1. Identifying Information:

Project title:	Village Based Participatory Breeding in the Mountain Slopes of Yemen
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Reporting period:	April 1st, 2001 – March 31st, 2002
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2. Achievements and Constraints:

In the three villages selected in the project area in the Northern Highlands (Hasn Azan, Bit Al-Wali and Al-Ashmor) and described in the 2000 reports, the farmers tested the barley and the lentil lines they selected during 2000. The six most promising barley lines were planted in the tree villages, including the local check. Only one line (Al-Erra 60) was common to all three villages, three lines were common to two villages and the other two were unique to a specific village. In the case of lentil, the number of lines was 7 in Hasn Azan, 8 in Al-Ashmor and 11 in Bit Al-Wali. The breeding material included both landraces and exotic germplasm. The total number of different lines was 17 out of the initial 50. All trials were planted in two replications and each entry was planted in plots of 10 rows at 25 cm distance and 5m long.

Both men and women conducted selection, individually and in groups of various sizes in both the barley and the lentil trials. In the barley trials, individual selection was conducted by 25 individual farmers (12 men and 13 women), by three groups of men, and by five groups of women. In the lentil trials, selection was conducted by 31 individual farmers (12 men and 19 women), and by four groups of men and 10 groups of women. The size of the groups varied from a minimum of 2 to a maximum of six persons.

The data were analyzed by GENSTAT using a new program developed at ICARDA. The environmentally standardized BLUP's (Best Linear Unbiased Predictors) were use to analyze genotype x environment interactions using clustering and ordination procedures (with the software GEBEI). Eventually, farmers' and breeders' selections were compared using similarity analysis. As in the previous year, we used the Euclidean distance as coefficient of similarity because this allows the use of the actual scores given by the participants. Both the farmers and the breeders scored all the entries in both replications, and therefore the average scores were used in the similarity analysis.

In 2001, the project was extended to the Central Highlands, which is a very different agro ecological environment from the terraced-agriculture of the Kuhlan Affar area. The barley trials were planted in three villages (Yarim, Balasan and Anis), while the lentil trials were planted only in Yarim and Balasan. Both the lentil and the barley trials were also planted in the research station at Dhamar, where most of the research for the Central Highlands is conducted, and where the headquarters of AREA are located.

The barley trials included 14 entries in Yarim, 15 in Balasan, 16 in Anis and 23 on station. Only six entries were tested at all locations, six were tested in three of the four

locations, nine in two of the four locations, and 4 in one locations only. The trials were conducted in two replications and with a plot size of 4 rows at 25 cm distance and 2m long.

The lentil trials included 20 entries common to all three locations and were conducted as described for barley.

Both the breeder and the farmers (men and women) conducted visual selection in the three villages. The total number of farmers involved in individual selection was 23 (16 men and 7 women) in barley and 14 (10 men and 6 women) in lentil. Farmers also conducted selection in groups of males (5 in barley and 3 in lentil) and females (6 in barley and 3 in lentil) as well as in groups of husband and wife together (8 in barley and 3 in lentil). A number of traits were measured in each plot, and the data were analyzed using the methods described earlier.

The socio-economic and Gender Analysis Survey on Participatory Households continued in Kuhlan Affar and Dhamar. This survey started in September 2001. Data collection was done by four women in Kuhlan Affar and by three women in Dhamar. Data collection proved to be hard due to the difficulty of communication with farmers especially with women who are not used to sit for long time responding to 'unusual' questions as they said. Contrary to other males research teams who collect information in the rural areas of Yemen, this group of women is mainly composed of extension agents, and need some additional practice in data collection in addition to some gender background that will help them understand the meaning of the questions. The analysis of these data is still in progress.

In lentil, a number of lines out yielded the local cultivars both in grain yield and in total biomass in the three villages in Kuhlan Affar: in Al-Ashmor, the yield increases of the best two lines was 97-98% for grain yield and 27-33% for biomass, in Bit Al-Wali it was 48-66% for grain yield and 52-63% for biomass, and in Hasn Azan it was 52% for grain yield and 15-48% for biomass.

The farmers selected exclusively the landraces (YG-35008 both in Al-Ashmor and Bit Al-Wali, YG-35007 and YG-NH in both Al-Ashmor and Hasn Azan, YG-3522 in both Bit Al-Wali and Hasn Azan, and YG-35014 in Bit Al-Wali).

The similarity between farmers' and breeder's selections was calculated using the mean of the scores given by the various participants. In both Al Ashmor and Bit Al-Wali, the highest similarity was between the scores given by the individual men and women, including the breeder and the group of male farmers, while the highest dissimilarity was between the selections made by the three groups of women and all other participants. The highest overall diversity between the selections made by the various participants was found in Hasn Azan. The selections made by all male farmers, the breeder (a male) and by some women, both as individual and in-group, clustered together with a very strong similarity. All the other six individual women, and two women's' groups were dissimilar from the previous cluster and also dissimilar among them.

The selection criteria used by the various participants were analyzed by calculating the simple correlation coefficients between the score of the participants and the mean of the traits scored in the breeding material. In Al Ashmor and Bit Al-Wali, all the correlation coefficients were identical because all the participants selected the same lines. The two selection criteria used by the participants were the height of the first pod and the number of pods per plant. In Hasn Azan, the number of pods per plant was the main selection criterion used by all participants. There was a slightly stronger correlation between the

scores of the breeder and the average score of the male farmers than between the scores of the breeder and of the male farmers and the average scores of the women.

In the Central Highlands the trials included a new set of entries and were conducted in incomplete blocks, with two replications and plot size of 4 rows at 30 cm distance and 2m long. On station, only the breeder conducted selection, while in the two villages the selection was conducted by the breeder and the farmers, both men and women. The total number of farmers involved was 21 (13 men and 8 women) in lentil and 20 (10 men and 10 women) in barley. A number of traits were measured in each plot and the data were analyzed using the methods described earlier.

In Balasan, none of the lines out yielded the local check for grain yield, while two out yielded the local check for biomass yield. In Yarim, 10 lines out yielded significantly the local check for grain yield, and only three for biomass yield. Only two lines out yielded the local check for both grain and biomass yield. These had the same phenology of the local check, similar height, but many more pods per plant.

On station, only one line out yielded significantly the local check, but only for grain yield and harvest index. This line was one of the top yielding lines in Yarim, but in Balasan it yielded less than check.

Genotype x location interaction effects were large, but not as large as usual, and they explained about 58% of the variation of the environmentally standardized grain yield, while the differences between genotypes explained about 42%: Balasan was the location contributing most to the interaction effects, while the research station and Yarim discriminated the lines in a similar manner. Line YG-35007 had the best overall adaptation, while lines Precoz-4605 and AS-9 were well adapted to Balasan, and lines YG-350011, and to a lower extent lines AS-7 and AS-12 were better adapted to Yarim and the research station.

The similarity analysis showed that at Balasan the scores given by the breeder, two male farmers, and one group of male farmers clustered together. The group of female farmers tended to cluster together with the three couples of wife-husband who did the selection together. The other male farmers (two individuals and one group, was more similar to the second group than to the first. At Yarim, gender effects on selection were less evident. However, the breeder scores were always more similar to those of some male farmers than to those of any female farmer.

Few correlation coefficients were significant either in Balasan or Yarim. In Balasan, only the score of the breeder was positively and significantly correlated with grain yield. The scores of the farmers were all negatively correlated to either biomass yield or grain yield. The scores of the breeder were negatively correlated with plant height and positively correlated with the number of pods per plant. The male farmers had a strong preference for short plants and small seeds. This contrasted with the preference of the husband-wife couples for taller plants (although the correlation was not significant), and for lines with the first pod far from the ground level. The correlations coefficients between farmers' scores (regardless of the gender) and breeder's scores were always very low.

In Yarim, the breeder used the number of pods per plant as main selection criterion like in Balasan, while the male farmers, on average, selected for late flowering lines. None of the correlation coefficients between the average score of the women and the various traits was significant: the largest was the one with days to maturity (preference for early maturing types). The correlation coefficients between farmers' scores (regardless of the

gender) and breeder's scores were higher than in Balasan, and the one between the male farmers' score and the breeder score was positive and significant ($P<0.05$).

In barley, all the lines selected in 2000 and tested in 2001 out yielded significantly the check in Al Ashmor and Hasn Azan. In Al Ashmor, the best selection (Al Erra 60) yielded as much as 3 times more than the check. This line was also the highest yielding line in Bit Al Wali where it out yielded the check by 56%, and in Hasn Azan, where it yielded more than twice the local check. A second promising line was Al Erra 58, which was selected and tested only in Bit Al Wali and Hasn Azan, where it out yielded the local check by 25 and 119%, respectively. Al Erra 60 was the earliest entry in all three locations, and this together with its high harvest index could explain its superiority.

The most frequently selected entries by all participants were Al Erra 60 (in all the three locations), Al Erra 58 (in Bit Al Wali and Hasn Azan), and also Al Erra 20 and Al Erra 18 in Al Ashmor and ACSAD 1474 in Bit Al Wali.

Al Erra 60 and Al Erra 58 are being multiplied and the seed will be distributed to farmers for planting in the next cropping season.

As in the case of the lentil trials, the similarity between farmers' and breeder's selections was analyzed using the mean of the scores given by the various participants. Al Ashmor was the only village in which there was dissimilarity in selection despite the low number of entries. In Bit Al Wali and Hasn Azan, all the participants as well as the breeder selected the same entries.

Only few correlation coefficients between the visual scores and the various traits were significant due to the low number of degrees of freedom. In Al Ashmor, the highest correlation coefficients were between the visual scores and grain yield, biomass yield, the number of seeds/spike, and harvest index. Also, the correlation coefficients between the visual score were high, positive and significant. The strongest disagreement seems was about plant height, which was negatively correlated with the visual score of the breeder but positively correlated with the visual score of both male and female farmers.

In Bit Al Wali, the correlation coefficients were similar across the participants. The only significant correlation coefficients were those between the visual score and grain yield, but there was a strong correlation with biomass yield and with plant height. The latter seems to be an important selection criterion for the breeder and for the farmers, both men and women.

In the barley trials planted in the Central Highlands locations, a number of promising lines were identified. In Yarim, two lines out yielded the local check (by 20 and 7%, respectively), and only one of the two out yielded the check also for biomass yield. Although these lines were developed from crosses involving the earliest parents available at ICARDA, none of the lines matched the earliness of the local check

In Balasan, several lines yielded as well as or more than the local check: two of the three top yielding lines were common to the top yielding lines in Yarim, and these had a phenology very similar to the local check. In Balasan most of the lines had better tillering, more seed per spike and longer spikes than the local check.

In Anis, five lines yielded about twice as much as the local check. With one exception, the top-yielding lines in Anis had a low ranking or were not tested (because not selected the year before) in the other locations.

Eventually, on the research station at Dhamar, the local check was not included among the test entries, and among the top yielding lines only one was common with the top 10 in another location (Balasan).

The similarity analysis revealed different patterns in different locations. In Balasan, the breeder's selections clustered with one of the male farmers groups. This cluster was dissimilar from the selections made by all the other participants. In Yarim, the breeder's selections clustered with one of the women's groups. This cluster was closer to two individual male farmers and different from the selections of all the other participants. In Anis, the selection of most of the male farmers and of the breeder tended to cluster together, similarly to some of the women selections, either individually or in groups. However, the clustering by gender was far from being perfect and there are cases of women's selections clustering together with males' selections and vice versa.

In Yarim, the women had a strong preference for early flowering and early maturing lines, while none of correlation coefficients between the breeder's score or the average scores given by the man and the agronomic data were significant. The correlation coefficient between the male score and the breeder score was larger than those with the women's scores. Few correlation coefficients were significant in Balasan, where the strongest correlation was between the score given the males and those given by women. Also, the correlation coefficient between the scores given by the farmers (men) was the only to be positive and significant indicating that in this location the male farmers were more effective than the breeder and the female farmers in identifying the highest yielding entries. By contrast, the scores given by the women were negatively correlated with the number of seeds/spike, but this did not affect the correlation with grain yield that was positive even if not significant.

The difficulties in maintaining reliable communications between from Aleppo and Dhamar continued to be one of the main constrains in interacting with scientists in Yemen.

3. Implication to the workplan

The work plan for 2001 was successfully implemented and the breeding component of the project has been concluded (the next cropping season falls outside the extension period granted to the project). The main outputs can be summarized as follows:

1. Information
2. Institutional impact
3. Women Participation
4. Identification of new varieties

Information
The project has generated a wealth of information on farmer preferences in some of the most remote areas of Yemen. It has also increased the awareness of the farmers of what plant breeding can offer and thus has created a demand for this type of work in other crops.

Institutional Impact
Although this project was one of the smallest handled by AREA (Agricultural Research and Extension Authority), it had a conceptual and cultural influence on the entire Institute. As a consequence, other projects started to incorporate participatory components, and participatory research is likely to become a common conceptual platform for AREA's activities.

Women participation
Among the participatory breeding projects' in which ICARDA collaborates, this was the only one with some degrees of women participation. This is likely to be associated with both a large presence of women in the extension service, and to the commitment of the regional coordinator (Mr. A. Lutf) who was able to create and to exploit opportunities for the participation of women.

Identification of new varieties
The project has generated new promising lines of both barley and lentil, which in the Kuhlan Affar went through three cycles of selection. These lines are now being multiplied to provide farmers with enough seed in the July 2002 planting. In the Central highlands we have conducted two cycles of selection. If resources allow, one more cycle of selection will be conducted on the lines selected by the farmers in the two previous cropping seasons.

During the next period (April 1st – June 31st, 2002), the following activities will take place:
1. An additional cycle of seed multiplication of the promising entries;
2. Fabrication at ICARDA and dispatch to Yemen of one or two plot thresher to make available to two villages in the Kuhlan Affar area;
3. Completion of the gender survey

4. Communications and Dissemination of Information:

The project was part of the presentation made by S. Ceccarelli at the workshop on "In-situ conservation of Agrobiodiversity" (Lima, Peru, 14-17 August, 2001), of the presentation made by A. Lutf at the National Coordination Meeting (Sana'a, Yemen, September 16, 2001), of the presentations made by S. Ceccarelli and A. Lutf at the "Food Barley Improvement Workshop" (Tunis, Tunisia, 14-17 January 2002, and of the training course on "Participatory Plant Breeding and Agrobiodiversity Conservation" (Amman, Jordan, March 17-20, 2002).

A video illustrating the different steps of PPB approach in inter-mountain plain was prepared with the collaboration of the Department of Communication.

5. Additional Comments:

The national coordinator visited ICARDA at the beginning of 2002 to analyze the data, and to prepare the first draft of the report, while S. Ceccarelli, S. Grando and M. Martini visited the project sites in September 2001, and M. Martini visited the Gender Analysis team in February 2001.