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CHARACTERIZATION OF FORTY ONE BARLEY LANDRACES USING MORPHOLOGICAL AND CYTOLOGICAL CHARACTERS AND RESPONSE TO SALINITY

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ABSTRACT

This study was carried out at the National Gene Bank and Genetic Resources of the Agricultural Research Center (ARC), Egypt to evaluate forty one diverse landraces of barley under salinity in a laboratorial experiment. Besides, the actual morphological differences among these barley genotypes were tested at different stages of growth in a field experiment during the two successive seasons of 2008/2009 and 2009/2010. Hoagland solution No.1 was used in the laboratory experiments as a base nutrient medium. Three salt treatments were tested, viz. (1) control, (2) 8000 ppm and (3) 12000 ppm. Results revealed highly significant differences in seedling height, fresh weight and dry weight among the 41 entries in their response to salinity stresses. The cytogenetical study revealed great differences in the mitotic index of the tested lines. The highest mitotic index was shown by 14 landraces. These landraces may be considered as more adapted to the Egyptian conditions than the other lines in which mitotic index was sharply reduced. In additional, the studied lines exhibited variation in frequencies of cells containing chromosomal aberrations in mitotic divisions. Twenty one out of the 41 lines tested showed no chromosomal aberrations. These lines had higher cytological stability and may be voluble to barely breeders in any future breeding programs. The results of the field experiments revealed great differences in certain morphological characters among the tested genotypes that could be used. Cluster analysis was applied by sequentially dividing groups of genotypes via un-weighted pair grouped method using arithmetic average. The analysis produced three main groups. Theses groups are split into many subgroups based on similarity and dissimilarity of genotypes. The results indicated that genotypes 1, 2, 3, 6, 9, 11, 19, 25, 26, 27, 37, 38 and 40 have a high distance level between each other and will produce good newly genetic combination if they are used in a crossing program.

Key words. ***Barely, Hordeaum vulgare, Landraces, Salinity stress, Cytological stability, Dendrogram.***

INTRODUCTION

Barley (*Hordeum vulgare* L.) is a major cereal crop cultivated in the rain fed areas of the West Asia and North Africa region, where drought is the most important abiotic factor limiting barley yield. Barley can be grown on many soil types including well drained, fertile loams and lighter clay soils. It tolerates loamy to heavy soils but will not do well in water logged soils. It has very good heat and drought tolerance, making it a valuable crop

for semiarid areas. Barley is also the most salt-tolerant among cereal crops. It grows at soil pH between 5.0 and 8.3. It thrives in cool, dry conditions

Screening for salt-tolerant barley germplasm is important to determine whether there is a genetic basis for selection and breeding purposes (Alonso *et al* 1999). Salt tolerance has been identified as a developmentally regulated, stage-specific phenomenon with tolerance at one stage of plant development being poorly correlated with tolerance at other stages (Foolad *et al* 1998). In addition, at each stage of plant development, salt tolerance appears to be controlled by more than one gene and to be highly influenced by environmental factors (Mano and Takeda 1995). Although field screening for salt tolerance has the advantage of testing germplasm under natural conditions, it is less efficient and more expensive than screening under controlled conditions (Shannon and Noble 1990).

Characterization and preliminary evaluation of crop germplasm for desired agronomic and genetic traits and identifying the desired genotypes for utilization in development of new improved varieties is the task of crop breeders and gene banks.

Evaluation of genotype performance under different stress conditions including salinity levels is important in plant breeding. The differential response of genotypes when subjected to different salinity levels possess a major problem of relating phenotypic performance to genetic constitution and makes it difficult to decide which genotype should be selected. It is important to fully understand the nature of genotype x salinity interaction to make testing and selection of more efficient genotypes.

Chromosomal stability represents one of the major factors for maintaining agronomical important genes in any field crop. Therefore, well adapted new varieties with high rate of cytological stability must be considered in a crossing program. Spontaneous abnormalities, either in form of chromosomal aberration or micronuclei, represent the major factors responsible for cytological instability. The micronuclei occur in two different types, compact and non compact. The possibility of genetic control of micronuclei types in barley was detectable (Fayed 1990).

The aims of the present study are to evaluate forty one local landraces of the genetic resources of barley (genetically diverse genotypes) for grain yield and its contributing characters under salinity during the germination throughout experiment in the laboratory and the field to identify the desired genotypes for utilization in development of new improved cultivars.

Cultural practices were applied as usually recommended for the ordinary barley fields.

MATERIALS AND METHODS

The studied barley genetic recourses were selected from the genetic resources of the National Gene Bank and Genetic Resources, Agricultural Research Center, Egypt which represent a wide genetic background. Moreover, these genetic resources included forty one entries representing collections from South Sina, Qena and Sohag Governorates (number 1 to 15 collected from South Sina; number 16 to 30 from Qena and number 31 to 41 from Sohag). The study was conducted during the two successive winter seasons 2008/2009 and 2009/2010 in National Gene Bank and Genetics Resources Laboratory and farm at Giza.

Laboratory screening experiment

In 2008/2009 a total of forty one landraces of barley genetic resources collected from South Sina, Qena and Sohag by the help of some farmers on the top and side mountains. The landraces were screened under controlled conditions, using plastic pots (10 cm diameter and 18 cm depth) filled with washed sand. Ten seeds from each entry were sown per pot. Salt treatments of 8000 ppm (S1) and 12000 ppm (S2) along with their control, fresh water (S0) were used. The treatments were sown in three replicates. Hoagland solution No.1 was used of nutrient solution (as the base nutrient medium). All irrigation water was prepared from salts of sodium and calcium chlorides in the ratio of 3:1. All irrigations with saline water and fresh water were applied at intervals of five days. The experiment was terminated after 35 days from sowing and data were recorded on height of plant, fresh and dry weight of seedlings.

Cytological studies

Seeds of the lines were germinated on moistened filter paper in Petri-dishes at room temperature (20-25C). Root-tips were collected and pretreated by fixed in ethanol-glacial acetic acid (3:1). After 24 hours root tips were transferred to 70% ethylalcohol and stored. The aceto-carmine staining method was used to stain the root tips cells as described by Fayed *et al* (1985) and Sayed-Ahmmed (1985). The fixed root-tips were washed thoroughly with distilled water and macerated by IN HCl at 60C for 3 minutes and then washed with distilled water. Subsequently, individual root tips were warmed gently in drop of aceto-carmine for a short time. The apexes of roots were squashed on dry clean slides and stained with a small drop of fresh stain. The covers lips were removed by the dry-ice method and the slides were immersed in 96% ethyl alcohol for few minutes and then mounted in Canada balsam and dried for each line. Scoring of the cytological criteria was carried out from at least twelve prepared slides. The prepared slides were used to determine the mitotic index and chromosomal aberrations.

The mitotic index represented the percentage of divided cells to the total cells examined. The percentage of each mitotic phase was calculated by dividing the number of cells in this phase on the total number of dividing cells per line.

The total numbers of chromosomal aberrations were estimated in dividing cells. The abnormalities included cells with micronuclei (compact and non-compact), fragments, stickiness binucleate cells and laggards.

Field experiments

In 2008/2009 and 2009/2010 the forty one barley landraces were sown in the field for multiplication and agro morphological characterization in two rows each row 3 m length and 10 cm spacing between plants with a seeding rate of 30 grains of per row cultural.

Parent's averages of the recorded data of some morphological and agronomic traits for barley landraces using the international descriptors (The International Union for the Protection of New Varieties of Plants) UPOV (1994) were calculated. The Decimal code for the growth stages of cereals, according to Tottman (1987) was also used to standardize the growth stage of varieties during morphological description and identification.

In order to detect patterns of genetic relationship in the landraces, data analysis on the means of clearly defined twenty one traits (plant growth habit; lowest leaves of hairiness of leaf sheaths; flag leaf anthocyanin coloration of auricles; time of ear emergence; plant frequency of plants with recurved flag leaves; flag leaf glaucosity of sheath; awns anthocyanin coloration of tips; awns intensity of anthocyanin coloration of tips; ear glaucosity; ear attitude; plant length (stem ear and awns); number of rows per ear; ear shape; awn length; ear length; grains husk; grain anthocyanin coloration of nerves of lemma; grain spiculation of inner lateral nerves of dorsal side of lemma; grains hairiness of ventral furrow; grain disposition of lodicules and kernel color of aleurone layer) were initially performed based on the Euclidean distance matrix. The data was subjected to analysis to produce a matrix of dissimilarity values and the phenotypic distance between each pair of landraces estimated as Euclidean distance.

The statistical analysis for the screening test was done following the procedure outlined by Gomez and Gomez (1984). The treatment means were compared using the newly least significant differences (NLSD) as outlined by Waller and Duncan (1969).

RESULTS AND DISCUSSION

Laboratory screening experiment

The results of the laboratory experiment are presented in Table (1). The analysis of variance of plant height, fresh weight and dry weight showed that the genotypes and salinity stresses highly significantly affected the three aforementioned traits

The height of seedlings decreased as a result of higher salinity levels. The decrease in height under 8000 ppm. was 19.37 when compared with the control. The average plant height for genotypes ranged from 17.60 to 27.85 cm. under control with an average of 23.04cm. The corresponding values under salt level 8000 and 12000 ppm ranged from 13.56 to 25.96 with an average of 19.37 and ranged from 10.43 to 21.78 with an average of 15.46 cm. respectively. In general, plant height diminished with increasing salinity levels in all landraces used, although statistically differences were found at the highest two salinity levels. Increasing salinity levels caused remarkable decreases in fresh and dry weight (Table 1). These results are in agreement with those by Epstein *et al* (1980), Abo-El-Enine *et al* (1981) and Ahmed *et al* (1998).

Fresh weight of seedlings ranged under the control from 1.76 to 5.24 with an average of 3.66 and under salt stress 8000 ppm ranged from 0.38 to 1.19 with an average of 0.59 while at 12000 ppm. it ranged from 0.36 to 1.02 with an average of 0.51. There was an average reduction of 83.78% and 85.94% for the two salt stress levels, respectively, compared with the control. The highest fresh weight was obtained by genetic resources number No. 5, 1.19 (51.69%) followed by No.12, 1.03 (68.00%); and No. 22, 0.98 (82.55%). These results are in agreement with those by Rawson *et al* (1988) and Ahmed *et al* (1998).

Dry weight production under 8000 ppm. ranged from 0.11 to 0.44 with an average of 0.24 and under 12000 ppm ranged from 0.09 to 0.25 with an average of 0.15 while the control ranged from 0.26 to 0.80 with an average of 0.49. Entry number 3 produced the highest dry weight under salt stresses treatments followed by entries number 1,16,33,36,37, 40, and 41. In conclusion, the screened entries under salinity levels, can be classified into three group; the first group of entries showed superior measurements in the three measured traits (entries number 12,19 and 22); the second group of entries showed superior values only in case of plant height and fresh weight (entries number 10,11 and 35) and the third group of entries showed superiority for plant height and dry weight (entries number 16,17,20,23,27,36,37,38,40 and 41). The obtained reduction in vegetative growth with increasing levels of salinity agreed with the findings of Epstein (1976), Epstein *et al* (1980) and Jaradat *et al* (2004).

Table 1. Plant height, fresh weight and dry weight of 41 barley landraces screened for their salt tolerance at seedling stage under laboratory conditions.

Landraces No.	Plant height, cm			Fresh weight, g			Dry weight, g		
	Control	Salt (8000ppm)	Salt (12000ppm)	Control	Salt 8000ppm	Salt 12000ppm	Control	Salt 8000ppm)	Salt 12000ppm
1	23.56	19.35	14.86	3.96	0.43	0.45	0.51	0.39	0.23
2	21.11	13.56	10.95	2.94	0.41	0.39	0.32	0.17	0.09
3	23.16	18.46	12.20	3.71	0.55	0.50	0.56	0.44	0.12
4	25.46	17.63	15.70	4.61	0.46	0.38	0.70	0.36	0.12
5	23.03	19.56	15.94	2.47	1.19	1.02	0.43	0.21	0.14
6	24.50	21.31	17.02	3.70	0.57	0.48	0.42	0.18	0.13
7	21.24	19.20	13.52	2.22	0.57	0.43	0.38	0.14	0.09
8	19.29	14.95	13.40	1.99	0.78	0.55	0.37	0.11	0.11
9	24.50	18.40	17.95	3.60	0.71	0.48	0.45	0.15	0.11
10	18.97	19.58	21.44	2.22	0.72	0.47	0.31	0.22	0.12
11	25.81	23.27	18.85	3.31	0.72	0.52	0.36	0.20	0.13
12	21.46	22.17	13.27	3.21	1.03	0.82	0.35	0.23	0.22
13	17.96	16.08	10.43	1.90	0.46	0.36	0.31	0.16	0.12
14	21.58	14.92	11.96	3.18	0.55	0.43	0.41	0.22	0.11
15	22.33	15.51	15.07	3.95	0.46	0.49	0.47	0.16	0.10
16	27.85	20.70	15.33	4.82	0.51	0.42	0.80	0.32	0.22
17	22.97	16.81	21.78	3.90	0.57	0.50	0.42	0.28	0.20
18	21.93	24.47	21.35	4.40	0.53	0.45	0.50	0.26	0.16
19	25.03	22.10	15.92	4.65	0.94	0.86	0.50	0.31	0.19
20	24.66	21.25	14.45	4.54	0.68	0.58	0.47	0.24	0.14
21	18.88	15.73	20.95	2.24	0.51	0.46	0.31	0.14	0.11
22	27.67	25.96	20.66	5.65	0.98	0.87	0.78	0.31	0.18
23	22.60	21.33	16.54	3.70	0.80	0.64	0.39	0.23	0.13
24	17.60	17.60	14.88	1.76	0.61	0.54	0.26	0.13	0.10
25	18.13	15.91	14.80	2.17	0.55	0.46	0.27	0.11	0.12
26	21.61	18.75	17.43	3.48	0.43	0.40	0.53	0.18	0.11
27	21.37	20.90	17.43	3.55	0.48	0.51	0.69	0.27	0.23
28	21.67	18.46	16.52	3.64	0.43	0.47	0.51	0.18	0.15
29	23.60	17.71	14.91	4.26	0.38	0.45	0.54	0.15	0.15
30	25.66	20.06	13.25	4.81	0.54	0.49	0.53	0.16	0.12
31	27.37	19.69	14.42	3.22	0.55	0.43	0.34	0.11	0.09
32	25.98	19.36	11.55	4.52	0.48	0.47	0.62	0.29	0.14
33	24.87	17.66	11.75	4.59	0.49	0.44	0.59	0.31	0.22
34	21.84	19.40	12.78	3.57	0.44	0.44	0.39	0.19	0.10
35	24.83	21.23	13.90	4.73	0.56	0.57	0.57	0.26	0.16
36	20.91	21.57	13.61	4.23	0.52	0.47	0.60	0.34	0.22
37	24.45	20.80	13.61	5.18	0.56	0.45	0.75	0.34	0.23
38	27.43	20.44	13.35	5.14	0.51	0.42	0.73	0.30	0.22
39	19.87	19.37	15.82	2.00	0.47	0.45	0.35	0.11	0.11
40	26.25	21.15	13.41	5.24	0.50	0.48	0.66	0.37	0.25
41	25.81	22.02	20.96	4.70	0.59	0.48	0.65	0.36	0.23
Average	23.04	19.37	15.46	3.66	0.59	0.51	0.49	0.24	0.15

	Plant height		Fresh weight		Dry weight	
L.S.D at	5%	1%	5%	1%	5%	1%
Salinity levels	0.21	0.28	0.04	0.06	0.01	0.07
Genotypes	0.78	1.03	0.17	0.22	0.04	0.05
Salinity x genotypes	1.36	1.79	0.30	0.39	0.06	0.08

Cytological studies

Mitotic activity

The data of mitotic activity, expressed by the mitotic index (MI), in the lines are given in Table (2). Data showed that, the variations in mitotic index between the different lines are observable. The highest score of MI was shown by lines 7 and 40 (16.79 and 15.99), while the lowest estimates (7.33,.7.18, 7.49, 7.64 and 7.51) were reported in the lines 1, 6, 20, 21 and 27 respectively. The high mitotic index may indicate more adaptation to the Egypt a conditions than the lines in which mitotic index was sharply reduced. The decrease in MI could be attributed to the increase in the length of interphase period (Dulaut and Olivero 1984). The frequencies of interphase observed in the lines which showed low MI in the present study were obviously higher than that of high mitotic division, indicating the role of prolonged interphase as suggested by the above authors. Variations in the frequency of the same mitotic phase were also found among the lines (Table 2). The frequencies of prophase stage in all studied materials were several times higher than the other two stages. In general, the frequency of prophase stage in the lines that showing high mitotic index was higher than that of those showing low mitotic index. These results, probably, indicated the direct control, involving specific gene,(s) for mitotic index and indices of separate phases.

The high frequency of prophase stage in all lines indicated that the events of interphase (G1 and S) were fastened and their duration was shortened as suggested by Webster and Davidson (1969). The variation in the frequency of prophase between the lines could be attributed to the differences in the time spent in prophase stage between the studied materials. In this respect, Kaltsikes (1972) found that the time spent in prophase varied between 0.45 and 0.55 hours in three lines of *Triticale*. The frequency of metaphase stage in some landraces (5, 7, 8, 29, 33 and 35) was higher than the other lines showing higher frequency in this stage (Table 2). These findings could be used to confirm the suggestions of Fayed *et al* (1988) that pedigree might cause an inhibition of spindle formation.

Chromosomal aberrations

The data presented in (Table 3) show, the percentage of cells containing chromosomal aberrations during mitotic division. It was obvious that, this percentage was depended on the lines examined. Only 19 landraces out of 40 tested lines showed chromosomal aberrations. The presence of abnormalities in those lines could be explained on the basis of cytological differences between the different lines of hexaploid barley. Such variations included chromosomal length (Fan 1985). The various types of chromosomal aberrations reported here and presented in (Table 3) were micronuclei (compact and non-compact) fragments, laggards, stickiness and binucleate cells (Figure 1).

Table 2. Mitotic index (M I) and frequency of mitotic phases in 40 barley Landraces.

Landraces No.	Total no. of studied cells	Total no. of divided cells	M I	Frequency of mitotic phases		
				Prophase	Metaphase	Ana-telophase
1	1324	97	7.33	5.14	0.98	1.21
2	1267	165	13.02	8.45	1.89	2.68
3	1321	163	12.34	8.40	1.82	2.11
4	1176	97	8.25	5.53	1.19	1.53
5	1343	175	13.03	9.60	1.94	1.49
6	1240	89	7.18	5.24	0.73	1.21
7	1090	183	16.79	12.29	3.03	1.47
8	1110	104	9.37	7.21	1.17	1.09
9	1133	101	8.91	6.35	1.24	1.32
10	1000	111	11.10	7.90	1.20	2.00
11	1047	87	8.10	5.68	1.21	1.21
12	990	111	11.21	8.08	1.41	1.72
13	1241	116	9.35	7.33	1.05	0.97
14	1048	115	10.97	8.21	1.53	1.24
15	1063	110	10.35	7.06	1.51	1.79
16	1176	128	10.88	7.40	1.87	1.62
17	1135	155	13.66	8.72	2.47	2.47
18	1064	112	10.53	7.71	1.03	1.78
19	1234	130	10.53	7.29	1.30	1.94
20	1121	84	7.49	6.16	0.62	0.71
21	1125	86	7.64	5.87	0.62	1.16
22	1009	93	9.22	6.54	1.19	1.49
23	1209	111	9.18	6.12	1.24	1.82
24	1057	95	8.99	6.05	1.23	1.70
25	1115	132	11.84	8.88	1.35	1.61
26	1127	151	13.40	10.38	1.51	1.51
27	1145	86	7.51	5.68	0.69	0.87
28	986	100	10.14	7.10	1.52	1.56
29	1251	129	10.31	6.24	2.72	1.36
30	1043	118	11.31	8.34	1.34	1.63
31	1048	139	13.26	9.45	1.72	2.10
32	1009	119	11.79	8.82	1.49	1.49
33	1076	140	13.01	9.85	2.23	0.93
34	997	82	8.22	6.32	1.00	0.90
35	1048	98	9.35	6.97	1.24	1.15
36	1024	104	10.16	7.32	1.07	1.76
37	1010	108	10.69	7.62	1.29	1.78
38	975	84	8.62	6.56	1.23	0.82
39	1013	113	11.15	8.29	1.28	1.58
40	988	158	15.99	12.04	2.13	1.82

Table 3. Percentage of different types of micronuclei and chromosomal aberrations in the 40 barley Landraces.

Landraces No.	Total no. of divided cells	Chromosomal aberrations	Percentage of types of micronuclei		Percentage of types of chromosomal aberrations			Laggards
			Compact	Non-compact	Fragments	Stickiness	Binucleate cells	
1	97	(5.15)	(2.06)	-	-	(2.06)	(1.03)	-
2	165	-	-	-	-	-	-	-
3	163	(2.45)	-	(1.23)	(0.61)	(0.61)	-	-
4	97	(4.12)	-	-	-	(2.06)	-	-
5	175	-	-	-	-	-	-	-
6	89	(2.25)	-	-	-	(2.25)	-	-
7	183	-	-	-	-	-	-	-
8	104	(4.81)	(1.92)	(0.96)	-	(1.92)	-	-
9	101	(3.96)	(1.98)	(1.98)	-	-	-	-
10	111	(3.60)	-	-	-	(1.80)	(1.80)	-
11	87	-	-	-	-	-	-	-
12	111	(5.41)	(0.90)	(0.90)	(1.80)	(1.80)	-	-
13	116	(6.03)	(1.72)	(2.59)	-	(1.72)	-	-
14	115	-	-	-	-	-	-	-
15	110	-	-	-	-	-	-	-
16	128	(7.81)	(2.34)	(1.56)	-	(1.56)	(2.34)	-
17	155	-	-	-	-	-	-	-
18	112	-	-	-	-	-	-	-
19	130	(2.31)	-	-	-	-	(2.31)	-
20	84	-	-	-	-	-	-	-
21	86	-	-	-	-	-	-	-
22	93	-	-	-	-	-	-	-
23	111	(6.31)	-	-	-	(1.80)	(4.50)	-
24	95	-	-	-	-	-	-	-
25	132	-	-	-	-	-	-	-
26	151	-	-	-	-	-	-	-
27	86	(5.81)	(1.16)	(1.16)	(1.16)	-	-	(2.32)
28	100	(4.00)	(2.00)	(2.00)	-	-	-	-
29	129	(3.10)	-	-	(2.32)	(0.77)	-	-
30	118	-	-	-	-	-	-	-
31	139	(5.04)	(1.44)	(1.44)	-	(2.16)	-	-
32	119	-	-	-	-	-	-	-
33	140	-	-	-	-	-	-	-
34	82	-	-	-	-	-	-	-
35	98	(2.04)	-	-	-	(2.04)	-	-
36	104	-	-	-	-	-	-	-
37	108	(5.55)	(1.85)	(1.85)	-	(1.85)	-	-
38	84	-	-	-	-	-	-	-
39	113	(4.42)	-	-	(1.77)	-	(1.76)	(0.88)
40	158	-	-	-	-	-	-	-

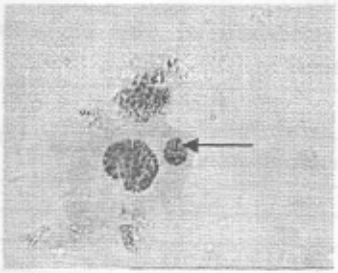

Fig. a: compact micronuclei

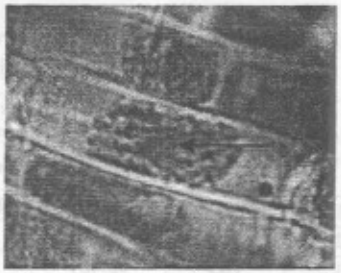

Fig. b: noncompact micronuclei

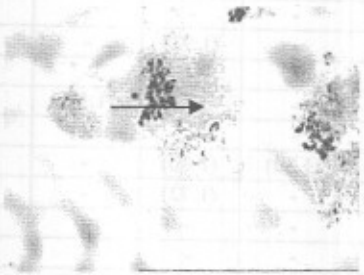

Fig. c: fragment chromosome

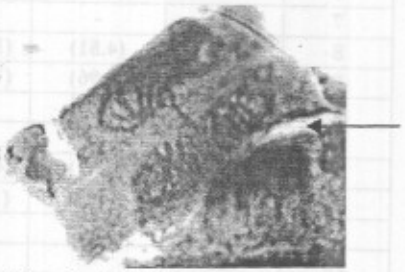

Fig. d: laggard chromosome

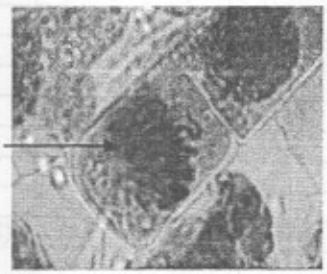

Fig. e: stickiness chromosome

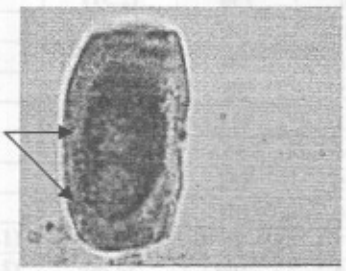

Fig. f: binucleate cells

Fig 1. (a to f): types of micronuclei and chromosomal aberrations in mitotic cell division.

Stickiness and micronuclei represented the most frequent types of chromosomal aberrations in mitotic division of studied materials. The other kinds of aberrations were found in relatively low frequencies. In the high of the present results, it was clear that the average frequency of chromosomal aberrations in all studied lines was of low magnitudes, probably, indicating that they have a high level of mitotic stability. These breeding materials could be useful in breeding programs to improve yield component characters in barley.

Morphological characters

Variety identification and description are the key issue for variety registration and granting the breeder's right (UPOV 1994). The plant variety posses the DUS (distinctiveness, uniformity and stability) requirements are the one suitable for registration. Thus, observations regarding the morphological description collected and recorded from planting till harvesting using UPOV guidelines and descriptors are presented in (Table 4). The measured morphological traits were used to estimate the genetic similarity and cluster analysis.

The data indicated that the plant growth habit of all genetic stocks of barley were semi erect and erect except number 1, 2 and 17 which were intermediate and number 4,13,18,23, and 37 which were semi prostrate. With regard to flag leaf anthocyanin coloration of auricles, twenty three genetic stocks (number 6, 11 ,12, 13, 16 ,18 ,19,20,24,25, 26,27,28, 29 , 30, 31, 32,34,36,37,39,40 and 41) were present for this trait while it was absent in the other genetic stocks. Regarding the time of ear emergence, barley genetic stocks were late for all genetic stock except number 14,21,31,32, and 33 which were very late. Concerning frequency of plants with recurved flag leaves, it could be classified into four categories. The first category shows low frequency of plants with recurved flag leaves (1,3,4,5,7,8,9,12,15,17,18,24,29,33,34,36, 37,40 and 41). The second category includes landraces 2, 6, 10, 14, 19, 20, 21, 26, 27, 31, 32, 35 and 39 which were medium for this trait. The landraces 11, 13, 22, 25, 28 and 38 showed high frequency of plants with recurved flag leaves. Whereas, the landraces number 16, 23 and 30 have very high for this trait as the fourth category. Flag leaf glaucosity of sheath was week in landraces 4, 5, 15, 17, 33, 40 and 41 and medium in 1, 3, 7, 10, 16, 19, 22, 23, 25, 27, 28, 29, 35, 36, 38 and 39. But, it was strong for landraces 2, 6, 8, 11, 12, 13, 21, 24, 26, 30, 31 and 37 and very strong for 9, 14, 18, 20, 32 and 34.

Regarding awns intensity of anthocyanin coloration of tips landraces could be classified into four categories. The first category shows weak awns intensity of anthocyanin coloration of tips in eleven landraces (1, 4, 11, 16, 22, 23, 24, 26, 32, 35, 36 and 38). The second category included twelve

Table 4. Morphological characteristics of barley landraces recorded according to UPOV Descriptor No.Tg/19/11-1994.

Character and stage	Degree	Score	Landraces													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Plant growth habit	Erect	1			1		1	1	1	1						
	Semi-erect	3									3	3	3	3		3
	Intermediate	5	5	5												
	Semi prostrate	7				7									7	
	Prostrate	9														
Lowest leaves of hairiness of leaf sheaths	Absent	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Present	9														
Flag leaf anthocyanin coloration of auricles	Absent	1	1	1	1	1	1		1	1	1	1				1
	Present	9						9					9	9	9	
Time of ear emergence	Very early	1														
	Early	3														
	Medium	5														
	Late	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
	Very late	9														9
Plant frequency of plants with recurved flag leaves	Absent	1														
	Low	3	3		3	3	3		3	3	3			3		
	Medium	5		5				5				5				5
	High	7											7		7	
	Very high	9														
Flag leaf glaucosity of sheath	Very weak	1														
	Weak	3				3	3									
	Medium	5	5		5				5			5				
	Strong	7		7				7		7			7	7	7	
	Very strong	9									9					9
Awns anthocyanin coloration of tips	Absent	1														
	Present	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Awns intensity of anthocyanin coloration of tips	Very weak	1														
	Weak	3	3			3							3			
	Medium	5					5		5		5					5
	Strong	7						7								
	Very strong	9		9						9		9		9	9	
Ear glaucosity	Very weak	1	1	1	1	1	1									
	Weak	3														
	Medium	5						5		5	5	5	5	5	5	5
	Strong	7														
	Very strong	9							9							
Ear attitude	Erect	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Semi erect	3														
	Horizontal	5														
	Semi recurved	7														
	Recurved	9														
Plant length(stem ear and awns)	Very short	1						1			1			1		
	Short	3		3		3	3					3	3		3	
	Medium	5	5		5				5	5						5
	Long	7														
	Very long	9														

Table 4. Cont.

Character and stage	Degree	Score	Landraces													
			15	16	17	18	19	20	21	22	23	24	25	26	27	28
Plant growth habit	Erect	1		1				1	1			1	1		1	
	Semi-erect	3	3				3			3				3		3
	Intermediate	5			5											
	Semi prostrate	7				7					7					
	Prostrate	9														
Lowest leaves of hairiness of leaf sheaths	Absent	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Present	9														
Flag leaf anthocyanin coloration of auricles	Absent	1	1		1				1	1	1					
	Present	9		9		9	9	9				9	9	9	9	9
Time of ear emergence	Very early	1														
	Early	3														
	Medium	5														
	Late	7	7	7	7	7	7	7		7	7	7	7	7	7	7
	Very late	9							9							
Plant frequency of plants with recurved flag leaves	Absent	1														
	Low	3	3		3	3						3				
	Medium	5					5	5	5					5	5	
	High	7								7			7			7
	Very high	9		9							9					
Flag leaf glaucosity of sheath	Very weak	1														
	Weak	3	3		3											
	Medium	5		5			5			5	5		5		5	5
	Strong	7							7			7		7		
	Very strong	9				9		9								
Awns anthocyanin coloration of tips	Absent	1								9	9	1	9	9	9	9
	Present	9	9	9	9	9	9	9	9							
Awns intensity of anthocyanin coloration of tips	Very weak	1														
	Weak	3		3						3	3	3		3		
	Medium	5			5	5		5					5			
	Strong	7	7						7							
	Very strong	9					9								9	9
Ear glaucosity	Very weak	1														
	Weak	3			3	3	3	3								
	Medium	5	5	5					5	5	5	5				
	Strong	7														
	Very strong	9											9	9	9	9
Ear attitude	Erect	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Semi erect	3														
	Horizontal	5														
	Semi recurved	7														
	Recurved	9														
Plant length(stem ear and awns)	Very short	1				1			1			1				
	Short	3	3	3	3			3								
	Medium	5					5			5	5					5
	Long	7											7	7	7	
	Very long	9														

Table 4. Cont.

Character and stage	Degree	Score	Landraces												
			29	30	31	32	33	34	35	36	37	38	39	40	41
Plant growth habit	Erect	1		1	1				1				1	1	1
	Semi-erect	3	3			3	3	3		3		3			
	Intermediate	5													
	Semi prostrate	7									7				
	Prostrate	9													
Lowest leaves of hairiness of leaf sheaths	Absent	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Present	9													
Flag leaf anthocyanin coloration of auricles	Absent	1					1		1			1			
	Present	9	9	9	9	9		9		9	9		9	9	9
Time of ear emergence	Very early	1												1	1
	Early	3													
	Medium	5													
	Late	7	7	7				7	7	7	7	7	7		
	Very late	9			9	9	9								
Plant frequency of plants with recurved flag leaves	Absent	1													
	Low	3	3				3	3		3	3			3	3
	Medium	5			5	5			5				5		
	High	7										7			
	Very high	9		9											
Flag leaf glaucosity of sheath	Very weak	1													
	Weak	3					3							3	3
	Medium	5	5						5	5		5	5		
	Strong	7		7	7						7				
	Very strong	9				9		9							
Awns anthocyanin coloration of tips	Absent	1	9	9	9	9	9	9	9	1	9	9	9	9	9
	Present	9													
Awns intensity of anthocyanin coloration of tips	Very weak	1													
	Weak	3				3			3	3		3			
	Medium	5	5	5	5								5		
	Strong	7						7							
	Very strong	9					9				9			9	9
Ear glaucosity	Very weak	1													
	Weak	3													
	Medium	5	5		5	5	5	5	5	5	5	5	5	5	5
	Strong	7													
	Very strong	9		9											
Ear attitude	Erect	1	1	1			1	1	1	1	1	1	1	1	
	Semi erect	3			3	3									
	Horizontal	5													
	Semi recurved	7													
	Recurved	9													
Plant length(stem ear and awns)	Very short	1			1	1		1	1	1	1	1			
	Short	3											3	3	3
	Medium	5	5	5			5								
	Long	7													
	Very long	9													

Table 4. Cont.

Character and stage	Degree	Score	Landraces													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of rows	Two	1														
	More than two	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ear shape	Tapering	1	1													
	Parallel	5		5	5	5	5			5	5	5	5	5	5	5
	Fusiform	7						7	7							
Awn length	Short	3	3		3		3	3	3	3	3	3	3	3		3
	Medium	5		5		5									5	
	Long	7														
Ear length	Very short	1														
	Short	3	3	3	3		3					3		3		
	Medium	5						5			5					
	Long	7				7			7	7			7		7	7
	Very long	9														
Grains husk	Absent	1														
	Present	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Grain anthocyanin coloration of nerves of lemma	Very weak	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Weak	3														
	Medium	5														
	Strong	7														
	Very strong	9														
Grain spiculation of inner lateral nerves of dorsal side of lemma	Absent	1														
	Weak	3				3	3			3	3	3	3	3	3	
	Medium	5		5	5			5	5							5
	Strong	7	7													
	Very strong	9														
	Strong	7														
	Very strong	9														
Grains hairiness of ventral furrow	Absent	1	1		1	1		1	1	1	1	1	1	1	1	1
	Present	9		9			9									
Grain disposition of lodicules	Frontal	1														
	Clasping	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2Kernel color of aleurone layer	Whitish	1	1		1	1	1	1	1		1	1	1	1		1
	Weakly colored	2		2						2					2	
	Strongly colored	3														

Table 4. Cont.

Character and stage	Degree	Score	Landraces													
			15	16	17	18	19	20	21	22	23	24	25	26	27	28
Number of rows	Two	1														
	More than two	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ear shape	Tapering	1														
	Parallel	5	5					5	5	5	5	5	5			
	Fusiform	7		7	7	7	7							7	7	7
Awn length	Short	3						3		3	3	3	3			3
	Medium	5	5	5	5	5	5		5					5	5	
	Long	7														
Ear length	Very short	1														
	Short	3	3		3											
	Medium	5							5							
	Long	7		7		7	7	7		7	7	7			7	7
	Very long	9											9	9		
Grains husk	Absent	1														
	Present	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Grain anthocyanin coloration of nerves of lemma	Very weak	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Weak	3														
	Medium	5														
	Strong	7														
	Very strong	9														
Grain spiculation of inner lateral nerves of dorsal side of lemma	Absent	1														
	Weak	3	3						3	3		3				3
	Medium	5			5	5		5			5		5	5	5	
	Strong	7		7			7									
	Very strong	9														
	Strong	7														
	Very strong	9														
Grains hairiness of ventral furrow	Absent	1	1	1	1	1		1	1	1	1	1	1			1
	Present	9					9							9	9	
Grain disposition of lodicules	Frontal	1														
	Clasping	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2Kernel color of aleurone layer	Whitish	1	1				1	1		1	1		1			1
	Weakly colored	2		2	2	2			2			2		2	2	
	Strongly colored	3														

Table 4. Cont.

Character and stage	Degree	Score	Landraces												
			29	30	31	32	33	34	35	36	37	38	39	40	41
Number of rows	Two	1													
	More than two	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ear shape	Tapering	1													
	Parallel	5	5										5		
	Fusiform	7		7	7	7	7	7	7	7	7	7		7	7
Awn length	Short	3				3	3	3	3	3	3	3		3	3
	Medium	5	5	5	5								5		
	Long	7													
Ear length	Very short	1													
	Short	3						3	3	3	3				
	Medium	5	5	5	5	5						5			
	Long	7					7						7	7	7
	Very long	9													
Grains husk	Absent	1													
	Present	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Grain anthocyanin coloration of nerves of lemma	Veryweak	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Weak	3													
	Medium	5													
	Strong	7													
	Verystrong	9													
Grain spiculation of inner lateral nerves of dorsal side of lemma	Absent	1													
	Weak	3	3	3	3			3				3			
	Medium	5				5	5		5	5	5			5	5
	Strong	7											7		
	Verystrong	9													
	Strong	7													
	Verystrong	9													
Grains hairiness of ventral furrow	Absent	1	1	1	1	1			1	1	1		1	1	1
	Present	9					9	9				9			
Grain disposition of lodicules	Frontal	1													
	Clasping	2	1	2	2	2	2	2	2	2	2	2	2	2	2
Kernel color of aleurone layer	Whitish	1	1	1	1	1	1			1	1	1	1	1	1
	Weakly colored	2						2	2						
	Strongly colored	3													

landraces (5,7,9,14,17,18,20,25,29,30,31 and 39) which were medium for this trait. Meanwhile, the landraces number 6, 15, 21 and 34 showed strong intensity. Whereas the landraces number 2, 8, 10, 12, 13, 19, 27, 28, 33, 37, 40 and 41 revealed very strong intensity and considered as the fourth category. Concerning ear glaucosity, landraces 1,2,3,4 and 5 showed very weak ear glaucosity, but it was weak for number 17, 18, 19 and 20 and medium for twenty six landraces, while the other landraces were very strong (No. 7, 25, 26, 27, 28 and 29). With regard to ear attitude, two landraces (No.31 and 32) were semi erect while the other landraces were erect. Regarding plant height, the landraces 6,9,12,18,21,24, 31, 32, 34, 35, 36, 37 and 38 were characterized by the shortest plant height, whereas the landraces number 25, 26 and 27 gave the tallest plants. Other landraces were medium in height.

Regarding ear shape, the tested barley landraces could be classified into three classes. The first one was the landrace 1 with tapering. The second class included twenty genetic stocks and they were parallel. The third class included landraces 6,7,16,17,18,19,26,27,28,30, 31, 32, 33, 34, 35, 36, 37, 38, 40 and 41 which were fusiform. With regard to awn length fifteen landraces (No. 2, 4, 13, 15, 16, 17, 18, 19, 21, 26, 27, 29, 30, 31 and 39) had medium awn length while the other landraces showed short awn length.

Concerning ear length, landraces 1, 2, 3, 5, 10, 12, 15, 17, 34, 35, 36 and 37 were short. But, ear length was medium for landraces number 6, 9, 21, 29, 30, 31, 32 and 38 while, the rest of landraces were long. Grain spiculation of inner lateral nerves of dorsal side of lemma can be used to identify landraces number 1, 16, 19 and 39 which were strong. By contrast, the landraces 4, 5, 8, 9, 10, 11, 12, 13, 15, 21, 22, 23, 28, 29, 30, 31, 34 and 38 were weak. The other tested landraces were medium for this trait. With respect to grain hairiness of ventral furrow, landraces No. 2, 5, 19, 26, 27, 33, 34 and 35 revealed the presence of grains hairiness of ventral furrow while they were absent for the other genetic stocks. The kernel color of aleurone layer of all landraces was whitish except number 3, 8, 13, 16, 17, 18, 21, 24, 26, 27, 34 and 35 were weakly colored.

Results in (Table 4) also indicated that, lowest leaves of hairiness of leaf sheaths, awns anthocyanin coloration of tips, ear attitude, number of rows, grains husk grain anthocyanin coloration of nerves of lemma and grain disposition of lodicules were similar. Therefore, these characters were not valuable as a descriptor for barley genetic resources under similar conditions.

Genetic similarity and cluster analysis

Many algorithms have been proposed for cluster analysis; the hierarchical analysis was used in this study. It produces a dendrogram such

as the ones shown in Fig. (2). For morphological and quantitative characters, number of clusters was chosen from the hierarchical analysis. Such as, genotypes were separated into meaningful genetic divisions based on knowledge of morphological and type (Table 4). The genotypes started at a distance of 0.0 to 5.831 and ending with groups at distance of 49.20. The distance matrix in Fig. (2) and (Table 5) shows that the smallest distance between two groups (group 40 and group 41) is 0.0 followed by the smallest distance between two genotypes (group 15 and group 17) is 5.83. Hence, at a distance level of 5.83 there are three groups (landraces No. 1 and 4), (landraces No. 15 and 17) and landraces No.10. The similarity between these groups is 94.16%. The next smallest distance between genotypes is 6.00 between (landraces No. 11 and 20). Hence, at a distance of 6.0 there are three groups (landraces No. 16 and 39), (landraces No. 11 and 20) and landraces No.13. This means that the similarity between these groups is 94.00%. The highest genetic distance was noted between (landraces No. 1 and 25) 49.02. The other landraces in between could be detected from the data presented in (Table 5).

The dendrogram based on genetic similarities Fig. (2) divided the 41 genotypes into three main clusters. The first main cluster separated at genetic distance equal 49.02 (Table 5). It included genotype number 25 only. The second main cluster included two genotypes 40 and 41at genetic distance about (0.00). The third main cluster included the other genotypes and separated to two sub clusters. The first sub cluster included genotypes (26, 27), (19, 33), (29, 30), (28), (7,8), (14, 23), 22 and 3. This sub cluster separated to three sub-sub clusters. The first sub-sub cluster included genotypes 26 and 27. The similarity between these groups is (86.88). The other genotypes were the second sub-sub cluster. The distance between these groups was average about (10.28). The second sub-cluster to five sub-sub clusters, the first sub-sub cluster included (16, 39) by distance (6.68) and (11, 20) and 13 by distance (8.68) .The average between this group was (7.68). The second sub-sub cluster included (1, 4), (15, 17) and 10. The coefficient value was (9.0) between (1, 4), 5.83 between (15, 17) and 12.65 between (1, 10).

The third sub-sub cluster included (24, 36), (21, 35), (6, 12), 31 and 18. The coefficient distance value was 10.488 between landraces (24 and 36) 6.856 between (21, 35) and 8.62 between (6, 18). The fourth sub-sub cluster included (2, 5) and 38. The degree of distance between (2, 38) was 13.25. The fifth sub-sub cluster included (32, 34), 9 and 37. The degree of distance was 12.166 between (32, 34), 18.00 between (9, 37) and 13.3 between (9, 32). Table (5) and Fig. (2) showed usefulness of cluster analysis for morphological traits in barley.

Table 5. Euclidean method for 41 genotypes including two groups for genotypes and dissimilarity for each other.

No.	Group 1	Group 2	Dissimilarity
1	40	41	0.00
2	15	17	5.83
3	11	20	6.00
4	6	12	6.24
5	6	31	6.81
6	21	35	6.85
7	7	8	7.55
8	16	39	7.68
9	14	23	7.87
10	6	18	8.62
11	11	13	8.68
12	1	4	9.00
13	14	22	9.27
14	2	5	9.48
15	10	15	9.88
16	7	14	9.89
17	24	36	10.48
18	29	30	10.48
19	11	16	10.80
20	19	33	10.81
21	6	21	11.14
22	28	29	11.66
23	3	7	12.14
24	32	34	12.16
25	1	10	12.64
26	26	27	13.03
27	6	24	13.12
28	2	38	13.25
29	3	28	13.30
30	9	32	13.32
31	3	19	13.98
32	1	11	14.34
33	2	6	15.12
34	1	2	16.71
35	9	37	18.00
36	3	26	18.18
37	1	9	20.62
38	1	3	26.79
39	1	40	33.61
40	1	25	49.02

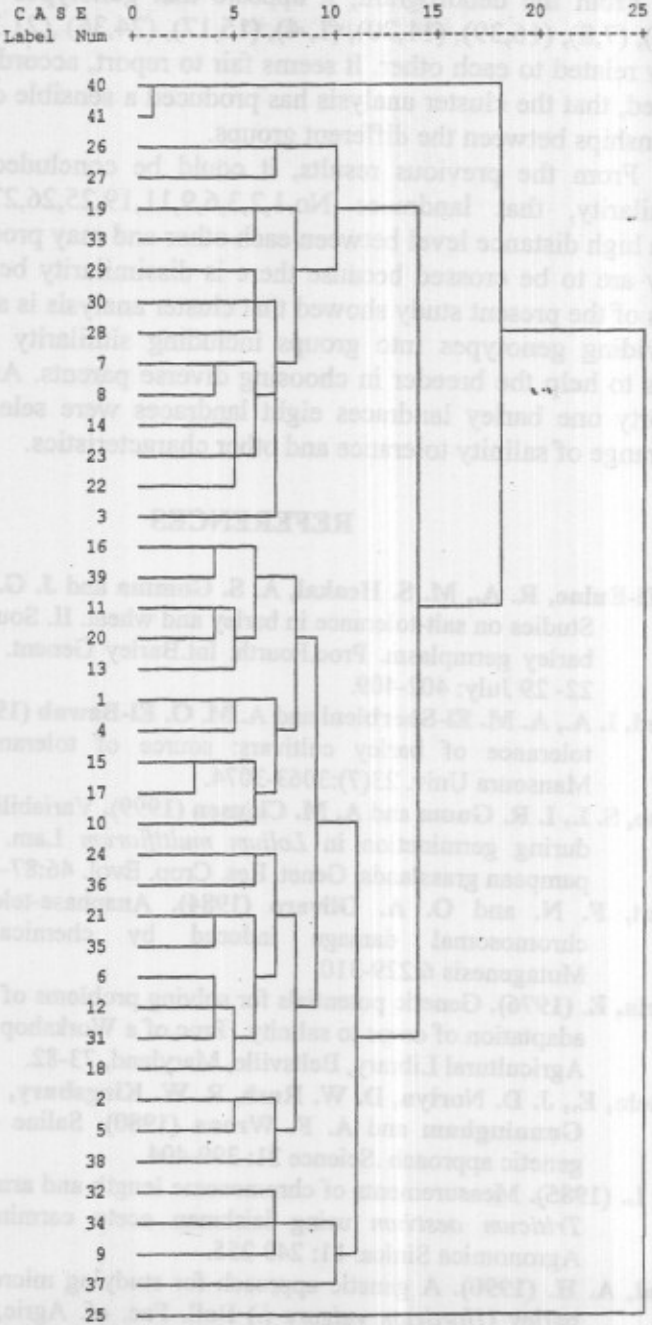

Fig. 2. Dendrogram using average linkage (between groups) for 41 landraces

From the dendrogram, it appears that genotypes (40,41), (26,27), (19,33), (7,8), (16,39), (11,20), (1, 4), (15,17), (24,36) ,(21,35) and (2,5) are closely related to each other. It seems fair to report, according to the results obtained, that the cluster analysis has produced a sensible description of the relationships between the different groups.

From the previous results, it could be concluded, as a result of dissimilarity, that landraces No.1,2,3,6,9,11,19,25,26,27,37,38 and 40 have a high distance level between each other and may produce good results if they are to be crossed because there is dissimilarity between them. The results of the present study showed that cluster analysis is a valuable tool for subdividing genotypes into groups including similarity and dissimilarity groups to help the breeder in choosing diverse parents. After evaluation of the forty one barley landraces eight landraces were selected due to their wide range of salinity tolerance and other characteristics.

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توصيف واحد وأربعون سلالة محلية من الشعير بإستخدام الصفات المورفولوجية والسيتولوجية والتأثر بالملوحة

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تهدف هذة الدراسة الى التمييز بين ٤١ مصدر وراثى لسلالات محلية من الشعير مجمعة من ثلاث محافظات وذلك من خلال تحديد الصفات المورفولوجية المميزة فى مختلف مراحل النمو وتقييم هذة المصادر الوراثية تحت تأثير الملوحة أثناء الإنبات في موسمين متتاليين ٢٠٠٨/٢٠٠٩، ٢٠٠٩/٢٠١٠ بهدف إمداد الباحثين فى مجال التربية بمعلومات عن أهم الصفات المورفولوجية والتحمل للملوحة والتى تساعد فى تحسين المحاصيل .وقد أستخدم المحلول المغذى (هوجلاند رقم ١) فى الإختبار كما استخدمت أملاح كلوريد الصوديوم والكالسيوم كمصدر للملوحة بنسبة ٣:١ على الترتيب وكانت نسب الملوحة ٨٠٠٠ جزء في المليون، ١٢٠٠٠جزء في المليون وكانت النتائج المتحصل عليها كما يلى :

أظهر تحليل التباين لكل من طول البادرة والوزن الغض والوزن الجاف وجود فروق عالية المعنوية بين السلالات المحلية المختبرة من حيث تحمل تأثيرات الملوحة وتم تقسيم النتائج المتحصل عليها من تأثير مستويات الملوحة الى ثلاثة مجاميع المجموعة الأولى لصفة طول النبات والوزن الغض والجاف وظهرت أحسن المصادر الوراثية رقم (١٢،١٩، ٢٢) وكانت المصادر الوراثية رقم (١١،١٠، ٣٥) أحسن المصادر الوراثية فى المجموعة الثانية لطول النبات والوزن الغض أما المصادر الوراثية رقم (٢٧،٢٣،٢٠،١٧،١٦، ٣٧،٣٦،٤١،٤٠،٣٨) لصفة طول النبات والوزن الجاف.

وقد أوضحت النتائج السيتولوجية إختلاف التراكيب الوراثية في النشاط الميتوزي حيث أظهرت ١٤ سلالة محلية ذات نشاطاً ميتوزياً عالياً في حين اظهرت ٩ تراكيب وراثية نشاطاً ميتوزياً منخفضاً وكانت باقي السلالات أظهرت قيم متوسطة من حيث النشاط الميتوزي ويمكن إعتبار التراكيب ذات النشاط الميتوزي العالي بأنها أكثر تأقلم للظروف البيئية المصرية مقارنة بالتراكيب الوراثية ذات النشاط الميتوزى المنخفض .

كما أظهرت النتائج السيتولوجية إختلافات واضحة بين التراكيب الوراثية فى محتواها من الإنحرافات الكروموسومية وتبين من خلال النتائج أن التراكيب الوراثية (١ ،٣، ٤ ،٦، ٨ ،١٠،٩، ١٢ ، ١٣ ، ١٦ ،١٩، ٢٣ ، ٢٧ ،٢٩،٢٨، ٣١ ،٣٥، ٣٧ ، ٣٩) ذات محتوى عالى من الإنحرافات الكروموسومية بينما التراكيب الوراثية (٢ ، ٥ ، ٧ ، ١١ ، ١٤ ، ١٥ ، ١٧ ، ١٨ ، ٢٠ ،٢١، ٢٢ ، ٢٤ ، ٢٥ ، ٢٦ ، ٣٠ ، ٣٢ ، ٣٣ ، ٣٤ ، ٣٦ ، ٣٨ ، ٤٠) لاتحتوى على أى نوع من الإنحرافات الكروموسومية مما يوضح أنها ذات ثبات سيتولوجى عالى ويوصى بإدخالها فى برامج التربية المستقبلية.

وقد أستخدمت التجارب الحقلية في عمل تحليل عنقودى لدراسة مدى التماثل والإختلاف بين السلالات المحلية. وقد تم تقسيم التراكيب الوراثية فى هذة الدراسة الى ثلاثة مجموعات بإستخدام طريقة المتوسطات الحسابية ، قسمت هذة المجموعة الى تحت مجموعات بناءً على درجة التشابة أو التباعد بين التراكيب الوراثية وقد أوضحت النتائج أن التراكيب الوراثية (١ ، ٢ ،٣ ، ٦ ، ٩، ١١ ، ١٩ ، ٢٥ ، ٢٦ ، ٢٧ ، ٣٧ ، ٣٨ ، ٤٠) بينها وبين التراكيب الأخرى عدم تشابة ويمكن من خلال التهجين بينها الحصول على توافيق هجينية جيدة فى برامج التربية.