Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation

GTZ Project No. 95.7860.0-001.13

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(ICARDA)

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Part 1. PROJECT SUMMARY

Title: Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation

Objectives of research

1. Improved barley varieties that fulfill the needs and objectives of poor farmers in the marginal rainfed environments.
2. Enhanced rate of adoption of new varieties through farmers' participation in selection and testing.
3. A participatory approach to breeding barley for stress conditions.

Abstract

Breeding philosophies and methodologies developed for favorable conditions and high input agriculture have been ineffective in generating improved cultivars for marginal conditions and low input agriculture. The proposed program will develop and implement a novel breeding approach for barley improvement in low potential, marginal rainfall environments of northern Syria based on: (a) early selection and testing under real farmer conditions, (b) use of farmers' selection criteria, (c) use of market derived economic criteria during both selection and testing, and (d) validation and quantification of grain and straw qualities used as selection criteria. The research will utilize the subjective assessments of producers and consumers to establish objective indicators of crop quality.

The expected outputs include increased adoption of new varieties in low-input agriculture and crop quality indicators, which are appropriate to the needs of producers and consumers. The new breeding program, targeted at marginal conditions and low-input agriculture, will move selection and testing work outside experiment stations and put breeding into the hands of farmers. We expect that, even in a relatively small geographical area, farmers will tend to exploit specific adaptation. Specific adaptation benefits biodiversity through selection and spreading of a number of different cultivars, instead of the few, often closely related, cultivars characteristic of conventional breeding for wide adaptation.

IARC programme and unit: Germplasm Enhancement and Breeding: Project 1.1 Barley Improvement, within the Germplasm Program of ICARDA

IARC project coordinator: Dr. Salvatore Ceccarelli, Barley Breeder, Germplasm Program

Collaborating institutions: Institut für Agrar- und Sozialökonomie in den Trope und Subtropen, University of Hohenheim, Germany
Agricultural Research Center, Ministry of Agriculture and Agrarian Reform, Syria

Project scientists (financed): Proportional time commitment of senior ICARDA staff
One National professional Officer, ICARDA
One Ph.D. student, University of Hohenheim
Research Technician at ICARDA

Project duration: January 1, 1996 to December 31, 1998
Approved no-cost extension through December 31, 1999

Budget summary (in US$):

	1st Year	2nd Year	3rd Year	Total
ICARDA	244,500	208,000	129,000	581,500
Hohenheim	45,200	35,600	0	80,800
Total	289,700	243,600	129,000	662,300
DM (at exchange rate of DM 1.49)	431,653	362,964	192,210	986,827

Part 2. ANALYTICAL SUMMARY

1. Identifying Information

Project No.: 95.7860.0-001.13	*Date:* January 1999
Title: Farmer Participation and Use of Local Knowledge in Breeding Barley for Specific Adaptation	*Reporting period*: January-December 1998
Reporter: Dr. S. Ceccarelli, Barley Breeder, Germplasm Program, ICARDA Project Coordinator	*Address*: ICARDA, P.O. Box 5466, Aleppo, Syria *Tel:* +963 21 2225112 *Fax* +963 21 2213490

2. Project Characterization

Characteristics of research	Increasing Productivity	Environmental Protection	Biodiversity	Policy & Socioeconomic Research	Strengthening National Programs
Basic +strategic	60	20	60	80	50
Adaptive-on farm	25	80	30		
Networking					
Training	10		10	20	50
Information	5				
Other					
	100	100	100	100	100

3. Achievements and Constraints

The major achievements during the reporting period were:

1. The interest of the farmers for participatory work increased considerably during 1998 and some of them enquired about the future of the project.
2. In the case of one farmer there was a considerable change in relationships and during 1998 the farmer's wife started to participate in the discussions.
3. The changes in preferences (both by farmers and breeders) observed under two different rotations indicated an important (yet unplanned) advantage of decentralized breeding, namely the possibility of adapting the breeding material to the changes occurring in the farming systems and agronomic practices in the target environments.
4. Decentralization has a more important role than participation in maintaining/enhancing genetic diversity.

The major constraints were:

1. the tragic loss of one research assistant and the resignation of one research technician in the barley project.
2. one of the participating farmers developed a poor relationship with the neighbors and the organization of the group selection in that site failed.
3. due to (1) the supervision of the activities during the harvesting was not as effective as in 1997, and in one location (Bari Sharki) the crop was harvested before the breeder did his selection.
4. the persistent unfavorable exchange rate.

4. Implications from Current Reporting Period.

1. The farmers are keen to continue with the selection activities, but some expressed concerned that the methodological requirements of the project imply that they grow not only their selections but also the selections of the breeder.
2. There is still some reluctance from some farmers to make the seed of the best entries available to the neighbors.
3. The information collected during 1998 indicates that a number of neighbor's farmers are interested in having these trials in their fields. This should be make possible to switch from an individual to community participation.

5. COMMUNICATION AND DISSEMINATION OF INFORMATION

1. Dr. S. Ceccarelli gave seminars both at ICARDA and at FAO on decentralized and participatory plant breeding and a short presentation at the Meeting of the CGIAR Genetic Resources Policy Committee in Aleppo (May 2-4, 1998)
2. Dr. S. Grando gave a presentation on participatory plant breeding at the National Coordination Meeting Morocco/ICARDA in Rabat.
3. Dr. S. Ceccarelli attended the Seminar "Assessing the Impact of Participatory Research and Gender Analysis" in Quito (September 6 - 9) to finalize the small grant projects supported by the System Wide Program on Participatory Research and Gender Analysis.
4. A manuscript entitled "A Methodological Study on Participatory Breeding. I. Selection phase." has been submitted to Euphytica for publication.
5. Part of the work of the project has been utilized in a Chapter of the book "Broadening the Genetic Bases of Crop Production" that will be published jointly by FAO and IPGRI titled "Decentralized Plant Breeding for Marginal Environments".
6. Two new project proposals, both inspired by this project, were prepared: one for Jordan currently considered by IDRC for funding, and one for Egypt, to be submitted to a donor shortly.

6. Status of Work Programme

	Work Plan for current reporting period	Work Plan for next reporting period	
Work Programme	Jan 01 - Dec 31,1998	Jan 01 - Dec 31,1999	Remarks
Component 1	Concluded		Concluded
Component 2 Output 1	a) observation and analysis of farmers' selection criteria b) relationship between the two selection cycles	a) observation and analysis of farmers' selection criteria b) relationship between the selection cycles	Continuing
Output 2	a) desirable characteristics verified during selection both by individual farmers and farmers' groups b) one or more validated lists of desirable characteristics	a) desirable characteristics verified during selection both by individual farmers and farmers' groups b) one or more validated lists of desirable characteristics	Continuing
Output 3	a) observation and analysis of perception of g x e interaction by comparing lines selected in different environments	a) observation and analysis of perception of g x e interaction by comparing lines selected in different environments	Continuing
Component 3	a) validation of the model	Concluded	
Component 4	a) selection by farmers and breeders in farmers fields and in the experiment stations b) lines selected by farmers and breeders	a) selection by farmers and breeders in farmers fields and in the experiment stations b) initial adoption of some lines	
Component 5	a) multiplication of the most promising lines for feeding trials b) analysis of data on straw and grain quality on each of the lines in 1997/98 season and correlation with farmers and breeder selection	a) multiplication of the most promising lines for feeding trials b) analysis of data on straw and grain quality on each of the in 1998/99 season and correlation with farmers and breeder selection	

7. Status of Funding

Please refer to Financial Report submitted separately.

Part 3. SCIENTIFIC SUMMARY

1. Component 2: Indigenous Knowledge

1.1 *Methodology*

During the field selection of lines made by groups of farmers and their neighbors, each participating farmer was asked two types of questions:

Quantitative questions: What is the score for this plot (line)?
(The answer was standardized from 0, the lowest, to 4, the highest).

Qualitative questions:

- What are the reasons for the score given to this plot?
- How do you like/dislike the barley in this plot?
- How do you like/dislike the seed?
- Why do you think so?
- What do you think of the head, stem, tiller, color of grain and grain size?
- Is this homogeneous/heterogeneous in size, color, height, etc.? If so, do you like it or not? (The previous question was asked if a farmer hadn't given any reason).
- Is there anything else you would like to mention about this plot (line)?

In addition, farmers were requested to provide information on sources of income, farm size, types of crops, etc., as the basis for examining whether these factors affect the farmers' preferences during selection.

1.2 *Farmers' Characteristics*

It was considered that one of the most important factors that may affect a farmer's selection criteria is the extent to which crop sales contribute to farm income (Table 1.1). Two farmers in Ibbin and Ebla, the two wettest locations, rely solely on crop sales while the majority of farmers obtain income from both crop and livestock production, as well as from off-farm activities. Although the percentages change from one site to the other, more than half of the farmers rely on three different sources of income.

Table 1.1. Main Source of income in % in each location (ranked by mean rainfall)

Location	Rainfall(mm)		Crop Sales (%)	Livestock Sales(%)	Off-Farm Income(%)
	Mean	97-98			
Ibbin	350	418	100	0	0
Ebla	350	368	100	0	0
Sauran	300	329	75	0	25
Tel Brak	290	298	50	30	20
Jurn El Aswad	285	202	95	0	5
Bari Sharki	270	316	50	20	30
Al Bab	260	269	29	1	70
Melabiye	253	167	60	20	20
Baylonan	250	200	60	30	10

The area planted with barley varies considerably between farmers, ranging from a maximum of 110.5 ha to a minimum of 1.5 ha (Table 1.2). The area allocated to barley is not a function of farm size, as can be seen from the percentage areas presented in Table 1.3. The percentage area planted to barley depends on both rainfall and the availability of water (see % area irrigated in Table 1.3), which permits greater crop diversification in drier areas. Farmers in higher rainfall areas (e.g., Sauran) or with access to irrigation (e.g., Melbiye, Tel Brak and Jurn El Aswad) allocate a greater area to wheat and other crops.

Table 1.2. Allocation of cropped area to different crops (hectares)

Location	Total (ha)	Barley (ha)	Wheat (ha)	Legumes (ha)	Trees (ha)	Other (ha)	Fallow (ha)	Irrigated Area (ha)
Baylonan	150.5	110.5	40.0	0.0	0.0	0.0	0.0	0.0
Tel Brak	360.0	103.0	122.0	0.0	0.0	35.0	100.0	157.0
Ebla	86.0	30.0	20.0	19.0	1.0	16.0	0.0	0.0
Bari Sharki	44.0	12.0	2.5	8.0	8.0	1.5	12.0	4.0
Melabiye	34.0	10.0	12.0	0.0	0.0	9.0	3.0	21.0
Jurn El Aswad	39.5	6.5	20.0	2.5	1.5	5.0	4.0	15.0
Sauran	10.0	6.0	0.5	1.0	2.5	0	0	0
Ibbin	169.0	5.0	43.0	40.0	1.0	40.0	0.0	40.0
Al Bab	12.0	1.5	7.0	3.0	0.5	0.0	0.0	0.0

Table 1.3. Allocation of cropped area to different crops (% of total cropped area), ranked by % area in barley

Location	Total area (ha)	% of total area						
		Barley	Wheat	Legumes	Trees	Others	Fallow	Irrigated
Baylonan	150.5	73.4	26.6	0.0	0.0	0.0	0.0	0.0
Sauran	10.0	60.0	5.0	10.0	25.0	0.0	0.0	0.0
Ebla	86.0	34.9	23.3	22.1	1.2	18.6	0.0	0.0
Melabiye	34.0	29.4	35.3	0.0	0.0	26.5	8.8	61.8
Tel Brak	360.0	28.6	33.9	0.0	0.0	9.7	27.8	43.6
Bari Sharki	44.0	27.3	5.7	18.2	18.2	3.4	27.3	9.1
Jurn El Aswad	39.5	16.5	50.6	6.3	3.8	12.7	10.1	38.0
Al Bab	12.0	12.5	58.3	25.0	4.2	0.0	0.0	0.0
Ibbin	169.0	3.0	25.4	23.7	0.6	23.7	0.0	23.7

Based on the information on farm size, area planted to barley and sources of income, the nine participating farmers are grouped in a 2 x 2 matrix shown in Table 1.4. The nine farmers are almost evenly allocated between the four categories. It should be noted that the farmer in Tel Brak, classified as "large-scale, on farm use", also owns a chicken farm, and barley is used to feed not only sheep but also chickens.

Table 1.4. Matrix of selection sites classified by farm size and crop use.

	Purpose of growing barley	
Barley area	Commercial (for sale)	On-farm use (livestock)
Large	Ebla, Sauran	Tel Brak, Baylonan
Small	Ibbin, Jurn El Aswad, Al Bab	Melabiye, Bari Sharki

1.3 *Analysis of farmers preferences*

The analysis of the quantitative scores made during selections is presented under Component 4. In this section, we present the results of the analysis of the qualitative assessment of the breeding material tested in 1997/98.

All the characters were translated literally into English, coded (from A1 through N50), sorted into categories such as head, stem, color, height, etc. and tabulated accordingly. The descriptors were also adopted from farmers' comments and translated. These are presented in a summarized form in Table 1.5, according to three different values, i.e., positive, negative and neutral. Descriptors that were mentioned by the farmers as a reason for raising the score were classified as "positive", while those descriptors that lowered the score by farmers were classified as "negative". Any description

that was mentioned by farmers, but had no apparent positive or negative affect on scoring, was listed as "neutral".

Thus, the descriptors in Table 1.5 represent farmers' preferences. In some cases aspects of different characters are inter-related. For instance, for row characters, six rows is included as a negative descriptor, because farmers rejected lines with six rows or remarked that six row barley lines were undesirable, for the reason that the grain and straw of the six row barley is considered to be less soft than those of two row barley. Softness of straw (palatability) is a major consideration of farmers when evaluating barley as a feed.

Table 1.5. Summary of the list of characters and farmers' descriptors used in evaluating lines

Characters	Positive descriptors (+)	Negative descriptors (-)	Neutral descriptors (N)
A: Height	Excellent, Good, Suitable for combine harvest, Homogeneous	Short, Unsuitable, Un-acceptable, Stunted, Heterogeneous	Medium
B: Grain	Excellent, Good, Full, Bigger, Heavy, Soft, Thin crust, Homogeneous-sized	Small, Weak, Thin, Little, Tough, Thick crust, Heterogeneous-sized	Medium softness, Medium weight
C: Straw	Good, Better, Soft	Inedible for sheep, Little, Tough	Medium
D: Head	Full, Unbent, Unbroken, Heavy, Good number of grains per head, Mature	Bent, Incomplete, Bad, Empty, Broken, Shattering, Weak neck	Medium
E: Color	Desirable, (Black/White) Heterogeneous	Undesirable (Black/White), Weak, Rejected, Homogeneous	
F: Row	Desirable two	Rejected six, Undesirable six	
G: Stem	Good, Thick, Strong	Thin, Weak, Bad	Medium
H: Tillering	Good, Excellent, High	Little, Below average, Weak	Medium
I: Maturity	Early, Homogeneous	Late, Early but attracts birds, Heterogeneous	Medium
J: Lodging	No	High, Expected	Medium
K: Productivity	High, Good, Profitable	Low	Medium
L: Adaptation	Tolerant to drought/ environmental conditions/ Suitable to dry region	Intolerant to drought, Needs more rain, unsuitable for this region	
M: Susceptibility	Unaffected by frost, Disease resistant	Affected by low temperature/natural factor	Affected by frost to some extent
N: General View	Good (Thick) vegetation, Good growth, Nice looking crop, Desirable for sheep	Very weak growth, Below average, Unacceptable for feed, Unsuitable for selling Stunted, Bad	Medium vegetation

In addition to the farmers' individual preferences, market preferences also have a bearing as they reflect demand and, therefore, are an indirect indicator of preferences. In the case of seed color, for example, market prices reflect differences in preferences between regions. In Hama province, where white seed is preferred, white seed is sold at a higher price than black seed. The situation is reversed in Raqqa and Hassake areas; the farmer from Malabiye told us that the market price for black seed was about twice that for white seed.

Farmers also have preference for different types of barley depending on end-use. For instance, the farmer in Tel Brak, who has a chicken production enterprise in addition to sheep, distinguishes between different types of barley for different uses: the black-seeded barley is used for sheep feed, as he believes that sheep prefer (eat more) of the black seeded barley and also that it is more nutritious, while the white-seeded barley is used for chicken feed.

Table 1.6 indicates how the positive descriptors actually mentioned by the nine host farmers during selection compare with their "ideal" descriptors of barley. Although the descriptions are not always exactly the same, most of the characteristics referred to are quite similar. It can be concluded that the farmers are, in general, consistent with their own stated ideal preferences when making selections in the field. Furthermore, there is evidence that the farmers' individual circumstances and their production objectives affect their preferences. In particular, characteristics associated with straw and feed quality are mentioned by most of the farmers who are producing barley for their livestock, and not at all by those who produce barley solely for sale.

For the plots (lines) with the top fifteen scores at each selection site, the frequency distribution of the barley characteristics was computed. The results for Tel Hadya (a relatively favourable site), Breda (a less favourable site) and in the farmers fields are shown in Tables 1.7, 1.8 and 1.9, respectively. In interpreting these tables, it is important to distinguish between the use of a characteristic as a criterion for selection by farmers, and the importance of that criterion in determining the top 15 selected lines. The percentage of farmers mentioning a certain characteristic gives an indication of the frequency in which that characteristic is used as a criterion for selection by farmers. The percentage of times that a characteristic was mentioned indicates how important it was in contributing to the selection by farmers of the top 15 lines at any given site.

To identify the most preferred characteristics, an index was computed as the average of Athe % of farmers who mentioned it" and Athe % of times a character was mentioned". All the characters mentioned by the farmers are displayed in descending order according to the value of the index. The total sample number ranged from 104 (farmers= field) to 134 (Breda). The maximum potential sample number was 135 (15 lines x nine farmers each) but some samples had to be discarded due to insufficient information in some of the answers.

Table 1.6. Ideal and Actual Descriptors in Farmers: Field

Location / Purpose	Zone	Positive descriptors in his field	Ideal descriptors for Barley	Reasons
Ibbin Crop sales	2	- Good productivity - (ditto) - No lodging under irrigation - (ditto) - Heavy grain weight - N/A - N/A - High market price	- Frost resistance - More tillering - No lodging - Suitable height - N/A - Early maturity - Disease resistance - N/A	- Better production - Better production - Suitable for combine harvesting and better yield - Suitable for combine harvesting - N/A - Unaffected by heat and can be harvested early - Better yield - N/A
Ebla Crop sales	2	 - High tillering - Good grain size - Heavy grain weight - Good length of heads - Early maturity	- Tall - Drought tolerant - Positive response to chemical fertilizer - Disease resistant - Non shattering of grain - White seeds	- Suitable for combine harvesting - Low precipitation - Better yield - ditto - ditto - High demand in the market
Tel Brak Crop sales Livestock sales (+chicken)	3	- Good grain size - Black seeds - Good tillers	- Good grain size - Heavy grain - Homogeneous grain size - N/A - Homogeneous grain color - Softness of grain - Good size of heads - Good tillers	- Better yield - Better production - Better market price - ditto - ditto - Better feed quality - ditto - ditto
Jurn El Aswad Crop Sales	3	- Drought tolerance - Good productivity	- Drought tolerance - Good heads - Suitable height - High tillering - Frost resistance - N/A	- Better production - ditto - Suitable for combine harvesting - More production - Better yield

Location / Purpose	Zone	Positive descriptors in his field	Ideal descriptors for Barley	Reasons
Baylonan Crop sales Livestock sales	2	- Good grain size - Drought tolerance - Desirable color (Abrash) - Desirable for feeding - Homogeneous height - Early maturity - Heavy grain - Good amount of straw	- Good grain size - Drought tolerance - Black Grain - Soft grain - Soft straw - Good height - N/A - N/A - N/A - High productivity	- Better production - Low precipitation in spring - Desired in the market - Good feed quality - ditto - Suitable for combine harvesting - Better production
Al Bab Crop sales Livestock sales	2	- High productivity - Desirable color (Abrash) - Suitable height	- High productivity - Abrash - Medium height - No lodging - High tillering	- Better production - Desirable as feed - Tolerant of lodging - Better production - ditto
Melabiye Crop sales Livestock sales	3	- No lodging - Drought tolerance - Good yield	- Strong and thick stem - Drought tolerance - Good yield - Tall heads - Big grain - Good height	- Tolerant of lodging - Low rainfall - More economic return - More grains - Better production - Suitable for combine harvesting
Bari Sharki Crop sales Livestock sales	3	- Suitable height - Early maturity - Acceptable productivity - Desirable white seeds	- Good height - Early maturity - Thick heads - White seeds - Two row variety	- Suitable for combine harvesting - Shortage of rain - More production - Higher market price - Good for feed due to the softness of grain/ straw
Sauran Crop Sales Livestock sales	2	- White seeds - Softness of straw - Good tillering - Tall heads - Good height	- Desirable white seeds - Softness of straw - More tillers - Tall heads - Good height	- Better market price - Good feed quality - More yield - Ditto - Suitable for combine harvesting

Note: Livestock means sheep in this table unless specified otherwise.

In Tel Hadya (Table 1.7), head characteristics and height were the most common criteria used by farmers (100% and 89% of farmers respectively) and were cited most frequently in selection (69% and 59% of selections respectively). These are followed by tillering, maturity, grain characteristics and lodging, all used as criteria by two-thirds of the farmers. Only three farmers considered grain color, and then only in 5% of selections, and only one farmer cited straw characteristics. Characteristics related to stems and adaptation were not mentioned at all. In Tel Hadya, a favourable site, with sufficient rainfall and deep soil, negative descriptors, such as "intolerant to drought", "needs more rain" and "unsuitable for this region" are not in evidence. Similarly, negative stem traits such as "thin" and "weak" were not recorded. Thus, under favorable conditions, farmers' selections appeared to be based primarily on characteristics related to productivity (head, tillering, grain) and height (favoring combine harvesting).

It should be noted in Table 1.7 (and in subsequent tables) that no single criterion is used for every selection. For instance although all nine farmers used head characteristics as a criterion, it was actually cited as a reason for selection in only 69% of the selections, implying that in some cases other criteria took precedence over head characteristics in determining the selection of a particular line.

Table 1.7. Farmers preferences during selection in Tel Hadya

Character	times mentioned	total # of samples	times mentioned (%)[a]	# of Farmers	% of Farmers	Index[b]
D: Head	92	133	0.69	9	1.00	0.85
A: Height	70	133	0.53	8	0.89	0.71
A1: Excellent, (Very) Good, Suitable, Tall, etc	70	133	0.53	8	0.89	0.71
A2: Medium	0	133	0.00	0	0.00	0.00
A3: Short	0	133	0.00	0	0.00	0.00
H: Tiller	48	133	0.36	6	0.67	0.51
I: Maturity	37	133	0.28	6	0.67	0.47
B: Grain	23	133	0.17	6	0.67	0.42
J: Lodging	16	133	0.12	6	0.67	0.39
N: General View	7	133	0.05	3	0.33	0.19
E: Color	7	133	0.05	3	0.33	0.19
E1: Color (Black)	5	133	0.04	2	0.22	0.13
E2: Color (White)	0	133	0.00	0	0.00	0.00
E3: Color (Abrash; mixed)	2	133	0.02	1	0.11	0.06
K: Productivity	15	133	0.11	1	0.11	0.11
C: Straw	2	133	0.02	1	0.11	0.06
M: Susceptibility	2	133	0.02	1	0.11	0.06
F: Row	1	133	0.01	1	0.11	0.06
F1: 2 rows	1	133	0.01	1	0.11	0.06
F2: 6 rows	0	133	0.00	0	0.00	0.00
G: Stem	0	133	0.00	0	0.00	0.00
L: Adaptation	0	133	0.00	0	0.00	0.00

[a] times mentioned (%) = times mentioned/ total # of samples
[b] index = (% times mentioned + % of farmers)/2

In Breda (Table 1.8), again head characteristics and height (tall plants) were the most common criteria used by farmers (eight out of nine farmers) and most cited as a reasons for selection of lines. As in Tel Hadya, tillering, maturity and grain were also important characteristics. Color was used as a criterion by four farmers (split equally: two preferring black and two preferring white grain) and influenced 25% of selections. One noticeable difference to the results for Tel Hadya is the lack of

mention of lodging. It should be noted in a low rainfall site such as Breda, lodging does not occur and, thus, would not figure in farmers' considerations. Lodging only becomes an issue under higher rainfall conditions such as at Tel Hadya.

Table 1.8. Farmers preferences during selection in Breda

Character	times mentioned	total # of samples	times mentioned (%)[a]	# of Farmers	% of Farmers	Index[b]
D: Head	102	134	0.76	8	0.89	0.83
A: Height	91	134	0.68	8	0.89	0.78
A1: Excellent, (Very) Good, Suitable, Tall, etc	83	134	0.62	7	0.78	0.70
A2: Medium	7	134	0.05	4	0.44	0.25
A3: Short	1	134	0.01	1	0.11	0.06
H: Tiller	65	134	0.49	6	0.67	0.58
E: Color	34	134	0.25	4	0.44	0.35
E1: Color (Black)	15	134	0.11	2	0.22	0.17
E2: Color (White)	19	134	0.14	2	0.22	0.18
E3: Color (Grey)	0	134	0.00	0	0.00	0.00
I: Maturity	7	134	0.05	4	0.44	0.25
B: Grain	18	134	0.13	3	0.33	0.23
N: General View	20	134	0.15	2	0.22	0.19
K: Productivity	15	134	0.11	1	0.11	0.11
F: Row	14	134	0.10	1	0.11	0.11
F1: 2 rows	14	134	0.10	1	0.11	0.11
F2: 6 rows	0	134	0.00	0	0.00	0.00
G: Stem	4	134	0.03	1	0.11	0.07
C: Straw	2	134	0.01	1	0.11	0.06
M: Susceptibility	1	134	0.01	1	0.11	0.06
J: Lodging	0	134	0.00	0	0.00	0.00
L: Adaptation	0	134	0.00	0	0.00	0.00

[a] times mentioned (%) = times mentioned/ total # of samples
[b] index = (% times mentioned + % of farmers)/2

In the farmers- fields (Table 1.9), only eight characteristics out of fourteen were mentioned. Of these, height and head characteristics were again the most common criteria, used by seven out of nine farmers, and cited in 91% and 82% of selections respectively. Tillering was also important, used by six farmers and mentioned in 56% of the selections, followed by grain characteristics, used as a criterion by four farmers and mentioned in 35% of selections. Lodging, maturity, "general view" and color were of minor importance (both in terms of number of farmers and number of times mentioned).

Table 1.9. Farmers preferences during selection in the farmers fields

Characteristics	times mentioned	total # of samples	times mentioned (%)[a]	# of Farmers	% of Farmers	Index[b]
A: Height	95	104	0.91	7	0.78	0.85
A1: Excellent, (Very) Good, Suitable, Tall, etc	94	104	0.90	7	0.78	0.84
A2: Medium	1	104	0.01	1	0.11	0.06
A3: Short	0	104	0.00	0	0.00	0.00
D: Head	85	104	0.82	7	0.78	0.80
H: Tiller	58	104	0.56	6	0.67	0.61
B: Grain	36	104	0.35	4	0.44	0.40
J: Lodging	16	104	0.15	2	0.22	0.19
N: General View	9	104	0.09	2	0.22	0.15
I: Maturity	3	104	0.03	1	0.11	0.07
E: Color	2	104	0.02	1	0.11	0.07
E1: Color (Black)	0	104	0.00	0	0.00	0.00
E2: Color (White)	2	104	0.02	1	0.11	0.07
E3: Color (Grey)	0	104	0.00	0	0.00	0.00
C: Straw	0	104	0.00	0	0.00	0.00
F: Row	0	104	0.00	0	0.00	0.00
F1: 2 rows	0	104	0.00	0	0.00	0.00
F2: 6 rows	0	104	0.00	0	0.00	0.00
G: Stem	0	104	0.00	0	0.00	0.00
K: Productivity	0	104	0.00	0	0.00	0.00
L: Adaptation	0	104	0.00	0	0.00	0.00
M: Susceptibility	0	104	0.00	0	0.00	0.00

[a] times mentioned (%) = times mentioned/ total # of samples
[b] index = (% times mentioned + % of farmers)/2

Viewing the results for the three sites together, it is clear that head characteristics (full heads, number of grains per head, heavy heads), height (important for ease of combine harvesting) and tillering are the three main criteria used by farmers in selection. Although some criteria are important to individual farmers, such as color, row (2- vs. 6-row), and straw characteristics, it should be noted that even for these individuals these factors were not cited frequently in selection. Thus, preferences for color, row-type and soft straw do not have a major influence on selection. Table 1.10 summarizes farmers' preferences in the two research stations (Tel Hadya and Breda) and in the farmers' fields, according to the computed index, which is a combination of the frequency with which a characteristic is used by farmers as a criterion and its importance in determining selection.

From Table 1.10, it is obvious that long heads and tall plants are the characteristics more frequently used as selection criterion, and those more frequently quoted by farmers regardless of the location in which the selection took place. While the preference for tall plants in dry areas (Breda and most farmers' fields) was not surprising, it was interesting to find the tall plants (provided they don't lodge) are desirable also in a wet environment such as Tel Hadya.

Tillering was consistently the third characteristic most frequently used as selection criterion, reflecting the desirability of a good biomass production early in the season as related, presumably with a higher amount of dry matter available for grazing in the case of failure of grain production. Good tillering ability, and hence high biomass before anthesis, are known to be related to higher grain yield. Furthermore, good tillering ability allows a greater flexibility in source-sink relationships at different levels of stresses. It interesting that the farmers attach a high importance to such a trait regardless of the environmental conditions of the selection site.

Table 1.10 Farmers preferences in research stations (TH=Tel Hadya; BR=Breda) and farmers fields (FF).

Rank	Characteristics	Index FF	Index BR	Index TH	Total Index	Average Index
1	D: Head	0.800	0.825	0.846	2.471	0.824
2	A: Height	0.850	0.784	0.708	2.342	0.781
	A1: Excellent, (Very) Good, Suitable, Tall, etc	0.840	0.699	0.708	2.246	0.749
	A2: Medium	0.060	0.248	0.000	0.308	0.103
	A3: Short	0.000	0.059	0.000	0.059	0.020
3	H: Tiller	0.610	0.576	0.514	1.700	0.567
4	B: Grain	0.400	0.234	0.420	1.054	0.351
5	I: Maturity	0.070	0.248	0.472	0.791	0.264
6	J: Lodging	0.190	0.000	0.393	0.583	0.195
7	E: Color	0.010	0.349	0.193	0.552	0.184
	E1: Color (Black)	0.000	0.167	0.130	0.297	0.099
	E2: Color (White)	0.070	0.182	0.000	0.252	0.084
	E3: Color (Grey)	0.000	0.000	0.063	0.063	0.021
8	N: General View	0.150	0.186	0.193	0.529	0.176
9	K: Productivity	0.000	0.112	0.112	0.223	0.074
10	F: Row	0.000	0.108	0.059	0.167	0.056
	F1: 2 rows	0.000	0.108	0.059	0.167	0.056
	F2: 6 rows	0.000	0.000	0.000	0.000	0.000
11	C: Straw	0.000	0.063	0.063	0.126	0.042
12	M: Susceptibility	0.000	0.059	0.063	0.122	0.041
13	G: Stem	0.000	0.070	0.000	0.070	0.023
14	L: Adaptation	0.000	0.000	0.000	0.000	0.000

While the three most important characteristics are the same in the farmers' fields and in the two research stations, the importance of the other characteristics varies with the environment in which the selection takes place. For example, early maturity, large grains and lodging resistance rank immediately after long heads, tall plant and high tillering in Tel Hadya, but lodging resistance is never used as selection criterion, or quoted, in Breda, while early maturity is used as selection criterion, or quoted, very seldom in farmers' fields.

Even though productivity was seldom used and quoted, farmers do use and quote all the most important yield components such as spike length, which also reflects a larger number of grains, tillering, which reflects a larger number of spikes per unit area, and eventually grain size.

1.4 *Future Analysis*

Further analysis of the field scoring not only for the host farmers, but also for the guest farmers, will be done during 1999. We will also incorporate the result of seed selection in 1997-1998 into the next report. In addition, a study on the large scale testing of the lines that were promising in 1997/98 is also planned.

2. Component 3: Market Study

This component of the research is conducted by the Institut für Agrar- und Sozialökonomie in den Tropen und Subtropen, University of Hohenheim, Germany. The report on this component had not been received at time of submission.

3. Component 4: Participatory Breeding

Methods and General Information

As indicated in the 1997 report, the lines selected during the cropping season 1997/98 were classified based on a) who selected them and b) where they were selected. For each of the nine farmers, this resulted in the following four groups of lines:

(a) selected by each farmer in his own field
(b) selected by each farmer in Tel Hadya
(c) selected by each farmer in Breda
(d) selected by the breeder in each of the farmer's fields

These four groups were specific for each of the nine sites, although a number of lines were in common among a various number of sites. In addition to these four groups of lines, other two groups of lines were those:

(e) selected by the breeder in Tel Hadya
(f) selected by the breeder in Breda

These two groups (e and f) were independent from the nine farmer's sites and were therefore common to all trials.

For those five locations where we conducted group selection (see Annual Report 1997), an additional group was made with the lines selected by the majority of the farmers in that group.

With the selected lines, and avoiding duplications within the same trials, we prepared a specific trial for each of the nine locations. The layout was improved compared with 1997 by adding systematic checks to the selected entries. In one farmer's site (Al Bab), where the farmer has introduced a forage legume crop in the rotation (common vetch, *Vicia sativa*), the trial was planted twice, once after barley and once after vetch. The code for the trial planted in Al Bab after vetch is 06BV, while the code for the trial planted after barley is 06BB.

All the nine trials were also planted in Tel Hadya and Breda, two of ICARDA's research stations. The total number of entries, which were tested, was 1083: the planting dates and the details of each trial are shown in Table 3.1.

Table 3.1 Composition and planting dates of the 1997/98 trials

Location (code)	Planting dates	Nr. of lines	Nr. of checks	Layout	Check
Ibbin (01)	14.11.97	134	14	37 x 4	Rihane-03
Ebla (02)	13.11.97	141	11	38 x 4	Rihane-03
Tel Brak (03)	8.11.97	115	17	33 x 4	Tadmor
Jurn El-Aswad (04)	7.11.97	136	12	37 x 4	Tadmor
Baylonan (05)	7.11.97	136	12	37 x 4	Zanbaka
Al Bab (06BB and 06BV)	10.11.97	129	15	36 x 4	Sara
Melabya (07)	8.11.97	148	12	40 x 4	Zanbaka
Bari Sharki (08)	12.11.97	140	12	38 x 4	Zanbaka
Sauran (09)	11.12.97	140	16	39 x 4	Arta
Total		1219			

In total 96 entries were common in all trials, either because they belonged to groups e. and f., or because all the farmers selected them, or because the breeder selected them in all locations.

Table 3.2. Different type of germplasm (in % of the total excluding the checks) in the 1997/98 trials

	Row Type			Seed color					
Location (code)	Six	Two	Landraces	Modern	Black	White	Seg.	Hom.	Het.
Ibbin (01)	0.24	0.76	0.41	0.59	0.13	0.81	0.06	0.58	0.42
Ebla (02)	0.28	0.72	0.38	0.62	0.11	0.82	0.07	0.57	0.43
Tel Brak (03)	0.14	0.86	0.50	0.50	0.14	0.77	0.09	0.57	0.43
Jurn El-Aswad (04)	0.15	0.85	0.53	0.47	0.15	0.77	0.08	0.58	0.42
Baylonan (05)	0.14	0.86	0.54	0.46	0.15	0.73	0.13	0.62	0.38
Al Bab (06)	0.12	0.88	0.57	0.43	0.13	0.76	0.11	0.54	0.46
Melabya (07)	0.17	0.83	0.52	0.48	0.15	0.75	0.10	0.56	0.44
Bari Sharki (08)	0.16	0.84	0.50	0.50	0.11	0.79	0.10	0.52	0.48
Sauran (09)	0.19	0.81	0.47	0.53	0.11	0.78	0.11	0.53	0.47

Table 3.3 Fertilizer application (kg/ha) in the nine villages and two research stations (Breda and Tel Hadya)

	Nitrogen			
Location (code)	at planting	in Spring	Total	P_2O_5
Ibbin (01)	82	100	182	97
Ebla (02)	0	50	50	30
Tel Brak (03)	0	0	0	0
Jurn El-Aswad (04)	0	0	0	0
Baylonan (05)	20	15	35	0
Al Bab (06BB)	20	15	35	20
Al Bab (06BV)	0	15	15	20
Melabya (07)	0	0	0	0
Bari Sharki (08)	0	0	0	0
Sauran (09)	20	20	40	45
Breda (BR)	0	0	0	0
Tel Hadya (TH)	0	0	0	30

Plot size was 8 rows at 20 cm distance and 7.5 m long (12 m^2). The agronomic management of the trial was left to each farmer. The application of fertilizer and the planting date in each of the farmers' fields and in the two research stations are given in Table 3.3. In all the sites the material was evaluated under rainfed conditions.

The plots were laid down in four strips of an equal number of plots each; for each trial, the same layout was used in the farmer field and in the two research stations: each plot was identified by a number on a plastic label held by a wooden peg as already done in 1997.

Each farmer was given a field book where he recorded the rainfall (measured through a rain gauge) and their selections. The field book was organized in such a way that for each entry it indicated the plot number in 1997 and in 1998. Therefore the farmers had the possibility of consulting the 1997 field book and the notes taken on those entries which were selected.

During 1998 we performed the same four types of selection as we did in 1997, namely:

(a) **Decentralized-participatory selection** (individual selection by each participating (host) farmer on his own field;

b) **Centralized-participatory selection** (individual selection by each participating farmer in Breda and Tel Hadya, two research stations representing a stress and a favorable environment, respectively);

c) **Decentralized-non participatory selection** (individual selection by the senior barley breeder of DASR (Directorate of Agricultural and Scientific Research) of the Ministry of Agriculture and Agrarian Reform in Syria in seven of the nine farmers' fields. In Ibbin (01) selection was not possible because the crop was damaged by a hail storm and in Bari Sharki the crop was harvested before the breeder could do the selection;

d) **Centralized-non participatory selection** (individual selection by the senior barley breeder of DASR in Breda and Tel Hadya;

e) **a different type of decentralized-participatory selection** consisting of group selection by neighbors farmers in six of the nine villages, namely Ebla (Jurn El-Aswad, Baylonan, Al Bab, Bari Sharki and Sauran). In each of the five villages a group of farmers (eight in four villages and nine in one), including the host farmer, did a one-time visual selection with a score from 0 (discarded) to 4 (best) with the assistance of a researcher who helped in recording both quantitative and qualitative data. At the end of the selection process, each farmer was asked to identify the best 15 entries and to rank them from best to worse (the best was given the rank of 15, the second best the rank of 14, and so on). The average score and the average ranking of each line were then combined in a preference index which gave the same weight to the average score and the average rank by dividing the first by 4 and the second by 15 then by averaging them. Therefore, the maximum index of preference would be 1, and the minimum 0.

The following characters were recorded by the scientists in each farmer field on a sample of 2.4 m^2 from each plot:

- grain yield
- total biological yield
- harvest index
- plant height
- kernel weight
- straw characteristics

Other traits recorded only in the research stations were:

- growth habit (on a scale 1=erect to 5=prostrate) at Tel Hadya
- growth vigor (on a scale 1=good to 5=poor) at Tel Hadya
- cold damage (on a scale 1=no damage to 5=maximum damage) at Tel Hadya
- lodging resistance (1 = resistant; 9 = susceptible) at Tel Hadya
- number of tillers per m2 at Tel Hadya and Breda
- agronomic score in Breda (1=best; 5=poorest)
- days to heading (as number of days from emergence to heading) at Tel Hadya.

The physical characteristics of the straw were analyzed with a SMS Texture Analyser as described in the 1997 Report.

The data were subjected to different types of analysis. Firstly, the entries were classified according to the six groups (from (a) to (f)), as listed above, and analyzed with an ANOVA for groups of unequal size. The means of the six groups were then used to analyze the effect of the selection environment and of who did the selection. The effect of the selection environment (experiment station vs. farmer field) was measured, for each trait by contrast:

(a) (Mean of BS and FS) - (Mean of BF and FF)

where BS and FS are the breeder and the farmer selections on station, while BF and FF are the breeder and the farmer selections in a given farmer field. This contrast was analyzed for both Tel Hadya and Breda, each compared with every farmers' field and for every character. The effect of who did the selection (breeder vs. farmer) was measured by the contrast:

(b) (Mean of BS and BF) - (Mean of FS and FS)

This contract was analyzed for each trait and for Tel Hadya, Breda and the nine farmers' fields. The interaction between the effects a) and b), indicating effectiveness of farmer selection vs. breeder selection differs between experiment station and farmers' fields, was measured by the contrast:

(c) (Mean of FF and BS) - (Mean of BF and FS).

This contrast was analyzed for Tel Hadya, Breda and for each farmer's field. Secondly, the entries were classified according to the six selection criteria used in 1998 and the mean of the different traits in the resulting groups were compared with the population mean using a t-test for groups of unequal size.

Eventually the similarity between the selections made by the farmers and the breeder in the research stations and the farmers field were compared with the dice coefficient described in the 1997 Annual Report. The dendograms of the various combinations of environments of selection and selectors were obtained by the unweighted pair group method with arithmetic average (UPGMA) cluster analysis. These analysis were done using the program NTSYS-PC version 2.0 (Numerical Taxonomy System, Applied Biostatistics, N.Y.).

3.1 *Results*

As found in the previous year, there were large differences in average grain yield (from about 400 kg/ha in Melabya to more than 3 t/ha in Tel Hadya), biological yield (from less than 2 t/ha in Tel Brak and Melabya to more than 8 t/ha in Tel Hadya), harvest index (from 0.4 and more in Ebla, Sauran, Breda and Tel Hadya, to 0.25 in Melabya), plant height (from just more than 20 cm in Melabya to more than 80 cm in Ebla) and in kernel weight (from less than 30 g in Baylonan and Bari Sharky to more than 40 g in Tel Hadya and Sauran) (Table 3.4).

This was partly due to the different levels of inputs (see Table 3.3) and partly to the large differences in total rainfall which ranged from less than 200 mm in Melabya to more than 400 mm in Tel Hadya. The coefficients of correlation (Table 3.5) between total rainfall and grain yield, total biological yield, harvest index, plant height and kernel weight were all highly significant ($P<0.01$), indicating that slightly more than 70% ($R^2 = 0.71$) of the variation in grain yield and almost 60% ($R^2 = 0.58$) of the variation in total biological yield were associated with the variation in total rainfall. There was a close association between plant height and grain yield ($r = 0.91$), plant height and total biological yield ($r = 0.91$) and between harvest index and kernel weight ($r = 0.82$).

The phenotypic correlation coefficients between grain yield measured in the eight farmers and the two research stations were generally low, and even when significant they indicated a maximum of 20% of variation in one location (Sauran) explained by the variation in another location (Tel Hadya). The highest positive correlation coefficients were between the highest yielding sites (Ebla, Bari Sharky, Tel Hadya, and Sauran), indicating a certain degree of coincidence in the performance of the barley entries in these locations. However, there was no relationship between the yield at Ebla and the yield at Sauran. In Al Bab, the grain yield in the trial planted after vetch was positively correlated with the yields at Bari Sharky and Tel Hadya, while the grain yield of the trial planted after barley was correlated with the grain yield at Jurn El-Aswad and weakly correlated with the grain yield at Tel Hadya. The correlation coefficients between low yielding locations were generally lower than correlation coefficient between high yielding locations. This trend, already observed last year, indicates that low yielding sites differ more among themselves than high yielding sites.

Table 3.4 Rainfall (recorded by farmers through rain-gauges), average grain yield (kg/ha), total biological yield (kg/ha), harvest index, plant height (cm) and kernel weight(g) in nine farmers' fields and in two research stations (Breda and Tel Hadya).

Location (code)		Rainfall	Grain Yield	Biological Yield	Harvest Index	Plant Height	Kernel weight
Ebla (02)	Mean	368	2849	7163	0.40	86.1	35.5
	s.e.		58	146	0.005	1.4	0.35
Tel Brak (03)	Mean	298	676	1647	0.39	40.3	34.3
	s.e.		30	46	0.009	0.9	0.32
Jurn El-Aswad (04)	Mean	202	773	2707	0.27	28.9	32.4
	s.e.		43	107	0.007	0.8	0.35
Baylonan (05)	Mean	200	825	3065	0.27	37.1	29.5
	s.e.		31	74	0.007	0.8	0.32
Al Bab (06BB)	Mean	269	1134	4110	0.27	42.7	30.8
	s.e.		48	136	0.005	0.8	0.33
Al Bab (06BV)	Mean	269	2567	7605	0.33	53.6	34.3
	s.e.		92	199	0.01	1.1	0.33
Melabya (07)	Mean	167	427	1717	0.25	22.9	31.2
	s.e.		20	55	0.008	0.5	0.43
Bari Sharki (08)	Mean	316	1794	6173	0.29	62.6	28.1
	s.e.		54	137	0.005	1.1	0.35
Sauran (09)	Mean	329	2159	5027	0.43	51.1	42.2
	s.e.		65	130	0.006	1	0.40
Breda (BR)	Mean	229	936	2414	0.40	36.2	35.0
	s.e.		15	32	0.005	0.8	0.30
Tel Hadya (TH)	Mean	411	3155	8125	0.40	76	42.3
	s.e.		41	101	0.005	1.1	0.38

[a] At Ibbin the crop was damaged by a hail storm and was not harvested
[b] At Al Bab the trial was planted both after barley (BB) and after common vetch (BV)
The data are based on the 96 entries common to all trials.

Table 3.5. Simple correlation coefficients between total rainfall and grain yield, total biological yield, harvest index, plant height and kernel weight (means of 96 barley entries in 8 farmers fields and two research stations).

Characters	Rainfall	Grain Yield	Biol. Yield	Harvest Index	Plant Height
Grain Yield	0.843**	1.000			
Biol. Yield	0.761**	0.964**	1.000		
Harvest Index	0.691*	0.546	0.331	1.000	
Plant Height	0.906**	0.909**	0.876**	0.534	1.000
Kernel weight	0.628*	0.604*	0.400	0.821***	0.421

Table 3.6. Phenotypic correlation coefficients between grain yield of 96 barley entries in nine farmers' fields and in two research stations (Breda and Tel Hadya).

	02	03	04	05	06BB	06BV	07	08	09	TH	BR
02	1.000										
03	0.095	1.000									
04	-0.047	-0.012	1.000								
05	0.084	0.015	0.161	1.000							
06BB	0.087	0.192	0.309**	0.105	1.000						
06BV	-0.086	-0.094	-0.053	0.019	0.118	1.000					
07	-0.045	0.066	0.094	0.032	0.033	-0.090	1.000				
08	0.306**	-0.283**	-0.105	0.037	0.090	0.287**	-0.074	1.000			
09	-0.031	-0.230*	0.135	0.112	0.086	0.201	0.048	0.244*	1.000		
TH	0.316**	-0.215*	0.010	0.090	0.235*	0.298**	-0.088	0.391**	0.446**	1.000	
BR	-0.001	0.216	0.100	0.373**	0.037	0.158	0.234*	-0.185	0.116	0.141	1.000

Contrary to the first year when the breeder selected many more lines than the farmers, there were no large differences in the number of lines selected by the breeder, the farmer and the groups of farmers in the different locations (Table 3.7). The difference between the two years is likely associated with the structure of the trials. In 1997 the same trial was planted everywhere, whereas in 1998 the trials differed (although a number of lines were in common) from location to location. Therefore in 1997 the breeder used the average performance of the lines across locations, while in 1998 this was not possible thus forcing the breeder to select for performance in individual locations.

Table 3.7 Number of lines selected by the host farmers and the breeder in nine farmers' fields (FF) and in two research stations, Breda (BR) and Tel Hadya (TH), and by the farmers groups in seven sites.

	Farmer			Breeder			Group
Location	FF	BR	TH	FF	BR	TH	FF
01	33	49	31	-	37	22	-
02	30	23	55	43	40	29	25
03	38	18	54	55	37	28	-
04	18	17	29	42	45	26	26
05	51	33	42	53	43	32	14
06BB	68	14	41	42	37	27	51
06BV	15	14	41	39	37	27	48
07	18	16	56	15	57	43	-
08	19	16	10	-	34	22	49
09	21	23	36	64	41	36	29
Mean	31	22	40	44	41	29	35

The total number of lines selected by the farmers was 341, or 31%, compared with 36% selected in the first year (Table 3.8). The majority (nearly 70% of the selected entries) were selections made by one farmer in his field. Few entries received a large consensus: two entries were selected by six farmers, six entries were selected by five farmers and thirteen were selected by four farmers.

With few exceptions, the lines selected more frequently by farmers in farmers fields were derived from crosses in which one or more parents were Syrian landraces and/or lines from *H. spontaneum*; they were all two-row types, predominantly white seeded and with a predominance of fixed lines over segregating populations.

It is worth noting that some of the most frequently selected lines (Moroc 9-75/A. Aswad and WI 2291/Tadmor) were sister lines obtained by Single Seed Descent from superior crosses identified in Breda before the beginning of the project.

Table 3.8 Farmer selection in farmer fields: number (and percentage) of lines selected by one or more farmers.

Selected by	1997		1998	
	No.	%	No.	%
one farmer	57	27.4	236	21.8
two farmers	18	8.7	52	4.8
three farmers	2	1.0	32	2.9
four farmers	0	0	13	1.2
five farmers	0	0	6	0.6
six farmers	0	0	2	0.2
Total	75	36.1	341	31.4

Table 3.9 Farmer selection in farmer fields: name of lines most frequently selected with their row type (RT), seed color (W= white, B= Black) and type of breeding material (TBM, F= fixed, S = segregating).

Nr. of times selected	Line No.	Name	RT	Seed color	TBM
6	181	Moroc 9-75/A. Aswad	2	B	F
6	189	Hml/SLB 45-34//Sara	2	W	S
5	45	Hml-02/5/WI2291/4/Avt/Ki//Avt/3/TolI/Bz	2	W	F
5	118	SLB 34-65/Arar	2	W	F
5	139	Sara 01	2	B	F
5	156	Moroc 9-75/A. Aswad	2	B	F
5	183	H.spont.21-3/Arar 84//WI2269/3/ Sara	2	W	S
5	187	SLB 15-05/3/H.spont.21-3/Arar 84//WI2291/Bgs	2	W	S
4	37	Roho//Alger/Ceres 362-1-1/3/WI2198/Lignee 131	2	W	F
4	131	WI2291/Tadmor	2	W	F
4	138	H.spont.41-5/Tadmor//Moroc 9-75	2	B	F
4	142	Tadmor//ER/Apm	2	B	F
4	143	Moroc 9-75/A. Aswad	2	B	F
4	148	WI2291/Tadmor	2	B	F
4	155	H.spont.41-1/Tadmor	2	W	F
4	185	H.spont.21-3/Arar 84//WI2291/Bgs/3/ Sara	2	W	S
4	186	WI2269/Arta/3/H.spont.21-3/Arar 84//WI2291/Bgs2	2	W	S
4	202	H.spont.93-4/3/Roho//Alger/Ceres 362-1-1/4/ Sara	2	W	S
4	203	H.spont.93-4/3/Roho//Alger/Ceres 362-1-1/4/WI2269/Arta	2	W	S
4	206	SLB 15-05/4/H.spont.96-3/3/Roho//Alger/Ceres 362-1-1	2	W	S

Some of the lines selected frequently by farmers in their fields were also selected frequently by farmers at Breda (Table 3.10) where five lines were selected by four farmers, seven by five farmers, two by six, two by seven and two by as many as eight farmers out of nine. The latter were also selected by four farmers in the farmers' fields.

Table 3.10 Farmer selection in Breda: name of lines more frequently selected with row type (RT), seed color (W= white, B= Black) and type of breeding material (TBM, F= fixed, S = segregating).

Nr. of times selected	Line No.	Name	RT	Seed Color	TMB
8	138	H.spont.41-5/Tadmor//Moroc 9-75	2	B	F
8	142	Tadmor//ER/Apm	2	B	F
7	181	Moroc 9-75/A. Aswad	2	B	F
7	139	Sara 01	2	B	F
6	148	WI2291/Tadmor	2	B	F
6	156	Moroc 9-75/A. Aswad	2	B	F
5	111	Sara	2	W	F
5	118	SLB 34-65/Arar	2	W	F
5	97	Carina/Moroc 9-75	2	W	S
5	49	Arar/PI 386540	2	W	F
5	40	LOCAL 2 (A.Aswad Hassakeh Zone C)	2	B	F
5	154	H.spont.94-5/Tadmor	2	B	F
5	143	Moroc 9-75/A. Aswad	2	B	F
4	141	Hml-02/A. Abiad//ER/Apm/3/Zanbaka	2	B	F
4	189	Hml/SLB 45-34// Sara	2	W	S
4	158	JLB 06-33/3/5604/1025//A. Abiad	2	BW	S
4	20	LOCAL 1 (A.Aswad Hassakeh Zone B)	2	B	F
4	43	ER/Apm//Lignee 131/4/Antares//12201/Attiki/3/RM1508/Por//WI2269	2	W	F

As observed in farmers' fields, the majority of lines selected more frequently by farmers in Breda were landraces (such as nr. 20 and nr. 40) or crosses with either landraces and/or *H spontaneum*. The only two exceptions were entries nr. 97 and 43.

The percent of lines selected in common by the breeder and/or the farmers in different locations varied between a minimum of 8.7% and 10.9% (Table 3.11) between the selections done by the breeder in Tel Hadya and those done by the farmers in Breda, and a maximum of over 60% between the selections done by farmers and breeder in farmers fields (62.6%) and between the selections done by the farmers and breeder in Breda (64.3%). The percent of lines selected by the breeder in Tel Hadya (centralized-non participatory breeding) which were in common with those selected by farmers in their fields (decentralized-participatory breeding) were slightly less than 20%.

Table 3.11 Percent of entries selected in common in various combinations of selectors and selection environments.

Selected by[a]	Nr. selected	Percent also selected by				
		F- BR	F – TH	B - FF	B - BR	B - TH
F - FF	341	23.5	31.4	62.6	36.4	19.4
F -BR	238	-	32.8	47.6	64.3	10.9
F- TH	400	19.5	-	34.5	36.3	40.0
B - FF	353	22.7	34.6	-	25.2	38.5
B - BR	414	37.0	35.0	32.9	-	19.3
B - TH	300	8.7	53.3	36.0	26.3	-

[a] F = Farmer, B = Breeder, FF = farmer field, BR = Breda, TH = Tel Hadya

3.1.1 *Effect of the selection environment*

The effect of the selection environment was estimated by the difference between the selections done by both the breeder and the farmer in Tel Hadya, in Breda and in the farmers' fields. The results are summarized in Tables 11 (contrast Tel Hadya vs. farmers' fields) and 12 (contrast Breda vs. farmers' fields). In the tables we show the sign of difference and the level of significance following a test for groups on unequal size using the variance of the check as error.

The environment where the selection was made in 1997 had a large effect on a number of traits measured in 1998, regardless of whether the selection was made by the farmers or by the breeder. This is indicated by the large number of significant differences in Tables 3.12 and 3.13. Some traits were affected consistently, i.e. in the same direction, while others were affected in a different way depending of the particular farmer field being compared with either Tel Hadya or Breda.

Table 3.12 Effect of the 1997 Selection Environments on different traits in 1998: Tel Hadya vs. Farmers fields.

	Selection at Tel Hadya vs. Selection on Farmer Field									
Trait	01	02	03	04	05	06BB	06BV[a]	07	08	09
GHTH	+ **	+	! **	! **	! **	! **	=	+ **	! **	! **
CDTH	! **	!	+ **	+ **	+ **	+ **	=	!	+ *	+ **
GVTH	+	+ **	+ **	+ **	+ **	+ **	=	+ **	+ **	+
DHTH	! **	!	+	+ **	+ **	+ **	=	+ **	+ **	!
LDGTH	! **	! **	! **	! **	! **	! **	=	! **	! **	! *
ASBR	!	+	!	+ **	+ **	+ **	=	+ **	+ **	+
PHBR	! **	!	! **	! **	! **	! **	=	! **	! **	! **
PHTH	! **	! **	! **	! **	! **	! **	=	! **	! **	!*
PHFF	n.a.	! *	! **	! **	! **	! **	! **	! **	! **	! **
TNTH	!	+	! *	! **	+	! **	=	!	!	!
TNBR	+	!	+	!	! **	! *	=	!	!	! **
GYTH	!	! *	+	+ **	+ **	+ **	=	+ **	+ **	+
BYTH	+	! **	!	! **	+	!	=	+	!*	!
HITH	! **	+ *	+	+ **	+ **	+ **	=	+ **	+ **	+
GYBR	+*	+	! *	! **	! **	! **	=	! *	!	! **
BYBR	!	!	!	! **	! *	! *	=	! **	! *	! **
HIBR	+ *	+	!	+ **	!	! **	=	+ **	+ *	! *
GYFF	n.a.	+	! *	!	!*	!	+	+	+ **	+ **
BYFF	n.a.	+	!*	!	+	!	+	+ *	+*	+ **
HIFF	n.a.	+	! **	!*	! **	+	+	! **	+ **	!
KWTH	! **	+	+ **	+ **	+ **	+ **	=	+ **	+ **	+
KWBR	! *	+ **	+ **	+ **	+ **	+ **	=	+ **	+ **	+
KWFF	n.a.	! *	! *	+	+	+ **	+ **	!	+ **	+*

[a] = the value is the same as indicated for 06BB

Table 3.13 Effect of the 1997 Selection Environments on different traits in 1998: Breda vs. farmer's fields.

	Selection at Breda vs. Selection on Farmer Field									
Trait	01	02	03	04	05	06BB	06BV[a]	07	08	09
GHTH	+ **	+ **	+ **	!	!	! **	=	+ **	! **	+ **
CDTH	! **	! **	! **	! **	+ *	+ **	=	! **	! **	! *
GVTH	! **	! **	!	+ *	!	+ **	=	+ **	+ **	!
DHTH	! **	! **	! **	+ **	+ **	+ **	=	+ **	+ **	! **
LDGTH	+ **	+ **	+	!	!	! **	=	! **	! **	+ **
ASBR	! **	! **	! **	+ **	+	+ **	=	+ **	+ **	! **
PHBR	+ **	+ **	+ **	! **	+	! **	=	! **	! **	+
PHTH	+ **	+ **	+ **	! **	+	! **	=	!	! **	+ **
PHFF	n.a.	+ **	+ **	! **	+	! **	! **	!	! **	+ **
TNTH	+ **	+ **	!	!	+ **	! **	=	+	! *	+ **
TNBR	+	!	+	!	!	+	=	!	+	! **
GYTH	! **	! **	! **	+ **	+ **	+ **	=	+ **	+ **	! **
BYTH	+ **	+	! *	!	+	!	=	+	!	+
HITH	! **	! **	!	+ *	+	+ **	=	+ **	+ **	! **
GYBR	+ **	+ **	!	!	! **	!	=	+	+	! *
BYBR	+ **	+ **	+	! **	+	!	=	! **	+	! *
HIBR	+ **	! *	!	+ **	!	+	=	+ **	+	+
GYFF	n.a.	!	+	+	! *	!	!	+ **	+	! **
BYFF	n.a.	!	+	+	!	!	!	+ *	!	! *
HIFF	n.a.	! **	+	+	!	!	+	+ *	+ **	! **
KWTH	! **	! **	! **	+	+ **	+ **	=	+ **	+ *	! **
KWBR	+ *	+ **	! **	+ **	+ **	+ **	=	+ **	+ **	!
KWFF	n.a.	+	!	+	!	+ **	+ **	+ *	+ **	!

[a] = the value is the same as indicated for 06BB

Selections made in Tel Hadya were less vigorous, more lodging resistant and had shorter plants, no matter where plant height was measured, than the selections in most farmers' fields. The effect of the selection environment on some traits there was different depending on whether the farmer field was a high or low yielding environment. For example, selections made in Tel Hadya in 1997, were later in heading in 1998 in Tel Hadya than those made in low yielding environments such as Bylounan (05), Jurn El Aswad (04), Al Bab (06), Melabya (07) and Bari Sharki (08), but significantly earlier that those made in a high yielding environment such as Ibbin (01). Selections made in Tel Hadya were also more cold susceptible that those made in most farmers fields (the main exception was Ibbin), had a worse agronomic score in Breda, and were more erect (exception were Ibbin and Melabya). One of the most consistent effect of the selection environment was on kernel weight. With few exceptions, the selections made by both the breeder and the farmers in Tel Hadya have larger kernels, both in Breda and at Tel Hadya, than the selections made in the majority of farmers' fields. One exception was Sauran, which did not differ significantly from Tel Hadya, and Ibbin. In the latter case the effect of the selection environment was the opposite, with the selections made in that farmer field having larger kernels that those made in Tel Hadya. When kernel weight was measured in farmers' fields, Tel Hadya had a positive effect in the case of Al Bab (in both the trial after barley and in that after vetch), in Bari Sharki and Sauran, but a negative effect in Ebla and Tel Brak.

In the case of grain yield, selections made in Tel Hadya in 1997 yielded significantly more in Tel Hadya in 1998 than selections made in farmers fields in five cases. In three cases (two of which representing farmer's fields in relatively favorable environments) the differences were not significant,

and in one case the selections made in the farmer's field (Ebla) yielded significantly more than the selections made at Tel Hadya. In two dry locations (Tel Brak and Bylounan), selections made in Tel Hadya yielded less than selections made in these two locations ($P<0.05$); the reverse was true in Bari Sharki and Sauran while in other locations the selection environment had no significant effect. In the case of total biological yield the selection environment either did not have effect or was negatively affected when selection was made in Tel Hadya. As a consequence of the effects of the selection environment on plant height and grain yield, selections made in Tel Hadya has a higher harvest index than selections made in farmers' fields, with the exception of Ibbin.

Grain yield and total biological yield in Breda were, in most cases, higher in the selections made in farmers fields than in those made in Tel Hadya with the surprising exception of the selections made in 1997 in Ibbin. Harvest index in Breda was higher in the selections made in Tel Hadya with the exception of those made in Al Bab (after vetch) and in Sauran.

In five locations there were no significant differences between the grain yield of the selections made in Tel Hadya and those made in farmers' fields. In two locations (Bari Sharki and Sauran) the selections made in Tel Hadya out yielded those made in farmer's fields, while in other two (Tel Brak and Bylounan) it was the reverse. In the case of total biological yield, significant differences were found only in four fields, with the selections made in Tel Hadya being superior in three cases and those made in farmers' fields in one. In four cases the selections made in Tel Hadya had a lower harvest index in farmers fields than the selections made in farmers fields, while in Bari Sharki it was the reverse.

When the comparison was made between the selections made in Breda and those made in farmer's fields, most of the traits were affected differently depending on the particular farmer field used for comparison. For example, selections made in Breda were more prostrate that those made in Ibbin, Ebla, Tel Brak, Melabya and Sauran, but more erect that those made in Al Bab and Bari Sharki. The selections made in Breda were more cold tolerant than those made in farmers' fields, except for Bylounan and Al Bab. The selections from Breda had significantly higher growth vigor than those made at Ibbin or Ebla, but significantly lower than those made in some of the dry sites. The selections made in wet sites (Ibbin, Ebla and Sauran) and in Tel Brak were later in heading than those made in Breda, while those made in dry sites were significantly earlier. The lodging resistance of the selections made in wet sites was higher than the selections from Breda, while the opposite tendency appeared when the comparison was made with the dry sites, although differences were not always significant.

Selections made in Breda had a better agronomic score in Breda than those made in wet sites while they had a poorer score than those selected in most of the dry sites. This was clearly related with plant height, which usually affects agronomic score: in fact selections made in Breda were taller (no matter were height was measured) than those made in wet sites, but shorter than those made in dry sites.

The selections made in Breda had more tillers/m^2 at Tel Hadya than those made in the wet sites and in one of the dry sites (Bylounan) and less tillers/m^2 than those made in Al Bab and Bari Sharki. In only one case the selection environment affected the tillering capacity in Breda.

The different results of the comparison between Breda selections and farmers' fields selections depending on which farmers' field is used, are particularly evident when considering grain yield, harvest index and kernel weight in Tel Hadya which were always higher in the farmers' fields selections when these were from wet sites or from Tel Brak, and always higher in Breda selections when the comparison was made with the selections from the dry sites (among the dry sites Breda is the closest to Tel Hadya). The effect on total biological yield showed the same trend but few differences were significant.

The effect of the selection environment on grain yield in Breda and in the farmer's fields was less clear than in Tel Hadya as only few differences were significant. The grain yield and the total biological yield in Breda of Breda selections was clearly higher than the selections made in Ibbin and Ebla, but they were both inferior to the selections made in Sauran.

3.1.2 Comparison between breeder and farmers

The results of the analysis of the differences between the selections made by the breeder and the selections made by the farmers at Tel Hadya, Breda and in farmers' fields are shown in Tables 3.14, 3.15 and 3.16, respectively.

Several significant differences were observed in 1998 between the selections made in 1997 by the breeder and the farmer in Tel Hadya (Table 3.14). However, the sign of the differences varied from farmer to farmer. For example, four farmers selected for more erect habit, while three selected for more prostrate habit, six farmers selected earlier types than the breeder, while two selected later types. There were only few significant differences for cold tolerance, growth vigor, lodging resistant, plant height and tillering ability.

Table 3.14 Effect of Breeder selection vs. Farmer Selection in Tel Hadya in 1997 on different traits in 1998.

Trait	01	02	03	04	05	06BB	06BV[a]	07	08	09
GHTH	+ **	+	!	! *	+ *	! *	=	! *	+ **	+ **
CDTH	!	+	! **	!	+ **	+	=	!	!	!
GVTH	!	! *	+	!	+	+	=	+	+	!
DHTH	+	! **	! **	+ **	+ **	+ **	=	+ **	+ **	+ **
LDGTH	+ **	! **	!	!	+	!	=	+	!	!
ASBR	! **	! **	+	! **	+	+	=	+	+	+
PHBR	+ **	+	+ *	+	!	!	=	!	!	!
PHTH	!	+ **	!	+ **	!	!	=	!	+	!
PHFF	n.a.	+	+	!	!	!	!	!	+	!
TNTH	+ *	!	!	!	!	!	=	+ *	! *	+ *
TNBR	!	+	!	+	+	!	=	! **	!	!
GYTH	!	+ *	+	+ **	!	+	=	+ **	+	+
BYTH	!	+ *	! **	+ *	!	+	=	! **	!	+
HITH	!	!	+ *	!	+	+	=	+	+	+
GYBR	+ **	+	! **	! *	+	!	=	! **	!	+
BYBR	+	+	!	+	!	!	=	! **	+	+
HIBR	+ **	!	! *	! **	+	+	=	+	! **	+
GYFF	n.a.	+	+	+	+	+	!	! **	!	! *
BYFF	n.a.	!	+	+	!	!	!	! *	!	! **
HIFF	n.a.	+	+	!	+	+	!	!	+	!
KWTH	+ **	!	!	!	! *	!	=	+ **	+ **	+ **
KWBR	+ **	! **	! **	! **	! **	+	=	+ **	+ **	+ **
KWFF	n.a.	+	!	! *	!	+	!	+	+	+ **

[a] = the value is the same as indicated for 06BB

Table 3.15 Effect of Breeder selection vs. Farmer Selection in Breda in 1997 on different traits in 1998.

Trait	01	02	03	04	05	06BB	06BV[a]	07	08	09
GHTH	! **	! **	! **	! **	! **	!	=	!	!	! **
CDTH	+	! **	+ **	+ **	+ *	+	=	!	+	+
GVTH	+ **	+ **	+ **	!	+ *	!	=	!	!	!
DHTH	+ **	+ **	! **	! **	! **	! **	=	! **	! **	! **
LDGTH	! **	! **	! *	!	! **	!	=	!	! **	! **
ASBR	+ **	+ **	+ **	! **	+	+	=	!	!	!
PHBR	! **	! **	! **	+	! **	!	=	+	+ *	+
PHTH	! **	! **	!	+	! **	!	=	!	+	+
PHFF	n.a.	! *	! **	+ **	! **	+ *	!	+	+	!
TNTH	! **	! **	!	!	!	! *	=	!	+	!
TNBR	!	! *	! *	!	! **	! **	=	!	!	+ *
GYTH	+ **	+	+ *	! **	+ **	+ **	=	+ **	+	+
BYTH	!	! *	!	!	!	! *	=	!	+	+
HITH	+ **	+ **	+	!	+ **	+	=	+	+	+
GYBR	!	+	!	! *	!	! **	=	+ **	+	+
BYBR	!	! *	!	!	! *	! **	=	+ *	!	+ *
HIBR	!	+ *	!	!	+ *	+ *	=	+	+	!
GYFF	n.a.	+	! *	!	+	+ *	! **	+	+	+ *
BYFF	n.a.	+	! *	+	+	+	! **	! **	+	+
HIFF	n.a.	+ *	! *	!	+	+	!	+	!	+ **
KWTH	+ **	+ **	+ **	+ *	+ **	+	=	+ **	+ **	+ **
KWBR	+ **	+ **	+	+ *	+ **	+ **	=	+ *	+ **	+
KWFF	n.a.	+ **	!	!	! **	+	+	+	+	+

[a] = the value is the same as indicated for 06BB

Table 3.16 Effect of Breeder selection vs. Farmer Selection in the farmers' fields in 1997 on different traits in 1998.

Trait	01	02	03	04	05	06BB	06BV[a]	07	08	09
GHTH	+ **	+ **	! **	! **	! **	+ **	=	+ **	! **	! **
CDTH	! **	! **	!	+ **	+ **	! **	=	!	!	+
GVTH	!	!	+ **	+	+	! **	=	+	+ **	!
DHTH	! **	! **	+	+ **	+ **	! **	=	+ **	+ **	! **
LDGTH	+ **	+ **	! *	!	!	+ **	=	! *	! *	+ *
ASBR	! **	! **	!	+ **	+	! **	=	+	+	! **
PHBR	+ **	+ **	+ **	!	+	+ **	=	! **	! **	+
PHTH	! **	+	+	!	+	+ *	=	! **	! **	+ **
PHFF	n.a.	+	+	! **	+	+ **	! **	+	! **	+ **
TNTH	!	+	!	!	!	+	=	!	!	+
TNBR	!	!	!	+	!	+	=	!	!	! *
GYTH	! *	!	! **	+ *	!	! **	=	+ **	+ **	! *
BYTH	!	!	! *	+	!	+	=	+ **	+	+
HITH	! **	!	!	+	!	! **	=	+	+	!
GYBR	+ **	+ **	! *	! *	! *	+	=	+ **	+	! **
BYBR	+	!	!	! **	+	+	=	! **	!	!
HIBR	+ **	+ *	!	+	!	!	=	+	+	!
GYFF	n.a.	!	!	!	!	!	! **	+ **	+	+
BYFF	n.a.	!	!	!	!	+	! **	! **	!	+
HIFF	n.a.	+	!	!	!	!	+	+	+	!
KWTH	+ **	+ **	+	!	+ *	+ **	=	+ **	+ **	!
KWBR	+ **	+ **	!	! *	!	+ **	=	+ **	+ **	!
KWFF	n.a.	+ **	!	!	!	+ **	+ **	+ **	+ *	!

[a] = the value is the same as indicated for 06BB

In the case of grain yield only few differences were significant. The breeder's selections yielded more than the farmers' selection in three cases, in two of which they also produced more straw.

In Breda (Table 3.14), the selections done by the farmers and the breeder in Tel Hadya did not differ, and when they did, the farmers' selections out yielded the breeders' selection in three out of four cases. Eventually, in farmers fields differences between the selections made by the farmers and the breeders in Tel Hadya were only significant in two cases, and in both of them farmers' selections yielded more.

Kernel weight, particularly in Breda, was almost always different in the selections made by the breeder and the farmer. Kernel weight in Tel Hadya was more often higher in the breeder's' selections, while kernel weight in Breda was higher in the breeders' selections in four cases, and higher in other four. Breeders selections had a larger kernel weight in Tel Hadya in four cases, the farmers' selections has larger kernels in only one case, and in all other cases the differences were not significant.

The were many more significant differences among the breeders and farmers selections made in Breda in 1997 (Table 3.15), and the differences were more consistent than those observed among the selections made in Tel Hadya. The breeders' selections in Breda always had a more erect habit than the farmers' selections, and in six cases the differences were significant, they tended to be more cold susceptible (with the exception of the selections made by the farmer from Ebla), they were earlier (but not in comparisons with the selections made by the farmers from Ibbin and Ebla), were more lodging resistant, were shorter (with some exceptions in Breda and farmers fields), and had larger kernels in

Tel Hadya and Breda. The differences between breeder and farmers' selections in Breda were less clear for other traits. In the case of grain yield, the selections made by the breeder in Breda yielded more than most of the farmers' selections in Tel Hadya, yielded more than farmers' selections in only one case in Breda, and in only two cases in farmers' fields where the farmers selections yielded significantly more in one case. Total biological yield tended was more often significantly higher in the farmer selections.

The comparison between the selections made by the breeder and the farmer in farmers' fields in 1997 (Table 3.16) resulted in several significant differences with a large variability in the signs of the differences depending on the particular farmer being considered. The most consistent differences were found for kernel weight, which with only one exception was higher in the breeder's selections. Grain yield in Tel Hadya and Breda was affected more by who did the selection than grain yield in farmers' fields: in both cases the number of differences in favor of the farmers' selections was slightly higher.

A summary of the effect of the selection done in 1997 by the breeder and the farmers in Tel Hadya, Breda and the farmers' fields on grain yield and total biological yield in 1998 is given in Table 3.17. In the case of grain yield, the number of differences in favor of the breeder's selections is nearly the same as the number of differences in favor of the farmers' selections. The effectiveness of the breeder seems to be as good as, or better than the farmer on station, while the farmers seem to be slightly more effective in farmers fields. In the case of total biological yield, farmers' selections were higher yielding more often than breeder's selections no matter where the 1997 selections were made.

Table 3.17 Number of significant differences in grain yield and total biological yield observed in 1998 between the selections done by the breeder's and farmers' in 1997.

Location in 1998	Selection in 1997 done at:					
	Tel Hadya		Breda		Farmer Fields	
	Breeder	Farmer	Breeder	Farmer	Breeder	Farmer
Grain Yield						
Tel Hadya	3	0	5	1	3	4
Breda	1	3	1	2	3	4
Farmer Field	1	2	2	2	1	1
Total	5	5	8	5	7	9
Total Biological Yield						
Tel Hadya	2	2	0	2	1	1
Breda	0	1	2	3	0	2
Farmer Field	0	2	0	3	0	2
Total	2	5	2	8	1	5

3.1.3 Effect of rotation on selection preferences

An interesting aspect of the influence of the selection environment on the type of germplasm selected by the breeder and the farmers is represented by the two different rotations under which the trial was planted in Al Bab. The two trials were identical, since in 1997 selection was made in the barley-barley rotation, and were adjacent to each other, being planted on both sides of the border between a barley field and a vetch field to minimize differences not attributable to the rotation.

To compare the selections done under the two rotations we calculated how many of the lines selected by each of the seven farmers who participated in the group selection in each of the two rotations, was also selected by the other six farmers and by the breeder in the same or in the other rotation. These numbers were expressed as percent of the lines selected by each of the same farmers (Table 3.18). The agreement between the selections made under the same rotation was on average twice as large as the agreement between selections made in the two different rotations. Only in one case the agreement between farmers was little affected by the rotation (this is the case of farmer number 2). The rotation also affected the agreement between farmers and breeder. When the breeder and the farmers selected in the trial planted after barley, the agreement varied from a maximum of 100% to a minimum of 46%. When the farmers selected in the trial planted after barley and the breeder selected

in the trial planted after vetch, the agreement was between 53% and 23%, and was from 1.4 to 3 times lower.

Table 3.18 Farmer and breeder selection in the same trial planted after barley (BB) and after vetch (BV). Percent of lines selected by each of seven farmers in the trial planted after barley which were also selected by the other six farmers and by the breeder either in the same trial or in the trial planted after vetch.

Farmer	Mean of other six Farmers		Breeder	
	After Barley	After Vetch	After Barley	After Vetch
1	0.38	0.14	1.00	0.33
2	0.33	0.29	0.73	0.53
3	0.34	0.14	0.87	0.27
4	0.33	0.19	0.53	0.33
5	0.31	0.13	0.85	0.38
6	0.39	0.19	0.50	0.29
7	0.31	0.12	0.46	0.23
Mean	0.34	0.17	0.71	0.34

The rotation affected the preference for one of the two opposite expression of the same trait (Table 3.19). For example, the farmer's selections were significantly taller than the population mean in the trial planted after barley, but significantly shorter in the trial planted after vetch. Also the farmer's selections in the trial planted after barley did not show any difference in lodging resistance compared with the population mean, while the selections made in the trial planted after vetch were significantly more lodging resistant than the population mean.

Table 3.19 Plant height (cm) and reaction to lodging (1=resistant; 9= susceptible) of lines selected in the same location under two different rotations (barley-barley and barley vetch).

	Plant height		Reaction to Lodging	
	Barley-barley	Barley-vetch	Barley-barley	Barley-vetch
Selections	48.1***	50.3*	2.6	1.2**
Pop. mean	43.2	54.6	2.4	2.4

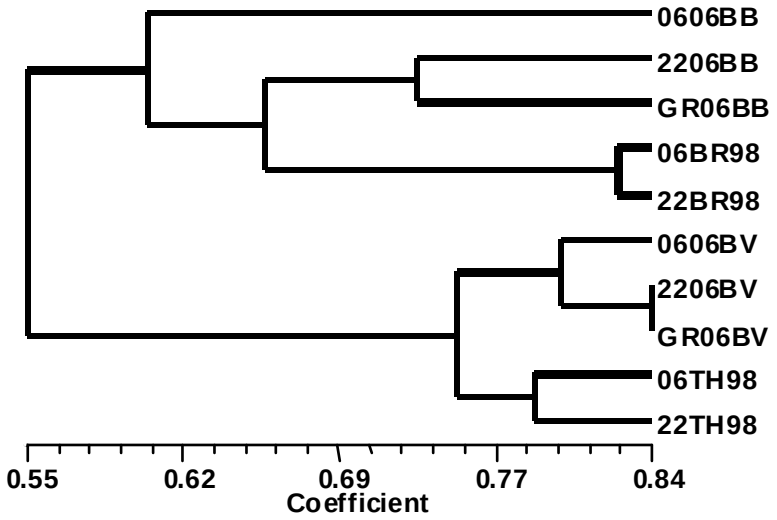
The effect of rotation on selection preferences was also analyzed with the similarity analysis by calculating the dice coefficients between the selections done by the host farmer, the group of farmers, and the breeder in the farmer's field (in both trials) as well as in Breda and Tel Hadya.

The dendogram of the similarity coefficients (Fig. 3.1) shows two distinct clusters; the first includes the selections made by the host farmer, by the farmers' group and by the breeder in the trial planted after vetch (BV) and those made by the host farmer and by the breeder in Tel Hadya. The second includes the selections made by the host farmer, by the farmers' group and by the breeder in the trial planted after barley (BB) and those made by the host farmer and by the breeder in Breda. The trial planted in Al Bab after vetch had an average grain yield of 1134 kg/ha, not very different from the average grain yield of Breda (936 kg/ha), while the trial planted after vetch had an average grain yield (2567 kg/ha) of the same order of magnitude of Tel Hadya (3155 kg/ha). Therefore, the effect of the rotation was to cause a genotype x environment interaction similar to what we observed often in comparing trials planted at Breda and Tel Hadya.

The effect of the rotation on the farmer preferences is further shown in Table 3.20 where we show the 5% most preferred lines by the farmers under the two rotations using the index of preference described earlier.

The 5% most preferred lines in the barley-barley trial were all different from the 5% most preferred in the barley-vetch trial. Of the most preferred lines in the barley-barley trial, only one was selected by the farmer in Tel Hadya, and none were selected by the breeder at Tel Hadya. By contrast, out of the six most preferred lines in the barley-vetch trial, four were selected by the farmer in Tel Hadya, and four were selected by the breeder at Tel Hadya.

Fig. 3.1 Dendogram of the host farmer in Al Bab (06), of the farmers' group (GR) and of the breeder (22) based on cluster analysis of their selections in the farmers' field (06), both in the trial planted after barley (BB) and in the trial planted after vetch (BV), in Tel Hadya (TH) and in Breda (BR).



The most preferred lines in barley-barley trials had a low index of preference in the barley-vetch trial (from 0.05 to 0.54); the line with 0.54 as index of preference ranked seventh in barley-vetch trial, and was the line with the best combination of preferences in the two trials. Similarly the most preferred lines in the barley-vetch trial had had indexes of preference ranging from 0.09 to 0.26 in the barley-barley trials.

These results illustrate an additional important advantage of participatory breeding programs which consists in the possibility of rapidly adapting the breeding material to the changes in agronomic practices and farming systems of the target environments. Selection under different rotations and agronomic practices is very difficult and very expensive to be incorporated in centralized breeding program. Decentralized plant breeding allows doing it at no additional cost provided innovative farmers are included among the participants or are added to provide this additional advantage.

Table 3.20. The entries most preferred by farmers from the same trial planted once after barley (top) and once after vetch (bottom). RT is the row type, F-BR, F-TH, BR-FF, BR-BR, and BR-TH indicate whether the entries were selected by the farmer in Breda or Tel Hadya, or by the breeder in the farmer field, in Breda or Tel Hadya, respectively. The two indexes of preferences, A and B, refer to the trial in which the selection took place and in the other trial, respectively.

Entry	RT	F-BR	F-TH	BR-FF	BR-BR	BR-TH	Index of Pref.(A)	Index of Pref.(B)
Most preferred in the barley-barley trial								
97	2	0	0	1	1	0	0.68	0.14
23	6	0	1	1	0	0	0.56	0.20
139	2	1	0	1	1	0	0.52	0.54
17	6	0	0	1	0	0	0.48	0.30
201	2	0	0	1	0	0	0.44	0.26
138	2	1	0	1	1	0	0.38	0.05
Most preferred in the barley-vetch trial								
3	6	0	0	1	0	1	0.86	0.26
41	2	1	1	1	1	1	0.65	0.21
119	2	0	1	1	0	1	0.59	0.11
82	2	0	1	1	1	0	0.58	0.18
34	2	0	1	1	0	1	0.56	0.14
31	2	0	0	1	1	0	0.55	0.09

Entry		Name
97	=	Carina/Moroc 9-75
23	=	Baca'S'/3/AC253//CI 08887/CI 05761/4/JLB 70-01
139	=	Sara 01
17	=	Bal.16/Api//Deir Alla 106/3/Comp.Cr.229//As46/Pro
201	=	Arabi Abiad/WI2291//Tadmor/4/H.spont.93-4/3/Roho//Alger/Ceres 362-1-1
138	=	H.spont.41-5/Tadmor//Moroc 9-75
3	=	Arar/Rhn-03
41	=	ChiCm/An57//Albert/3/Alger/Ceres 362-1-1
119	=	ER/Apm//Lignee 131/3/Lignee 131/Arabi Abiad
82	=	Carina/WI2291
34	=	Emir/Sbt//CM67/3/F8-HB-854-23/121//148-221/4/CI 08887/CI 05761/5/Cerise/Lignee 1479
31	=	WI2198/Hml-02//INRA55-86-2/Rt1703

3.1.4 Yield gains in farmers' fields

There was a wide range of variation for yield in the farmers fields (Table 3.21) including a number a very low yielding entries in the driest locations. The number of lines out yielding significantly the mean of the check plots varied from a minimum of 4 in Tel Brak to a maximum of 29 in Bari Sharki. The latter is probably due to a poor choice of the check in that location.

The average yield advantage ranged from 15% to slightly more than 40%. The majority of the lines out yielding significantly the checks were selected (in one of the various types of selection) for a third year evaluation in 1999.

Table 3.21 Mean grain yield, range of variation, number and grain yield of lines out yielding significantly the mean of the checks in farmers' fields and their yield advantage.

	02	03	04	05	06BB	06BV	07	08	09
Grand Mean[a]	2804	716	738	828	1109	2564	420	1730	2219
Max	4338	1663	2175	1925	2763	5694	1131	3600	4381
Min	643	138	125	138	0	1063	31	600	894
nr lines > check	7	4	10	9	7	17	7	29	19
Mean[b]	4167	1495	1618	1463	2190	4306	840	2581	3382
mean check	3616	1049	1138	1026	1656	3368	662	1969	2689
mean yield increase	15.2	42.5	42.1	42.6	32.3	27.9	26.9	31.1	25.8
Selected for 1999	all	all	8	all	all	all	all	25	13

[a] These means do not correspond to the values given in Table 4 because based on all entries and not on those common to all trials

[b] Means of the lines out yielding significantly the mean of the check

3.1.5 Actual selection criteria

We followed the definition of actual selection criteria (as opposed to declared selection criteria) given in the 1997 report, as those traits for which the mean of the selected lines differs significantly from the mean of the population from which the lines were selected. To identify the actual selection criteria used by the farmers and by the breeder we used the data recorded on the plant characteristics listed at pg. 10-11. The difference between the mean of the lines selected by the breeder or by the farmers in either the farmers' fields or the experiment stations and the mean of the initial population of 208 lines was tested with a t-test for groups of unequal size (Table 3.22). The data in the table are the number of times the difference between the mean of the selected lines was significantly different from the population mean. The total number of differences analyzed was nine for each trait and in each column, with the exception of breeder selection which was done on seven farmers' fields only, and of plant height, kernel size, grain yield and total biological yield that were measured in only eight farmers' fields.

The traits, which were more often selected for by the farmers, were taller plants and higher grain yield in their fields; lodging resistance, larger kernels, higher grain yield and shorter plants in Tel Hadya; and taller plants and higher grain yield in Breda. The traits, which were more often selected for by the breeder, were taller plants and higher grain yield in farmers' fields; later heading, lodging resistance, higher grain yield, larger kernels and shorter plants in Tel Hadya; and higher grain yield and taller plants in Breda.

Breeder and farmers had a similar ability in identifying lines out yielding significantly the population mean in farmer's fields and in Breda. However, in Tel Hadya the breeder's selections always out yielded significantly the population mean, while in the case of the farmers this happens only in 5 out of 9 cases. It must be pointed out that the real issue in participatory plant breeding is whether the farmers' selection in their own fields is reliable and not whether they are able to select efficiently in an environment such as an experiment station located in a high rainfall area which is not familiar to most of them.

Table 3.22 Actual selection criteria used by farmers and breeder: number of significant differences between the mean of the selected lines and the population mean (t-test for groups of unequal size).

Trait[a]	Expression	Farmers' selection			Breeder's selection		
		his own field	Tel Hadya	Breda	farmers field	Tel Hadya	Breda
Growth habit	Erect	1	2	0	0	2	0
	Prostrate	1	0	1	2	0	0
Growth vigor	Poor	0	3	0	0	0	0
	Good	2	0	3	1	0	1
Cold tolerance	Resistant	2	0	2	2	0	0
	Susceptible	0	2	0	0	0	0
Heading	Earlier	2	0	2	1	0	0
	Later	1	1	0	1	9	0
Lodging	Resistant	1	9	0	1	8	0
	Susceptible	2	0	3	1	0	0
Tillering in TH	Higher	2	0	1	1	0	0
	Lower	0	1	0	0	0	0
Tillering in BR	Higher	0	0	0	1	0	0
	Lower	0	0	0	0	0	1
Kernel size[b]	Larger	0	6	2	1	7	2
	Smaller	1	0	2	0	0	0
Height[b]	Taller	5	0	6	5	0	4
	Shorter	1	4	1	0	4	0
GY FF	Higher	4	0	0	4	1	0
	Lower	0	1	0	0	0	0
GY BR	Higher	2	0	5	2	0	5
	Lower	0	0	0	0	4	0
GY	Higher	1	5	0	0	9	0
	Lower	3	0	2	1	0	0
BY FF	Higher	1	0	1	3	3	0
	Lower	0	1	0	0	0	0
BY BR	Higher	2	0	3	1	0	2
	Lower	0	0	0	0	2	0
BY	Higher	0	0	0	0	1	0
	Lower	0	0	0	0	0	0

[a] GY = grain yield; BY = total biological yield; BR = Breda; FF = Farmer Fields

[b] measured at the selection site.

Of interest are some of the correlated responses to selection for grain yield. For example, farmers' selection in farmers' fields and in Breda resulted in a decreased grain yield at Tel Hadya in three and two cases, respectively. Also the selection of the breeder in Breda caused a decrease in grain yield at Tel Hadya in four cases.

The environment of selection affected the preference for one of the two opposite expression of the same characters. In the case of lodging (Table 3.23), the selections made in farmers' fields (by the breeder and the farmer) were more lodging resistant (like those made in Tel Hadya) than the population mean when the field was in a high rainfall area, but were more lodging susceptible (like those made in Breda) than the population mean when the field was in a low rainfall area.

Table 3.23 Resistant or susceptible to lodging? Reaction to lodging (1 = resistant, 9 = susceptible) in the trials planted at Ibbin and Melabya of barley lines selected by the breeder and the farmer at Tel Hadya, Breda and the farmer's field compared with the population mean with a t-test for samples of unequal size.

Selected by	Selected at			Selected at		
	Tel Hadya	Ibbin	Breda	Tel Hadya	Melabya	Breda
Farmer	1.2*	1.4*	3.5*	1.6**	5.3***	5.3***
Breeder	1.0*	-	2.1	1.0**	5.6***	2.5
Pop. Mean	2.4			2.6		

Similarly in the case of plant height (Table 3.24) the breeder, and less consistently the farmer, selected for shorter plants in Tel Hadya, but for taller plants in dry sites such as Breda, Al Bab and Melabya.

Table 3.24 Tall or short? Plant height (cm) in the trials planted at Al Bab (after barley) and in Bylounan of barley lines selected by the breeder and the farmer at Tel Hadya, Breda and the farmer's field compared with the population mean with a t-test for samples of unequal size.

Selected by	Selected at			Selected at		
	Tel Hadya	Al Bab	Breda	Tel Hadya	Bylounan	Breda
Farmer	71.1*	42.9*	48.1***	79.0	45.1***	43.0**
Breeder	71.8*	40.7	46.5*	74.0**	42.8*	37.9
Pop. Mean	77.5	37.7	43.3	80.3	39.6	36.6

3.1.6 Effectiveness of selection

It has been shown earlier that grain yield was used as selection criteria by both the breeder and the farmer. Here we address the question of whether, and how effectively, the breeder and the farmers were able to identify the highest yielding entries in each location. As a measure of effectiveness we considered how many entries among those that the farmers and the breeder selected in the farmers' field out yielded significantly ($P<0.05$) the mean of the systematic check used in that location (checks are shown in Table 3.1). These entries will be defined as the highest yielding entries.

The total number of highest yielding entries was 109 (8.9% of the total number of lines tested, excluding the checks) (Table 3.25). In each trial the number of highest yielding entries varied from a minimum of 4, or 3.5%, in Tel Brak (location 3), to a maximum of 29 (20.7%) in Bari Sharki (location 8).

The breeder in Tel Hadya was able to select the largest number of highest yielding entries, followed by the farmers groups selecting in farmers' fields and by the farmers selecting in their own fields.

However, when expressed as percentage of the total number of entries selected by the different participants in the different environments, the largest percent of highest yielding entries was among the selections made by the groups of farmers, followed by the individual farmers' selections in farmers' fields and by the breeders' selections in farmers' fields. In all these cases some highest yielding entries were identified and selected in every farmer's field.

This contrasts with the percent of highest yielding entries among the breeder's selections in Tel Hadya which although not very different, is the result of some remarkable successes, such as the identification of the highest yielding entries in Bari Sharki and Sauran, and of some remarkable failures, such as the inability to identify any of the highest yielding lines in Tel Brak and Al Bab (the trial planted after barley).

Of particular interest is that selection in Tel Hadya was able to identify some of the highest yielding entries in the barley-vetch rotation in Al Bab, but none of the highest yielding entries in the same trial planted after barley.

Table 3.25 Number of entries out yielding significantly the mean of the checks in farmers' fields (in parenthesis the percentage of the total number of selected entries).

Locations	Total	F-FF	F-BR	F-TH	B-FF	B-BR	B-TH	GR
02	7	4 (13.3%)	0 (0.0%)	3 (9.7%)	2 (4.7%)	2 (5.0%)	3 (10.3%)	1 (4.0%)
03	4	4 (10.5%)	0 (0.0%)	0 (0.0%)	4 (7.3%)	1 (2.7%)	0 (0.0%)	-
04	10	2 (11.1%)	2 (11.8%)	2 (6.9%)	4 (9.5%)	4 (8.9%)	3 (11.5%)	3 (11.5%)
05	9	5 (9.8%)	2 (6.1%)	4 (9.5%)	7 (13.2%)	3 (7.0%)	4 (12.5%)	4 (28.6%)
06BB	7	7 (10.3%)	2 (14.3%)	0 (0.0%)	6 (14.3%)	5 (13.5%)	0 (0.0%)	5 (9.8%)
06BV	17	11 (73.3%)	1 (7.1%)	8 (19.5%)	9 (23.1%)	2 (5.4%)	5 (18.5%)	12 (25.0%)
07	7	2 (11.1%)	3 (18.8%)	1 (1.8%)	5 (33.3%)	3 (5.3%)	2 (4.7%)	-
08	29	3 (15.8%)	7 (43.8%)	6 (60.0%)	-	7 (20.6%)	10 (45.5%)	16 (55.2%)
09	19	3 (14.3%)	2 (8.7%)	3 (8.3%)	10 (15.6%)	2 (4.9%)	9 (25.0%)	5 (14.3%)
Total	109	41 (14.8%)	19 (10.9)	27 (6.7%)	47 (13.3%)	29 (7.0%)	36 13.1%)	46 (16.6%)

3.2.7 Effect of decentralized-participatory selection on diversity

One of the hypotheses to be tested with this project is related to biodiversity. Because of the emphasis on specific adaptation, it is expected that, starting from the same gene-pool, centralized-non participatory breeding will ultimately result in fewer and less diverse lines than decentralized-participatory breeding.

To test this hypothesis, we compared the frequency of different types of germplasm after two cycles of contrasting types of selection, namely decentralized-participatory and centralized-non participatory. The composition of the initial population of 208 entries is shown in the first column of Table 3.26 with regards to germplasm types such as row type (two vs. six-row), modern or landraces, fixed or segregating and seed color.

The total number of entries left after two cycles of decentralized-participatory selection was double the number of entries left after two cycles of centralized-non participatory selection in Breda and three times higher than the number of entries left after two cycles of centralized-non participatory selection in Tel Hadya.

The reduction in the total number of entries does not give a full picture of the decrease in diversity associated with centralized selection. In fact, both in Tel Hadya and in Breda, some type of germplasm disappeared after two cycles of selection. This was the case of landraces and black-seeded types in Tel Hadya, and of the six- row types in Breda.

Table 3.26 Number (and percent of the original population) of different types of germplasm after two cycles of decentralized-participatory selection and centralized-participatory selection (in two different research stations) done in an initial population of 208 barley entries.

	Initial population	Decentralized Participatory	Centralized-non Participatory (TH)	Centralized-non Participatory (BR)
Total	208 (1.00)	52 (0.25)	17 (0.08)	26 (0.13)
2 row	158 (0.76)	42 (0.81)	12 (0.71)	26 (1.00)
6 row	50 (0.24)	10 (0.09)	5 (0.29)	0 (0.00)
Modern	100 (0.48)	23 (0.44)	17 (1.00)	10 (0.38)
Landraces	108 (0.52)	29 (0.56)	0 (0.00)	16 (0.62)
Fixed	100 (0.48)	27 (0.52)	10 (0.59)	17 (0.65)
Heterogeneous	108 (0.52)	25 (0.48)	7 (0.41)	9 (0.35)
White	161 (0.77)	38 (0.73)	17 (1.00)	16 (0.62)
Segregating	19 (0.09)	5 (0.10)	0 (0.00)	0 (0.00)
Black	28 (0.14)	9 (0.17)	0 (0.00)	10 (0.38)

The same phenomenon, i.e. the disappearance of some germplasm types, does occur also in decentralized-participatory selection, but different germplasm types disappear in different locations.

For example, two cycles of decentralized-participatory selection led to the disappearance of six-row types in all the sites except Ibbin and Ebla, but to an increase of the frequency of the six-row types in wet sites which went from 24% in the original population to 50% in Ibbin and 56% in Ebla. Figure 3.2 shows the example of Ibbin and Bylounan)

The frequency of landraces, which changed in opposite directions depending on whether centralized-non participatory selection was conducted in Tel Hadya or in Breda, also changed in opposite directions in decentralized-participatory selection depending on whether the location was dry or wet.

Fig. 3.2 Change in the frequency of two- and six row-types after two cycles of centralized-non participatory selection in Tel Hadya (wet research station) and two cycles of decentralized-participatory selection in Ibbin (wet) and Bylounan (dry).

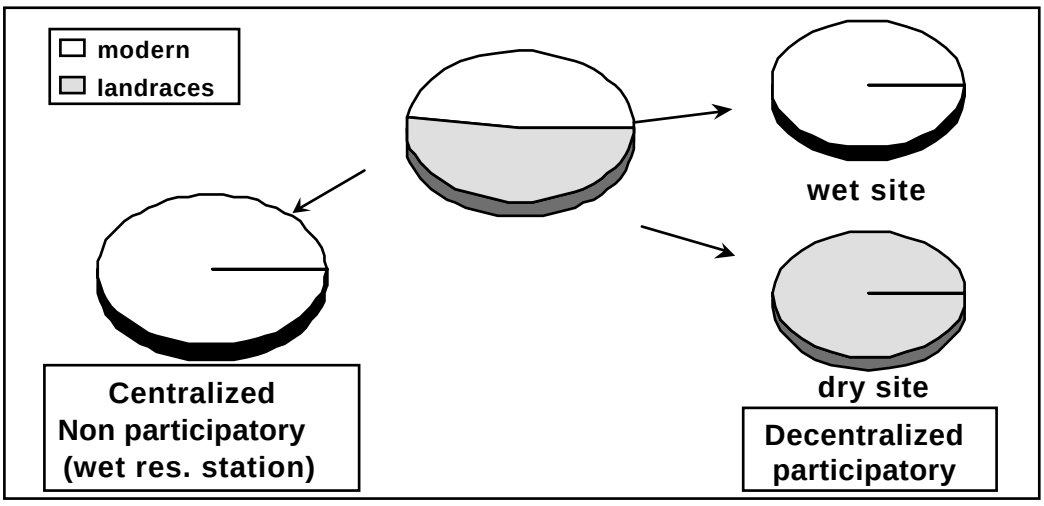


Fig. 3.3 **Change in the frequency of modern and landraces after two cycles of centralized-non participatory selection in Tel Hadya (wet research station) and two cycles of decentralized-participatory selection in Ebla (wet) and Melabya (dry).**

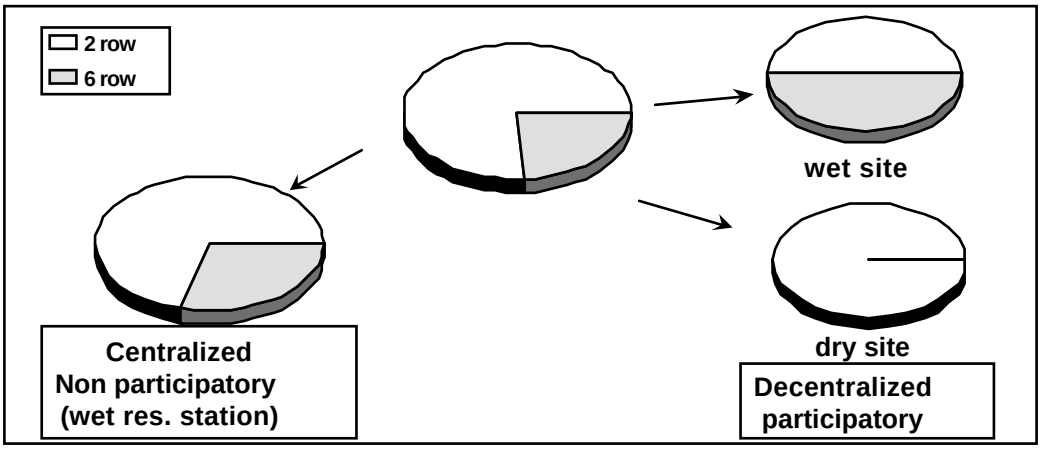


Fig. 3.4 **Change in the frequency of black-seeded and white seeded entries and of entries segregating for seed color after two cycles of centralized-non participatory selection in Tel Hadya (wet research station) and two cycles of decentralized-participatory selection in Ebla (wet) and Jurn El-Aswad (dry).**

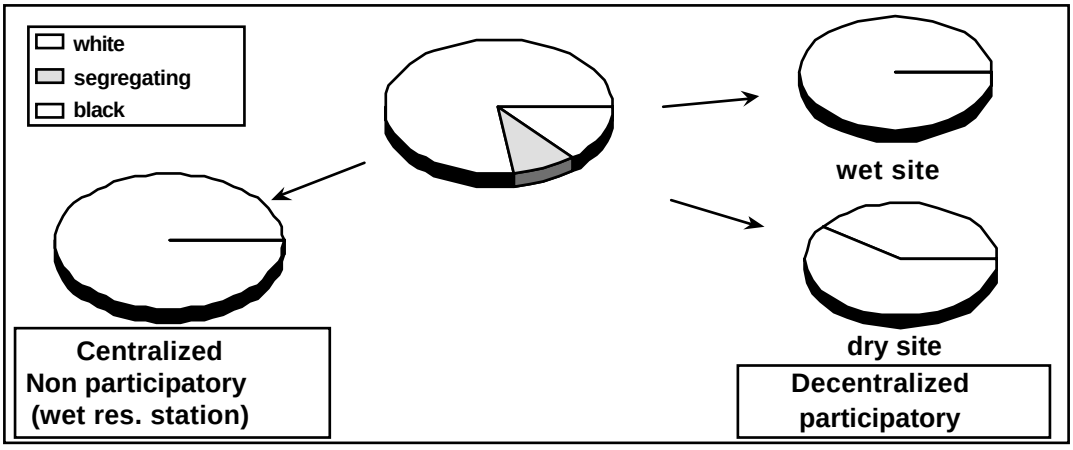


Figure 3.3 shows the case of Ebla, where two cycles of decentralized-participatory selection led to the disappearance of landraces, like in the centralized-participatory selection in the wet research station, while in Melabya two cycles of decentralized-participatory selection led to the disappearance of modern germplasm.

Decentralized-participatory selection had the same effect of centralized-non participatory selection in the wet research station on the black seeded types leading to their disappearance (Fig.4 shows the example of Ebla). This also happened in Sauran and Bari Sharki, where farmers notoriously favor white seeded types. However, in dry sites the frequency of black-seeded types increased almost two-fold in two cycle of selection, as in Jurn El-Aswad (shown in Fig. 3.4). In one extreme case (Bylounan), the population of entries resulting from two cycles of decentralized-participatory selection was only made by black-seeded entries and by entries segregating for seed color in equal proportions.

In conclusion, the selection done by farmers and breeder has similar, negative consequences on genetic diversity. However, in a decentralized breeding program, different genes will be fixed in different sites, and while the genetic diversity will decrease at any particular site, it will be maintained, or even increased across sites.

3.1.7 1998/99 trials

Based on the selection conducted during 1998 in each of the ten trials, (the trial planted in Al Bab in a vetch-barley rotation was considered as an additional trial), we assembled the following groups of lines:

(1)	The lines selected by the farmer	in his own field
(2)	"	in Tel Hadya
(3)	"	in Breda
(4)	The lines selected by breeder	in the farmer field
(5)	"	in Tel Hadya
(6)	"	in Breda
(7)	The lines selected by the farmers groups (where available)	

With the selected lines, and avoiding duplications within the same trials, we prepared a specific trial for each of the nine locations. In Al Bab the trials continued in the same two rotation as in 1998. The farmer at Ibbin, due to personal problems, could not continue to plant barley on his farm. Therefore, Ibbin was replaced by a new site, Tel Tafer, with similar soil type, rainfall and cropping system.

The layout included a systematic check every ten entries. The total number of entries (including the checks) in each trial is listed in Table 3.27 together with the layout of the trial, the planting dates and the name of the check used in each location.

Table 3.27 Composition and planting dates of the 1998/99 trials

Location (code)	Planting dates (1998)	Nr of lines	Layout	Check
Tel Tafer (01)	19.11	120	30 x 4	Rihane-03
Ebla (02)	12.11	132	33 x 4	Rihane-03
Tel Brak (03)	8.11	116	29 x 4	Tadmor
Jurn El-Aswad (04)	6.11	116	29 x 4	Tadmor
Baylonan (05)	6.11	128	32 x 4	Zanbaka
Al Bab (06) after barley	5.11	128	32 x 4	Sara
Al Bab (10) after vetch	5.11	108	27 x 4	Sara
Melabya (07)	8.11	132	33 x 4	Zanbaka
Bari Sharki (08)	10.11	120	30 x 4	WI2291
Sauran (09)	11.11	120	30 x 4	Arta

The same ten trials, with a total of 1220 lines, were also planted in Tel Hadya and Breda, where each farmer will conduct the selection within his own trial, while the breeder will select in every trial.

In addition to the trials described in Table 3.28, at each farmer's field we planted the lines which were considered by the farmer the best at his particular location. These lines were planted unreplicated, besides the project trials, but in plots 30 m long and 1.8 m wide, which will produce enough seed to plant about ¼ hectare in the following cropping season. The total number of lines among which we may find some being adopted next year is large (128). Of these the majority (56) are present only once, 20 are present twice, 8 are present three times and only one is present in four farmers' fields, indicating clearly a predominance of "pocket" varieties.

Table 3.28 Number of lines representing farmers' first choice planted in the different locations in 1998/99.

Location (code)	Nr of lines
Tel Tafer (01)	15
Ebla (02)	24
Tel Brak (03)	10
Jurn El-Aswad (04)	15
Baylonan (05)	10
Al Bab (06) after barley	11
Al Bab (10) after vetch	12
Melabya (07)	11
Bari Sharki (08)	9
Sauran (09)	11
Total	128