The environment needs more if it is closer to the ideal environment. Therefore, concentric circles are drawn to visualize the distance between each environment and the ideal environment, while ideal environments are used as the center [27, 28]

According to the GGE ranking biplot (Fig. 6), it is possible to estimate average yield and stability performance. The average yield of genotypes can be easily determined based on the estimation of their parameters on the ATC X-axis. Therefore, the GGE ranking confirms G3 as the highest yielding genotype following Biplot G3 and G9. The stability of each genotype is explored based on its projection on the ATC y-axis. The shorter the distance from the midline to the genotype, the more stable it is. Therefore, based on Figure 6, G3 and G7 are considered to be the most stable genotypes, while G2, G5 and G6 are considered the most stable genotypes. Furthermore, depending on the location of the genotypes from the vertical bold lines, the G3, G7 and G9 genotypes are placed above the vertical bold lines so that they have a higher average seed yield, but in contrast, G6, G8, G5 and G4, because they are under vertical bold lines with average yield.

According to the graphic analysis and average yield of the AMMI stability parameters [29], most of these parameters represent a consistent sense of stability. Most sustainability statistics relate to the concept of static (biological) or dynamic (agricultural) sustainability (Baker & Lyon. 1988). Stable stability is consistent with eco-psychological buffering, whereas dynamic stability is related to eco-psychological sensitivity. Although the dynamic stability is constant, it depends on the specific tested genotype. The concept of static sustainability is more useful than the dynamic concept of sustainability in widespread climate change, especially in developing countries [30, 31, and 32] reported a steady emption ham of stability for the EV, SIPC and AMGE parameters, which were computed for a significant number of Golob's F-tests. In contrast there are no reports on the stability nature of the AMMI stability parameters based on other F-tests. However, the AMMI stability parameters seem to have consistent and dynamic conceptions of stability with respect to the nature of the crop, the conditions of the experiments, and similar results. Similar results are being developed for site-specific and extensive compatibility genotypes that yield high yielding varieties of oats [33] especially for farmers. Such a strategy should be considered as the major difference in the cultivation of different types of cereals in western Nepal and Nepal Akuna [34]. The genotype that works best for farm interest traits is expressed in the growing environment in which G3 is tested, the phenotypic effects are influenced by G x E interactions and their effects should be adjusted by turning them into normal effects. Soybean genotypes X. The relative contribution of squares to increased environmental interactions is the height of the plant in the environment, the number of pods per plant, the number of breeding nodes in the main stem, the number of breeding nodes in transit, and the number of events. The grain and grain yield per plant. The biometric approach is effective in understanding the treatment level and general effects of the factorial experiment, making this AMMI method widely used in soybean. Finally, the AMMI model analysis is intended to be an effective tool on complex GE interactions in multi-environment [35] and annual testing of durum wheat. Furthermore, along with differences in crops and areas (such as climatic conditions, soil characteristics, etc.), the observed GE interactions can be partially understood by the structure of the dataset and the selection of genotypes. The AMMMI approach is a good approach in determining the most suitable genotype. The genotype G3 (IC-109728) was considered the most stable genotype with respect to good stability (based on AMGE-dependent parameters) and high yield (12.8 g plant-1) (Fig. 1,2,3,4, 5 and 6) (pooled Fig -7). It is therefore recommended that the Mountain Agricultural Research and Extension Center, SKUAST-Kashmir be cultivated. The main purpose and beauty of this scientific program is the inclusion of Self Help Groups, Sarpunchs and Punches in various places in Ladakh, and the women folk from different villages also participate in the vast majority of Ladakh. Knows, engages in farm work. To educate them on the importance of buckwheat seeds for human health and their native land species conservation strategies for future breeding programs. When he finally saw the yield potential of these experimental means and satisfied the establishment community for the revival of buckwheat cultivation, he saved this endangered crop on the brink of extinction.

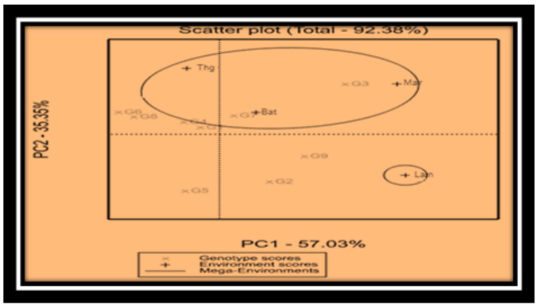


**Figure 3:** Polygon view of GGE biplot showing environments interaction and their specifically adapted genotypes; Genotype denoted as G1, G2. G3... and environment denoted as Mlk=MAR& ES- Kargil, Mes=Battalic, Paw=Thasgam, Skt= Lanskarchy

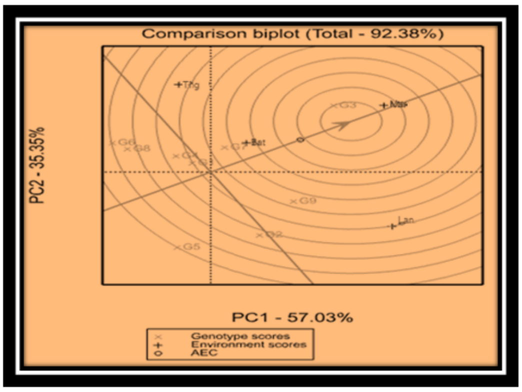


**Figure 4:** GGE biplot graph showing mega environments with their winning genotypes. Genotype denoted as G1, G2. G3... and environment denoted as Mar=MAR& ES- Kargil, Bat=Battalic, Paw=Thasgam, Skt= Lanskarchy

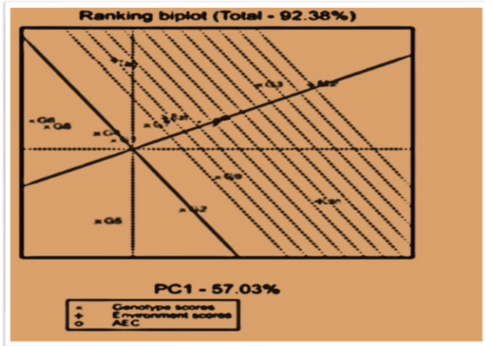


**Figure 5:** Average tester coordination (ATC) view of the GGE comparison biplot showing mean performance and stability of genotypes. Genotype denoted as G1, G2. G3... and environment denoted as Mar=MAR& ES- Kargil, Bat=Battalic, Thg=Thasgam, Lan= Lanskarchy

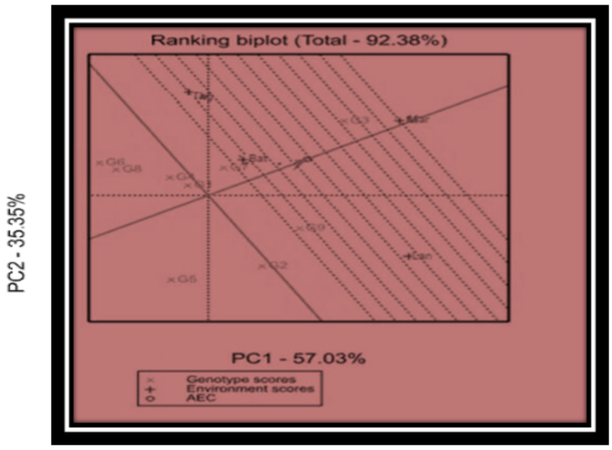


**Figure 6:** Average tester coordination (ATC) view of the GGE ranking biplot showing mean performance and stability of Buckwheat genotypes. Genotype denoted as G1, G2. G3... and environment denoted as Mar=MAR& ES- Kargil, Mat=Battalic, Thg=Thasgam, Lan= Lanskarch

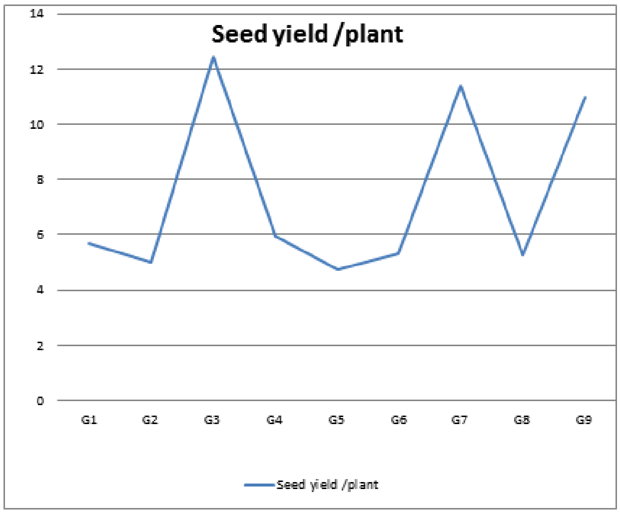


**Figure 7** Pooled Seed yield plant-1 (gms) at different locations

## Revitalization and conservation through participatory plant breeding

One week before harvest, Focal Group Discussion (FGD) and Kisan walk were conducted to assess the trails, the maximum rank value for the MAR&S ES Predictive Scoring, i, and genotype G1 based on PRA performance in Kargil, followed by G7 (2) and G8 ( 3) (Table 1). The lowest priority was recorded for G2, G4 and G1. Similarly, in Batalik Ladakh, G-1 and G-(3) scored highest, followed by G-1 and G-2 and G-4. After G3, G7 and G8, peasant votes for genotypes were maximized. Maximum negative votes were recorded for G2 and G5. The most preferred genotypes in Thasgam and Ladakh are G3 (1) and G7 (6) followed by G8 and G9. The genotypes that received the least number of negative votes were G4. There is a significant interaction between genotypes and locations observed from preferential ranking data. Due to genotype preference, seed-1 yield depends on a number of characteristics, including plant height, number of leaves and internodes, primary branches, secondary branches, and maturity days. Table (6) gives preliminary data of rank sums for various entries collected from four mother trials and estimated 228 farmers, including farmers tested in their fields. The lowest cumulative rank was recorded with a ranking order of 0.77 over the G3, and G7 (1.55) was ranked second best, followed by G9 (2.88) and G8 (3). The G3, G7, G9 and G8 rankings clearly show that the index is similar and has been cultivated over the past two decades by priority rankings and local Cargill, local draws and native Himachal. The reason why genotype is preferred in most farmers' interviews is that high seed yield is related to a number of characteristics such as seed yield plant-1, plant height, number of leaves, number of internodes, primary branches, secondary branches and days to maturity. Days to maturity Buckwheat is an important aspect of cultivation because it can severely affect its seed early in the winter, which can cause total crop failure because this crop is very sensitive to weather fluctuations. Participatory Veritable Selection (PVS) method is used to assess, identify and disseminate various genotypes of cultivated area according to the interests and aspirations of the farmer through their studies in different regions and crops. [36;10]. Farmers finally agree that the G3 and G7 genotypes, as well as their native land species, are four times higher seed yield based on consistent seed yield and other yielding characteristics in other environments.

| Genotypes code | KARGIL – Ladakh (n=25, f=18) Farmers trial | | BATTALIC-Ladakh (n=35, f=28) Farmers trial | | LANCHARCHY-Ladakh (n=28, f=23) Farmers trial | | THASGAM-Ladakh (n=32, f=27) Farmers trial | | DRASS-Ladakh (n=38, f=31) STATION TRIAL | | MAR&ES-Ladakh (n=33, f=21) STATION TRIAL | | GM PORA-Ladakh (n=37, f=33) STATION TRIAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring | POSITIVE VOTES | Preferential Scoring |
| G1 | 2 | -0.99 | 3 | -0.54 | 1 | -0.86 | 2 | -0.12 | 4 | -0.01 | 1 | -0.78 | 5 | -0.52 |
| G2 | 3 | -0.89 | 2 | -0.43 | 3 | -0.45 | 4 | -0.12 | 5 | -0.64 | 3 | -0.63 | 7 | -0.36 |
| G3 | 24 | 0.86 | 26 | 0.87 | 23 | 0.79 | 26 | 0.87 | 29 | 0.89 | 19 | 0.51 | 30 | 0.91 |
| G4 | 8 | -0.27 | 9 | -0.38 | 6 | -0.78 | 9 | -0.14 | 10 | -0.02 | 2 | -0.71 | 9 | -0.52 |
| G5 | 11 | -0.12 | 10 | -0.57 | 9 | -0.11 | 11 | -0.13 | 13 | -0.20 | 10 | -0.10 | 8 | -0.31 |
| G6 | 9 | -0.37 | 8 | -0.71 | 10 | -0.01 | 12 | -0.13 | 14 | -0..45 | 11 | -0.03 | 6 | -0.38 |
| G7 | 20 | 0.65 | 19 | 0.63 | 22 | 0.78 | 24 | 0.82 | 26 | 0.81 | 15 | 0.12 | 25 | 0..87 |
| G8 | 13 | 0.11 | 15 | 0.47 | 14 | 0.23 | 17 | 0.69 | 12 | 0.02 | 8 | 0.31 | 12 | 0.04 |
| G9 | 12 | 0.09 | 11 | 0.01 | 8 | -0.12 | 15 | 0.52 | 20 | 0.69 | 12 | 0.06 | 10 | -0.28 |
| n = Number of farmers assembled; f = Effective number of farmers who participated in preferential scoring | | | | | | | | | | | | | | |

**Table 4.** Farmer's preference ranking (scoring) of different test varieties of Buckwheat at seven location of Ladakh

| | Indidual Ranks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Genotypes code | MOTHER TRIALS | | | | GRAND MOTHER TRIALS | | | RANKS and Pooled Score | | |
| | KARGIL Farmers trial | BATTALIC Farmers trial | LANCHARCHY Farmers trial | THASGAM Farmers trial | DRASS STATION TRIAL | MAR&ES STATION TRIAL | GM PORA STATION TRIAL | Cumulative Rank | Average Of ranks | Pooled preference score |
| G1 | 9 | 8 | 9 | 9 | 9 | 9 | 9 | 62 | 6.88 | -3.82 |
| G2 | 8 | 9 | 8 | 8 | 8 | 7 | 7 | 55 | 6.11 | -3.52 |
| G3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 0.77 | 5.7 |
| G4 | 4 | 6 | 7 | 7 | 7 | 8 | 6 | 45 | 5 | -2.82 |
| G5 | 6 | 5 | 5 | 6 | 5 | 4 | 5 | 36 | 4 | -1.54 |
| G6 | 5 | 7 | 4 | 5 | 4 | 5 | 8 | 38 | 4.22 | -2.08 |
| G7 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 14 | 1.55 | 4.68 |
| G8 | 3 | 3 | 3 | 3 | 6 | 6 | 3 | 27 | 3 | 1.69 |
| G9 | 2 | 4 | 6 | 4 | 3 | 3 | 4 | 26 | 2.88 | 0.97 |
| Standard Error | SE = Standard error | | | | | | | 4.03 | 0.75 | 0.46 |

**Table 5.** Cumulative/average

# CONCLUSION

AMMI significantly influenced (p <0.01) the yield of buckwheat seed from a combined analysis of variation, genotypes, environment and GEI. Therefore, the result indicates that the bauxite genotypes for the seed yield are genetically variable, and their response locations vary as the test locations are completely variable. GGE Biplot recognizes two major distant mega environments as well as their specially adapted lines. GGE Biplot reports that G3 is the highest yielding and stable genotype, and that G3 is considered the ideal genotype by comparative biplot. However, AMMI biplot analysis showed that almost all good dinner genotypes were adapted specifically for the test sites. PVS is a fast and inexpensive way to identify farmer-preferred farmers if there are appropriate agricultural options, and this breeding method is intended to achieve our goals: reproduction, conservation, expansion, and identification of high yielding genotypes. Very useful (G3 and G7), it has been very challenging for buckwheat commercial growers over the past two decades. The main reason that this crop is on the brink of extinction is that the experiment now protects the crop on the brink of extinction in the Ladakh Himalayas and some tribal areas of Kashmir because its seed is highly nutritious and demanding it will improve the economy and lilihood od farmers.

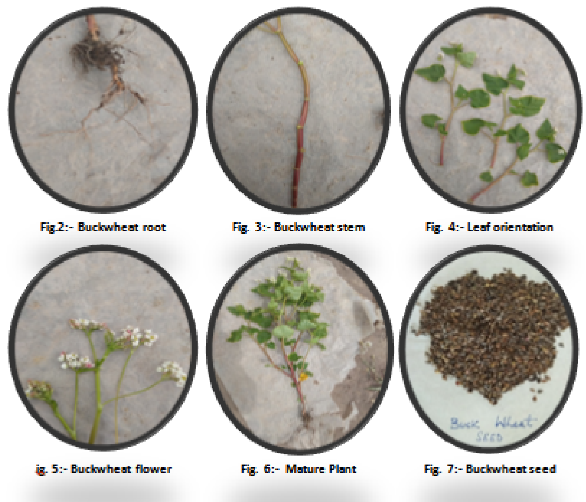


Fig. 8:- Different parts of buckwheat Plant

# REFERENCES

1. Ahmad M Zafar G., Mir S.D., Dar Z.A., Razvi S.M., Iqbal S., and Habib M, Genetic analysis for fodder yield and its important traits in oats (Avena sativa L.). Indian Journal of Genetics and Plant Breeding. (2014), 74(1):112-114

2. Ahmad M., Faizan Ahmad G. Zaffar Eajaz Ahmad Dar, Shahid Qayoum, Tawsaif A. Wani A. A. Lone Iqbal S., and Majeed A et al, Buckwheat (Fagopyrum esculentum) - nutritive and health promoting crop of tribal people: strategies for revival in the face of extinction in Ladakh. (2019). SKUAST Journal of Research 21(2): 115
3. Ahmad M. Ahmad F. Ahmad EA, Breeding Strategies and Conservation Techniques for Improvement of Buck Wheat under Cold Arid and High Altitude Conditions of Ladakh, Jammu and Kashmir. International journal of Pure and Applied Bioscience. (2018), 6 (1): 246-257
4. Romanova, O. Koshkin., V. Photoperiod response of landraces and improved varieties of buckwheat from Russia and from the main buckwheat cultivating countries. In: Dobranszki, J. (Ed.), Buckwheat 2. Eur. J. Plant Sci. Biotechnol. 4 (Special Issue 1), (2010), 123–127.
5. Hara T. Iwata H. Okuno K. Matsui K. Obsawa R. QTL analysis of photoperiod sensitivity in common buckwheat by using markers for expressed sequence tags and photoperiod-sensitivity candidate genes. Breed. Sci. (2011), 61, 394–404.
6. Ahmad, M. Ahmad F. Dar Evaluation of Buck Wheat (Fragrarium esculentum) genotypes under high altitude cold arid regions of Kargil (J&K). International journal of Pure and Applied Science (2018), 8 (3) 220-228
7. Ahmad M. Ahmad F. Dar EA, Buch Wheat (Fagopyrum esculentum) -A Neglected Crop of High Altitude Cold Arid Regions of Ladakh: Biology and Nutritive Value. Int. J. Pure App. Biosci (2018), 6 (1): 395-406 (2018)
8. Kempton RA, The use of biplots in interpreting variety by environment interactions. Journal of Agricultural Science (1984), 103: 123-135.
9. Uzma Mehraj, Ahmad, M Participatory breeding of forage oats in Kashmir valley. Indian Journal of Genetics and Plant Breeding. (2016), 76(2):217-220
10. Ahmad, M. Zafar, G., Razvi S.M., Dar Z.A. Genetic analysis for beta glucan, grain protein and other important traits in oats (Avena sativa L.). Indian Journal of Genetics and Plant Breeding. (2015), 75(1):136-139
11. Ahmad M. Zafar G., Wani BA, Genotype x environmental interaction and stability analysis for grain quality and yield in oats (Avena sativa L.). Electronic Journal of Plant breeding (2016), 7(4): 1132-1135.
12. Saleem N., Ahmad M. Vashnavi R. Bukhari A. and. Dar ZA Stability analysis in Wheat: An application of additive main effects and multiplicative interaction. African Journal of Agriculture Research, (2015), 10(4): 295-300.
13. Zeleke A. Sentayehu A. Seed Yield Stability and Genotype × Environment Interaction in Common Bean (Phaseolus vulgaris L.) Varieties in Dawro Zone, Southwestern (2017), 26(5);221-224
14. Gauch HG., Zobel RW AMMI analysis of yield trials. In M.S. Kang & H.G. Gauch, eds. Genotype-by-environment inter action, (1996), 85-122. Boca Raton, FL, CRC Press.
15. Eberhart SA. Russell WA, Stability parameters for com- paring varieties. Crop Science (1966), 6: 36– 40.
16. Witcombe JR. Joshi KD. Gyawali S. Musa A M. Johansen C. Virk DS. and Sthapit BR et al, Participatory plant breeding is better described as highly client-oriented plant breeding. Four indicators of client-orientation in plant breeding. Exp. Agric (2005), 41: 299-319
17. Gauch HG. Model selection and validation for yield trial with interaction. Biometrics (1988), 44: 705-715.
18. Zobel, RW. Wright JM, and Gauch JH. Statistical analysis of yield trial. Agronomy. Journal, (1988), 80:388 393.
19. Crossa J Statistical analyses of multilocation trials. Advanced Agronomy (1990), 44: 55–85.
20. Hongyu k. Garcıa-Pena Kempton RA, The use of biplots in interpreting variety by environment interactions. Journal of Agricultural Science (1984), 103: 123-135.
21. Zobel, RW. Wright JM, and Gauch JH. Statistical analysis of yield trial. Agronomy. Journal, (1988), 80:388 393.
22. Crossa J, Statistical analyses of multilocation trials. Advanced Agronomy (1990), 44: 55–85.
23. Dehghani H. Sabaghpour SH. Ebadi A, Study of genotype × environment interaction for chickpea yield in Iran. Agronomy Journal (2010), 102: 1–8.
24. Yan W. Hunt LA.,Sheng Q and Szlavnics Z, Cultivar evaluation and mega-environment investigation based on the GGE biplot. Crop Science. (2000), 40: 597-605.
25. Yan W and Rajcan, Biplot analysis of test sites and trait relations of soybean in Ontario. Crop Climatological Information for Kargil, Ladakh", Hong Kong Observatory, 2018 (2002)
26. Ahmad M. Zaffar G. Mehraj U. Stability analysis for forge quality traits in Oats (Avena Sativa L.) over environments. International Journal of Science and Nature. (2015), 6(4); 590-595
27. Hara T. Iwata H. Okuno K QTL analysis of photoperiod sensitivity in common buckwheat by using markers for expressed sequence tags and photoperiod-sensitivity candidate genes. Breed. Sci. (2011), 61, 394–404.
28. Woyann LG, Milioli AS, Bozi AH , Repeatability of associations between analytical methods of adaptability, stability, and productivity in soybean. Pesq Agropec Bras. (2018), 53(1):63-73.
29. Szareski VJ, Carvalho IR, Demari GH, Pelissari G, Path analysis applied to agronomic traits of contrasting growth habit soybeans. Aust J Crop Sci. (2018), 12(4): 531-538.
30. Zobel, RW. Wright JM, and Gauch JH. Statistical analysis of yield trial. Agronomy. Journal, (1988), 80:388 393
31. Ahmad, M., Faizan Ahmad, Ejaz Ahmad Dar, Rizwan Rashid, Shahnowa Ahmad, MH Khan, Rohie Hassan and NR Sofi et al, Stability and Scrutiny Using (Ammi): Model of Bread Wheat Over the Years in Cold Arid Harsh Conditions of Kargil and Zanaskar (Ladakh)- India. Acta Scientific AGRICULTURE (2019), 5(10)-1-11 (IF 0.74)
32. Zhou M, Kreft i. Woo SH. Chrunqoo N. Wieslander G, Molecular breeding and nutritional aspects of Buckwheat. Academic Press; (2016), 299-320. ISBN: 978-0-12-80369-2-1 Elsevier Inc.
33. Ahmad M. Ahmad F. Zaffar G. Buckwheat (Fagopyrum esculentum) - nutritive and health promoting crop of tribal people: strategies for revival in the face of extinction in Ladakh. SKUAST Journal of Research (2019), 21(2): 115-127
34. Hongyu k. Garcıa-Pena Kempton RA, The use of biplots in interpreting variety by environment interactions. Journal of Agricultural Science. (1984), 103: 123-135.