

WHEAT INFORMATION SERVICE

ISSN 0510-3517



No. 70

March, 1990



Wheat Information Service

International Wheat Research Organization

Yokohama, Japan

WHEAT INFORMATION SERVICE

International information journal for wheat genetics, breeding, cytology, cultivation, production, genetic resources, and evolution. Founded in 1952. Published by International Wheat Research Organization. Aimed at exchanging the research informations among wheat researchers regardless the organization or authority.

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A note on drought resistance in wheat

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Breeding major food crops for stable yields under drought/rainfed stress environments has become a subject of major interest (Fischer et al 1982). Various mechanisms imparting drought resistance like: escape, endurance avoidance and tolerance etc. have been put forward by various workers. However, still plant breeders are largely guided by the grain yield response in selecting for drought resistance due to lack of well defined informations on the above mechanisms. The black box approach i.e. testing of performance of genotypes under stress situation is a very useful step in breeding programmes mainly because it allows a direct estimate of drought resistance or susceptibility of individual genotypes.

Though striking increases have been achieved in the wheat yields all over the world with the development of modern high yielding and high input responsive varieties after the introduction of dwarfing genes (Norin 10), however, yields under drought/rainfed conditions are still low/stagnant. The rainfed wheats accounts for about 35 per cent of the total acreage of wheat in India, therefore, it would be desirable to screen the genotypes under rainfed conditions so that the best/better genotypes could be identified and utilized in future breeding programmes.

Having this in mind, a total of 115 genotypes of wheat including *T. aestivum* and *T. durum* mostly taken from "National Drought Screening Nursery" were screened for their yield performance at Haryana Agricultural University, Regional Research Station, Bawal for three years; 1979 – 80, 1980 – 81 and 1981 – 82 to identify varieties best suited under drought/rainfed conditions. Bawal is situated in South-Western part of Haryana State. The climate in this zone is semi-arid with very erratic rainfall. The soil is loamy sand, weakly alkaline (pH 7.8), bulk density 1.45g cm³ having 84.6 per cent sand, 6.7 per cent silt and 8.7 per cent clay. The data were recorded on grain yield/m row length (g) and total dry matter produced i.e. biological yield/m row length (g). The harvest index (%) was calculated by dividing grain yield with total biological yield.

Genotypic differences were found highly significant for all the three characters studied in the present study (grain yield, biological yield and harvest index) indicating, thereby, that sufficient genotypic variability existed in the material. Based on the results of three years on grain yield, 15 varieties have been identified which yielded consistently good. Their data are presented in Table 1. These varieties appeared to be the most drought tolerant or can give good yields under drought/rainfed conditions particularly South-Western part of Haryana State. Many of these varieties have been recommended for commercial cultivation under drought/rainfed conditions in various states in India like, C306, NI 5439, Narbada 4, WL 410 etc. and also have been identified better under drought by Chowdhury and coworkers while studying 60 wheat genotypes under six varying levels of irrigations under Bawal conditions. Chowdhury et al (1985) reported C306,

Narbada 112, N 7231 and HI 617 as the outstanding varieties under zero irrigation. While studying stability parameters, Chowdhury et al (1985) identified varieties Narbada 112 and N 7231 suitable for poor environment. Variety C306 appeared to be the stable over wide range of environments. Chowdhury et al (1986) also reported low/moderate drought susceptibility indices (\bar{s}) for some of these varieties. Those having \bar{s} below 0.7 as least drought susceptible or most drought tolerant ones were NI 5749, HS82, MP 823 A and HD 2037 while moderately drought tolerant i.e. having \bar{s} value between 0.7 to 1.0 were NI 5439, K7527, HP1258, N7231, Narbada112 and MP195. Based on drought susceptibility index and productivity under drought environment, varieties Narbada 4, and HS 82 were found to be best for drought conditions. There were varieties like C306, Narbada112, N7231, HI 617 and NI 5749, which has \bar{s} value on higher side, but gave higher yields under drought conditions and this were best for drought environment. The drought susceptibility index of variety C306 was also reported between 0.91 to 1.08 by Fischer and Maurer (1978).

The results of the present study also showed that the grain yield was contributed mainly by the total biological yield in most of the varieties. Chowdhury et al (1985) also reported that grain yield was mainly contributed by total biological yield. The correlation studies also showed +ve correlation of grain yield with plant height, total biological yield and harvest index.

Table 1. Mean performance of 15 best varieties of wheat under rainfed conditions over three years

Variety	Mean grain yield / m row length during:		
	1979-80	1980-81	1981-82
1. MP157	107	103	120
2. MP823A	105	117	85
3. Narbada 112	100	140	100
4. HP1258	110	105	110
5. MP195	115	83	115
6. HY-11	95	112	110
7. C306	105	82	130
8. NI5439	125	84	130
9. K-7527	120	80	130
10. N-7231	85	110	115
11. HI 617	100	73	125
12. HS 82	85	127	90
13. WL-410	95	124	125
14. Narbada 4	85	119	105
15. HD-2037	130	69	120

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Hybrid necrosis in bread wheat. III

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Hybrid necrosis is the pre-mature gradual death of leaves and leaf sheaths in certain crosses of wheat and is the major barrier in combining desirable traits into hybrid combinations. Based on the earlier studies, two complementary genes, namely, *Ne1* and *Ne2* when brought together in hybrid combination, either in homo- or heterozygous form, cause necrosis (Hermsen 1963). The degree of necrosis in F_1 plants varies depending on the multiple alleles (s, m and w) of these two genes (*Ne1* and *Ne2*). Hermsen (1963) has given 0-9 grades of necrosis in hybrids (F_1) depending on different combinations of the three alleles of *Ne1* and *Ne2* genes as:

- 0-3 Weak necrosis (Hybrids produce normal seeds).
- 3-6 Moderate necrosis (Hybrids produce pre-mature seeds).
- 6-9 Severe (No seed obtained from hybrids).

Indian varieties have been reported to be generally having *Ne1* gene, while Mexican varieties are supposed to have *Ne2* genes (Gill et al 1969, Anand et al 1969, Chowdhury 1981, 1983). Because of these reasons, many times it becomes cumbersome to combine desirable traits of Indian varieties with that of Mexican, if the genotypes in combination have *Ne1* and *Ne2* genes, respectively. This problem has already been experienced in case of variety C306, which is one of the top drought tolerant varieties and has good quality grains. Since it carries *Ne1* gene, therefore, many of its crosses with Mexican wheat varieties fail, when the other parent has *Ne2* gene, though some way-outs have been suggested to overcome the necrosis in F_1 generations of such crosses (Dhaliwal et al 1986).

While breeding of high yielding and drought/rust resistant varieties, we at Haryana Agricultural University are attempting a number of crosses in bread wheat every year and screening their hybrid generations. While doing so, we came across many of the crosses showing necrotic behaviour in F_1 generation. We have already published two lists of such crosses (Chowdhury 1981, 1983). Here we have compiled the third list of bread wheat crosses showing necrosis. Depending on the gene combination we have sorted-out wheat genotypes having *Ne1* or *Ne2* genes. Other varieties have also been listed which have given indication of non-carrier of either *Ne1* or *Ne2* or both (Table 1). The data on morphological features like plant height and number of leaves (green as well as dry) per tiller of some of the necrotic F_1 hybrids have been given in Table 2.

The observations made on these necrotic F_1 hybrids showed that the yellowing of leaves started at 2-3 leaf stage and most of the hybrids died at the 5-6 leaf stage without producing ear, showing the characteristic of severe necrosis of grade 7 as described by Hermsen (1963).

Table 1. List of carrier/non-carrier of necrotic gene in bread wheat

<i>Ne1</i> Carrier	<i>Ne2</i> Carrier	Non-Carrier of <i>Ne1</i>	Non-Carrier of <i>Ne2</i>	Non-Carrier of <i>Ne1</i> and <i>Ne2</i>
C306	cm 58803	K 227 - 1	HS 33	HS 90
GP 104	cm 59376	K 227 - 7	HS 43	HS 74
GP 106	cm 66675	WL 1562	NI 574	NI 5439
WH 157	WH 331	Hindi 62	WH 129	HI 1011
AP 105	P 48 B	Kharchia-65	DL 172	HD 2281
	Raj 939			
	CBS 102			
	PC 89			
	UP 262			
	WL 410			
	IWP72			
	CBS 289			
	Kalyansona			

Table 2. Morphological characteristics of some of the F₁ hybrids showing necrotic behaviour in bread wheat

Cross	Necrotic behaviour	Plant height(cm)	No. of leaves/tiller		
			Green	Dry	Total
CBS 102 x C306	Severe	12.67	1	4	5
x WH331	Normal	36.67	5	0	5
x WL410	Normal	32.00	4	1	5
x TWP72	Normal	29.33	5	0	5
GP 104 x C 306	Normal	63.00	5	1	6
x WH331	Weak	45.00	1	5	6
x WL410	Severe	35.00	1	4	5
x IWP72	Severe	40.00	1	4	5
C 306 x IWP72	Severe	58.00	1	4	5
x WH331	Weak	46.00	0	5	5
x UP262	Severe	—	1	4	5
x P 48B	Severe	—	0	5	5
x Raj939	Severe	45.00	1	4	5
x CBS289	Severe	30.00	1	5	6
WH 157 x WH331	Weak	76.00	2	4	6
cm 58803 x C306	Severe	10.00	0	5	5
cm 59376 x C306	Severe	8.0	1	5	6
cm 66675 x C306	Severe	24.00	0	5	5
Raj 939 x C306	Severe	45.00	0	5	5

It is well established that Indian variety C306 carries *Ne1* gene. Therefore, the varieties like IWP72, WH331, UP262, P48B, Raj 939, CBS289, Cm 58803, Cm 59376, Cm 66675, CBS102, PC89, WL410, Kalyansona, which have produced necrotic hybrids with C306, carry *Ne2* gene. Similarly, the variety GP104 which did give normal plants with C306 but showed necrosis with above listed varieties, must have *Ne1* gene. Other varieties like GP106, WH157 and AP105 also gave indication of having *Ne1* gene in their genotypic back-ground. The crosses involving WH331 showed less necrosis, indicating that this variety may be having m or w allele of *Ne2* but it needs further confirmation. There were varieties like WH157, IWP72 and WL410 which were earlier reported to be non-carrier of necrotic genes, have now been identified having *Ne1* (WH157) and *Ne2* (WL410 and IWP72) genes. These information will be of importance to the wheat breeders/geneticists in their hybridization programme.

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Ribonuclease activity and soluble proteins in *Lr* isogenic lines of wheat (*Triticum aestivum* L.)

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Summary

Quantitative variation for soluble proteins and RNA degrading enzymes viz; ribonuclease I and ribonuclease II and nuclease I were studied in ten leaf rust isolines of wheat and two cultivars "Thatcher" and "Prelude" at early stages of germination. Crude seed extract showed maximum amount of soluble protein. Two distinct reductions at 24 hr and 96 hr stages were noticed for soluble proteins. Specific activity of RNase I and RNase II + Nu I showed a continuous increase upto 96 hr stage and then declined at one week stage. Specific pattern in reduction to ribonuclease and proteins for isogenic lines with or without *Lr* genes was not observed.

Introduction

Numerous biochemical changes accompany seed germination (Breevers 1968, Koller et al 1962). Proteins which are frequent reserve material in seed is mobilised and degraded in an ordered series of events. New proteins may be synthesised with advancement of germination (Hadwiger and Wagoner 1983). Ribonucleases are present in the resting seeds and their activity shows a steady rise on imbibition of water (Stern and Hotta 1963). High activity of plant ribonucleases has been correlated with pathogenesis (Chakravorty et al 1974).

Though studies have been conducted after pathogen infection yet there is little information about activities of ribonucleases in healthy plants which differ in their resistance to leaf rust. In present study soluble proteins and ribonucleases were studied in isogenic lines of wheat with leaf rust resistance (*Lr*) genes in different genetic backgrounds.

Material and Methods

Material consisted of ten isogenic lines of wheat with *Lr* genes in genetic backgrounds of "Thatcher" (Tc) and "Prelude" (Pr) and parental cultivars "Thatcher" and "Prelude". The entries were sequenced alphabetically as a) (Tc), b) (Pr), c) *Lr1* (Tc), d) *Lr1* (Pr), e) *Lr3bg* (Tc), f) *Lr3ka* (Tc), g) *Lr3ka* (Pr), h) *Lr10* (Tc), i) *Lr10* (Pr), j) *Lr16* (Pr), k) *Lr16* (Pr), l) *Lr17* (Pr). Seeds were grown in petridishes in an incubator for different germination stages of 0, 24, 48, 72, 96 hrs and one week at a temperature of 25°C. Sample material of each (2 g) was homogenised in 3 ml acetate buffer (pH 5.2) and centrifuged at 12,000 × g for 20 min at 0°C. Soluble proteins were estimated according to Bradford (1976) using BSA as a standard. Ribonuclease I

(RNase I) and combined ribonuclease II and nuclease I (RNase II + Nu I) activities were assayed by the procedure of Sodek and Wright (1969). Spectrophotometric readings were converted to standard units as described by Wilson (1975).

Results and Discussion

a) Soluble proteins

Crude seed extract revealed highest estimate of soluble protein. As the germination progressed to one week stage, soluble protein content decreased steadily in all isogenic lines as well as in control cultivars (Table 1). Three fold decrease was noted at one week stage over the zero hour stage. Decrease in soluble protein content can be well correlated with mobilization of reserves from the storage tissues and transfer of solubilized derivatives to the growing embryo axis during termination (Ledoux et al 1962).

Breevers (1968) observed an ordered series of events leading to degradation of storage proteins in legumes. Two distinct reductions at 24 hr and 96 hr stages were observed. First reduction is attributable to higher activity of proteases in the germinating seeds (Koller et al 1962). Whereas reduction at later stage could be due to higher activity of ribonucleases (Ledoux et al 1962, Vold and Sypherd 1968) which degrade RNA molecules and thus affect protein synthesis.

Table 1. Soluble protein content (mg/g) at different stages of seed germination in isogenic lines of wheat

Genotype	Stages of germination					
	0hr	24 hr	48 hr	72 hr	96 hr	One week (168 hr)
Thatcher (Tc)	29.75	17.5	15.20	14.75	10.00	7.75
Prelude (Pr)	29.75	19.25	17.00	15.25	7.25	6.75
Lr1 (Tc)	27.23	18.75	16.00	15.25	7.75	6.50
Lr1 (Pr)	26.25	18.25	15.75	15.25	7.25	7.00
Lr3bg (Tc)	28.75	19.10	16.00	14.25	8.25	5.00
Le3ka (Tc)	26.25	17.00	15.25	14.75	9.25	4.50
Kr3ka (Pr)	25.80	19.25	15.25	15.00	8.75	4.25
Lr10 (Tc)	28.75	17.50	15.00	12.50	9.25	5.50
Lr10 (Pr)	27.10	17.00	14.75	13.50	9.50	5.25
Lr16 (Tc)	28.00	18.25	14.50	13.25	9.30	7.25
Lr16 (Pr)	27.75	19.00	15.75	14.00	9.75	7.25
Lr17 (Pr)	28.25	18.25	16.20	13.50	9.50	7.25

Table 2. Specific activity (Enzyme unit/mg of protein) of ribonuclease I and combined ribonuclease II and nuclease I at different stages of germination in *Lr* isogenic lines of wheat

Genotype	Stage of germination											
	0 hr		24 hr		48 hr		72 hr		96 hr		One week (168 hr)	
	RNase I	RNase II + Nu I	RNase I	RNase II + Nu I	RNase I	RNase II + Nu I	RNase I	RNase II + Nu I	RNase I	RNase II + Nu I	RNase I	RNase II + Nu I
Thatchr (Tc)	3.5	5.0	8.3	9.9	10.3	11.3	11.5	12.2	13.6	13.7	11.1	11.8
Prelude (Pr)	4.0	4.8	8.5	8.7	10.5	9.8	11.8	12.2	15.6	16.1	11.9	12.6
<i>Lr1</i> (Tc)	3.6	5.5	8.0	9.0	9.9	10.7	11.5	12.0	14.0	15.6	11.5	12.1
<i>Lr1</i> (Pr)	4.1	5.7	8.0	9.5	10.0	10.9	11.4	12.0	13.2	16.0	11.4	12.0
<i>Lr3bg</i> (Tc)	4.0	5.0	8.5	9.8	10.5	10.9	13.5	12.5	13.9	15.0	11.7	12.4
<i>Lr3ka</i> (Tc)	3.9	5.7	8.0	10.2	10.3	11.8	11.8	12.2	13.0	15.0	11.5	12.6
<i>Lr3ka</i> (Pr)	4.0	5.9	7.8	8.8	10.1	11.4	11.8	11.8	12.4	13.4	10.9	12.0
<i>Lr10</i> (Tc)	3.6	5.0	8.3	9.5	10.3	11.3	13.0	13.1	13.4	14.7	12.3	13.0
<i>Lr10</i> (Pr)	4.2	5.6	8.4	10.2	10.5	11.6	12.9	13.3	13.4	13.8	11.3	11.6
<i>Lr16</i> (Tc)	3.0	4.9	6.9	9.0	8.8	10.8	12.4	11.9	14.0	13.0	11.6	11.9
<i>Lr16</i> (Pr)	3.8	5.0	7.7	9.2	9.5	10.6	12.4	12.0	13.0	13.5	12.3	12.2
<i>Lr17</i> (Pr)	3.9	5.5	7.7	10.0	10.0	11.0	12.0	12.0	14.0	14.0	12.0	12.3

b) Ribonucleases

The lowest specific activity was recorded for RNase I and RNase II + Nu I in the crude seed extract. Ninety-six hr stage marked four fold increase in specific activity when compared to zero hour stage (Table 2). At one week stage activity was less than that of 96 hr stage. Rise in ribonucleases activities have been observed in germinating seeds of barley (Ledoux et al 1962), wheat (Vold and Sypherd 1968) and pea (Barker et al 1974). Grellet et al (1968) observed parallel increase in RNase activity with RNA synthesis and accumulation during germination. Low activity at one week stage may be due to the dilution of RNases. There were not much differences in the specific activity amongst genotypes with or without *Lr* genes. RNase II + Nu I showed more activity compared to RNase I at comparable stages of germination.

A negative relationship was observed between soluble protein and specific activity of RNases. Such a relationship emphasizes the control of ribonucleases on protein degradation and protein synthesis during germination.

Acknowledgement

Financial assistance received from the university is gratefully acknowledged.

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Root distribution and top growth of a wheat mutant and its mother cultivar under irrigated and rainfed conditions

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Introduction

Wheat is mostly grown in semiarid climatic conditions where moisture is usually the limiting factor. The ability of a plant to capitalize on available moisture for sustained top growth largely depends upon its root system. Although moisture is available in upper soil profile during vegetative growth period, however, in semiarid climate often all the moisture is used by grain filling time (Asana 1974) and it is the root system the lower stratum that facilitates grain filling (Behl et al 1986). Understanding of genotypic plasticity of root system in terms of vertical and lateral distribution as a mechanism of adaptation in rainfed environments alongwith top growth pattern will help wheat breeders in developing productive genotypes for target environments. Present study deals with root distribution and top growth pattern of a developmental mutant of spring wheat and its mother cultivar under irrigated and rainfed conditions.

Materials and Methods

High yielding spring wheat cultivar WH147, its radiation induced high temperature tolerant mutant (WH147M) and a standard check variety C306 were grown under irrigated and rainfed sandy loam field conditions at Haryana Agriculture University farm. This experiment was laid out in randomized block design with four replications, the plot size being 6 rows of 4 m length spaced 25 cm apart. Observations on root distribution (using a modified trench profile method by Bohm 1976), number of tillers per plant, number of spikes per m², spike length (cm) and grain yield (g/m²) were recorded. Also, observations on number of leaves per plant, total leaf area per plant (cm²) and dry hight of leaves per plant were recorded on WH147 and WH147M only in a separate experiment under irrigated conditions. The date were subjected to analysis of variance.

Results

Analysis of variance indicated sufficient variation among genotypes for all the characters under irrigated as well as rainfed condtions. Comparative evaluation of the three genotypes for root growth and distribution envisaged that root growth (inferred from root length and counts) was, in general, better in irrigated than rainfed conditions (Table 1). However, root growth in variety C306 was at per in both the environment. Maximum root density was found in 10 – 20 cm of the

Table 1. Root distribution pattern of wheat genotypes under irrigated and rainfed conditions

Soil profile depth (cm)	Irrigated						Rainfed					
	WH147		WH147M		C306		WH147		WH147M		C306	
	Root counts	(%)	Root counts	(%)	Root counts	(%)	Root counts	(%)	Root counts	(%)	Root counts	(%)
10	630	29.4	1500	30.0	1100	47.00	330	27.7	509	18	512	20.8
20	542	25.3	560	11.2	518	22.15	185	15.5	234	8.2	268	10.9
30	158	7.4	388	7.8	164	7.0	135	11.3	257	9.2	299	12.6
40	160	7.5	292	5.8	100	4.7	104	8.7	287	10.0	195	7.9
50	120	5.6	260	5.2	130	5.6	72	6.0	205	7.0	180	7.3
60	188	8.8	402	8.06	74	3.2	80	6.7	250	9.0	174	7.0
70	124	5.8	375	7.5	95	4.0	74	6.2	262	9.2	195	7.9
80	65	4.6	318	6.4	72	3.0	55	4.6	226	8.0	206	8.4
90	58	2.7	342	6.9	45	1.9	100	8.4	177	6.0	154	6.2
100	40	1.9	300	6.0	40	1.7	60	5.0	240	8.4	148	6.0
110	40	1.9	250	5.0	-	-	-	-	204	7.0	135	5.5
Total	2145	-	4987	-	2338	-	1190	-	2851	-	2466	-

soil profile wall in all the varieties and in both the environments. An over all basis, root counts in WH147M were approximately two times more than WH147 in both the environment and C306 in irrigated conditions. Further, WH147 in both exhibited considerably better root growth than C306 in rainfed conditions too. Also, mutant developed a very stable root system below 10 cm profile downwards. The mutant recorded significantly higher number of spikes per m², greater spike length and higher grain yield per m² as compared to WH147 and C306 under irrigated as well as rainfed conditions (Table 2). The mutant (WH147M) showed parity for number of tillers per plant with that of C306 in rainfed and WH147 in irrigated conditions. On an average, the mutant recorded 47 per cent and 10 per cent higher grain yield over WH147 in rainfed and irrigated conditions respectively. Compared to WH147, the mutant recorded approximately two times higher number of leaves per plant (46.3) and dry weight of these leaves (45.4g) and three times more leaf area per plant (1702 cm²).

Table 2. Performance of wheat genotypes under irrigated and rainfed conditions

Genotypes	Condition	No. of tillers/Plant	No. of spikes/Plant	Spike length (cm)	Grain yield (g/m ²)
WH147	Irrigated	5.5 ± 0.90	427 ± 84.4	8.9 ± 0.27	603.0
C306	Irrigated	4.1 ± 0.92	376 ± 43.9	8.4 ± 0.25	526.4
WH147M	Irrigated	4.9 ± 0.22	480 ± 65.7	9.4 ± 0.13	667.0
WH147	Rainfed	3.5 ± 0.31	323 ± 36.8	6.77 ± 0.54	315.0
C306	Rainfed	4.2 ± 0.50	325 ± 36.7	7.82 ± 0.33	361.2
WH147M	Rainfed	4.2 ± 0.70	339 ± 18.4	8.82 ± 0.39	465.0

Discussion

With the advent of newer high yielding wheat varieties which incorporate dwarfing genes, concern has been expressed that root system of these varieties must also be shortened, with undesirable consequences when they are grown in water stressed environments. As such, genotypic variation in the root system of wheat has been the subject of numerous studies (O'Toole and Bland 1987). Differences in root characters of cultivars have been demonstrated and various parameters are correlated with top growth. Klepper et al (1984) observed that tiller development in cereals may be synchronized with root axis production and the number of roots on a tiller may be predicted from the number of leaves on the same tiller. In present study, higher number of leaves per plant coupled with better root growth in case of WH147M, substantiating this fact. Further, water

is most rapidly taken up by younger roots localized in 10 – 15 cm profile (Fischer and Turner 1978). However, in semiarid rainfed environments, invariably and the moisture in this soil profile is used for vegetative growth and plant encounters stress at the time of grain filling. In most cases the problems can be tackled by developing cultivars with improved root system, capable of extracting moisture from lower soil stratum to ensure adequate supply of water to the growing plant which can maintain favourable water potential and avoid dehydration during grain filling period which hampers the starch deposition in grains (Singh and Mehta 1986). Ability for rapid lateral root distribution with higher rate of root elongation would thus be advantageous. Therefore, breeding semi-dwarf high yielding wheat genotypes with developmental plasticity for root system merits prior consideration, particularly, for rainfed areas. This kind of specific variability can be generated through mutagenesis. Marx (1983) has reviewed such developmental mutants in annual seed crops. WH147M, a high thermo tolerant genotype (Sheoran et al 1983) with considerably better yield compared to its locally adapted mother cultivar and standard check C306, seems to be one such developmental mutant with some compensatory mechanism for adaptation in rainfed conditions. This was corroborated by our earlier studies as WH147M was found to maintain better water potential at grain filling stage (Behl et al 1986). Therefore, the mutant WH147M can be used as a source material to incorporate vigorous root system and dense crop canopy in other desirable back grounds to ensure maximum water use rainfed environment by way of extracting more moisture from lower soil profiles and avoiding evapotranspirational losses.

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II. Record

The plant expedition research from south eastern anatolia (Atatork dam) C7 square

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During the 1987 Ministry of Agriculture, Forestry and Rural Affairs has organized scientific expedition including field and forage crops. The expedition, most of the important areas for the studies on origin of wheat and its relatives in Turkey have been explored. The area of the present project are the remaining very important places for the survey of wheat and Aegilops.

The present program have be carried out under co-operation with FAO and respective Governmental organization.

The party leaved around June 6 and return June 20, 1987. Detailed schedule will be arranged to the local situation.

The list published in this research cotains 82 species records for C7 which were collected from the different villages of county, Center, Kahta, Samsat, Gerger, Silverek, Hilvan and Bozova in Adiyaman and Urfa provinces. 42 new species records for C7 square. The new grid system of Davis.

Collection Diary and Summary

Report of a joint expedition through Turkey to collect species of the Triticinae under the auspices of the University of California-Riverside, Department of Botany and Science. The Food and Agriculture Organization of the United Nations by the J. Giles Waines.

1987 June 9, speedometer reading at Urfa Atatürk Dam.

43546; 10 km East of Atatürk-Dam, Adiyaman,
Hayas village cemetery, Alt. 400m.

Site No. Acc. No.

1	4	<i>Ae. speltoides aucheri</i>
	5	<i>Ae. triuncialis</i>
	6	<i>Ae. speltoides</i>
	9	<i>Ae. triuncialis</i>
	13	<i>Avena sterilis</i>

Site No.	Acc. No.	
1	16	<i>Hordeum vulgare</i> (awned)
	18	<i>Avena</i> sp.
	27	<i>Ae. triuncialis</i>
	32	<i>Aegilops</i> sp.
	34	<i>H. murinum</i>
	37	<i>Scale</i> sp.
	46	<i>Ae. juvenalis</i>
	47	<i>Ae. triuncialis</i>
	48	<i>Ae. biuncialis</i>
	49	<i>Ae. triuncialis</i>

43549; 3 km North of the Hayas village heavily grazed area. Alt. 410m.

Site No.	Acc. No.	
13	1	<i>H. bulbosum</i>
	2	<i>Ae. triuncialis</i>
	14	<i>H. spontaneum</i>
	15	<i>Ae. columnaris</i>
	17	<i>H. spontaneum</i>
	21	<i>Ae. biuncialis</i>
	24	<i>H. spontaneum</i>
	30	<i>Ae. triuncialis</i>
	31	<i>Ae. columnaris</i>
	37	<i>Aegilops</i> sp.
	44	<i>Avena</i> sp.
	53	<i>Ae. columnaris</i>
	59	<i>Ae. columnaris</i>
	60	<i>Ae. triuncialis</i>
	61	<i>Ae. columnaris</i>
	62	<i>H. spontaneum</i>
	64	<i>Ae. biuncialis</i>
	65	<i>Ae. biuncialis</i>
	66	<i>Ae. triuncialis</i>
	67	<i>Ae. columnaris</i>
	68	<i>Ae. columnaris</i>
	69	<i>H. vulgare</i> (6 rows)

June 10, 1987

43604; Atatürk-Dam to Turus village fifth km, Alt. 400m.

Site No.	Acc. No.	
40	1	<i>T. aestivum</i> (awned)
	2	<i>H. vulgare</i>
	3	<i>T. durum</i>
	4	<i>T. aestivum</i> (awnless)

43614; North east of Turus village Alt. 630m. Field of mixed wheat and barley.

Site No.	Acc. No.	
41	3	<i>H. vulgare</i> (2 rows)
	4	<i>T. aestivum</i>
	5	<i>T. durum</i>
	6	<i>Ae. columnaris</i>
	10	<i>A. sterilis</i>
	13	<i>Ae. columnaris</i>
	14	<i>Ae. spelt. aucheri</i>
	15	<i>Ae. umbellulata</i>
	16	<i>Ae. triuncialis</i>

43617; East of the Bebek village, Alt. 630m. Field of mixed wheat and barley.

Site No.	Acc. No.	
42	1	<i>T. durum</i>
	2	<i>T. aestivum</i>
	3	<i>T. aestivum</i>

43622; 5 km east of the Bebek village. Road of Bebek to Araplar. Alt. 550m.

Site No.	Acc. No.	
43	2	<i>Avena</i> sp.

43622; 5 km East of the Bebek to Araplar road. Alt 470m. Field of mixed wheat.

Site No. Acc. No.

- | | | |
|----|---|---------------------------------|
| 44 | 1 | <i>T. aestivum</i> (red head) |
| | 2 | <i>T. aestivum</i> (white head) |
| | 3 | <i>T. durum</i> (white head) |
| | 4 | <i>T. durum</i> (black awned) |
| | 5 | <i>H. bulbosum</i> |
| | 8 | <i>T. aestivum</i> (awnless) |

43623; South-East of the Bebek to Araplar road, Alt. 430m field of mixed wheat, barley and oat.

Site No. Acc. No.

- | | | |
|----|----|-------------------------------|
| 45 | 1 | <i>H. vulgare</i> (2 rows) |
| | 2 | <i>H. vulgare</i> (6 rows) |
| | 3 | <i>Ae. spelt. aucheri</i> |
| | 4 | <i>Ae. triuncialis</i> |
| | 5 | <i>T. aestivum</i> (red head) |
| | 6 | <i>T. aestivum</i> (awnless) |
| | 9 | <i>T. aestivum</i> (w. head) |
| | 10 | <i>T. durum</i> |
| | 13 | <i>A. sterilis</i> |

43626; S.E. of the Araplar to Hayas, Alt. 410, river bank waste area.

Site No. Acc. No.

- | | | |
|----|----|---------------------------|
| 15 | 7 | <i>H. murinum</i> |
| | 13 | <i>Ae. spelt. aucheri</i> |

43629; S.E. of the Cat village, river bank and cultivated area, field of mixed wheat and barley, Alt. 410m.

Site No. Acc. No.

- | | | |
|----|---|---------------------------|
| 46 | 5 | <i>Ae. triuncialis</i> |
| | 6 | <i>Ae. spelt. aucheri</i> |

- | | |
|---|----------------------------|
| 8 | <i>H. vulgare</i> (2 rows) |
| 9 | <i>T. aestivum + durum</i> |

43630; Asphalt of Cat to Bebek, S.E. of the Ziyaret river, cultivated and waste land, field of mixed wheat, Alt.420m.

Site No. Acc. No.

- | | | |
|----|----|--|
| 47 | 1 | <i>T. durum</i> (red head) |
| | 2 | <i>T. durum</i> (white and small head) |
| | 3 | <i>T. durum</i> (white head) |
| | 4 | <i>T. durum</i> |
| | 5 | <i>T. aestivum</i> (red head) |
| | 6 | <i>T. aest.</i> (white head) |
| | 7 | <i>T. aestivum</i> |
| | 8 | <i>Ae. triun.</i> (no seed) |
| | 9 | <i>Ae. spelt. auc.</i> (no seed) |
| | 10 | <i>Ae. triun.</i> (no seed) |
| | 11 | <i>Ae. columnaris</i> |
| | 12 | <i>Ae. umbell.</i> (no seed) |
| | 13 | <i>Ae. biuncialis</i> |
| | 14 | <i>A. sterilis</i> |
| | 17 | <i>Aegilops</i> sp. |
| | 26 | <i>H. bulbosum</i> |
| | 28 | <i>H. spontaneum</i> |

43631; S. of the Cat to Havas, road side waste area, Alt. 415m.

Site No. Acc. No.

- | | | |
|----|----|--------------------------------|
| 14 | 4 | <i>A. sterilis</i> |
| | 10 | <i>Ae. biun.</i> (black glume) |
| | 11 | <i>H. bulbosum</i> |
| | 12 | <i>Ae. columnaris</i> |
| | 15 | <i>T. aest. + durum</i> |
| | 16 | <i>T. aest. + durum</i> |
| | 17 | <i>T. aest. + durum</i> |
| | 18 | <i>T. aest. + durum</i> |
| | 19 | <i>T. aest. + durum</i> |
| | 20 | <i>Avena eriantha</i> |

43634; N. of the Zivaret river, cultivated land and road side, Alt. 540m.

Site No. Acc. No.

48	3	<i>Ae. umbellulata</i>
	4	<i>Ae. umbell.</i>
	7	<i>Ae. umbell.</i>
	9	<i>Ae. biuncialis</i>
	10	<i>H. vulgare</i> (2 rows)
	14	<i>Ae. speltoides</i> (mixed)

June 11, 1987, 43637; N. of the Bebek, direction of Bebek to Adiyaman, field of mixed wheat, Alt. 655m.

Site No. Acc. No.

49	2	<i>T. aestivum</i> (whitehead)
	3	<i>T. aest.</i> (red awned)
	4	<i>T. aest.</i> (awnless)

43674; N. of the Bebek, cultivated land and road side, Alt. 650m field of mixed wheat.

Site No. Acc. No.

50	1	<i>T. durum</i> (blackhead)
	2	<i>T. dur.</i> (white head)
	3	<i>T. aest.</i> (white head)
	4	<i>T. boeoticum</i>
	5	<i>T. boeo.</i> (white awned)
	6	<i>T. boeo.</i> (yellow awned)
	7	<i>T. boeo.</i> (black awned)
	8	<i>T. boeo.</i> (black head)
	14	<i>Avena</i> sp.

43678; E. of the Bebek to Kiliclar road, roadside, cultivated land, Alt. 580m.

Site No. Acc. No.

52	1	<i>T. durum</i>
	2	<i>T. durum</i>

3	<i>T. aest.</i> (düz buoday)
4	<i>T. aest.</i> (no seed)
5	<i>T. aest.</i> (no seed)
6	<i>T. aest.</i> (no seed)
7	<i>H. bulbosum</i>
8	<i>Ae. triuncialis</i>

43679; E. of the Kiliclar village cultivated land, Alt. 580m.

Site No. Acc. No.

53	1	<i>H. vulgare</i> (2 rows)
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43681; S.E. of the Mazilik to Yazili, field of mixed wheat road side, Alt. 520m.

Site No. Acc. No.

54	1	<i>Ae. spelt. auc.</i> (no seed)
	2	<i>Ae. triuncialis</i>
	3	<i>I. aest.</i> (red head)
	4	<i>I. aest.</i> (white head)
	6	<i>A. sterilis</i>
	7	<i>H. bulbosum</i>

43687; N.E. of the Yazili village range land, Alt. 555m

Site No. Acc. No.

55	2	<i>Ae. umbellulata</i>
	3	<i>Ae. spelt. aucheri</i>
	4	<i>Ae. spelt. ligustica</i> (no seed)
	5	<i>Ae. spelt. aucheri</i> (no seed)

43689; S.E. of Bardakci village road side of cultivated land, field of mixed wheat, Alt. 555m.

Site No. Acc. No.

56	1	<i>T. durum</i> (black head)
	2	<i>T. durum</i> (mixed)
	3	<i>T. durum</i> (Malatya)

- 4 *Avena* sp.
- 5 *H. spontaneum*
- 10 *H. sterilis*

43692; N.E. of Kamisli village, road side,
Alt. 605m.

Site No. Acc. No.

- 57 1 *Ae. umbellulate*
- 2 *Ae. spelt. ligustica*
- 3 *Ae. spelt. aucheri*
- 5 *Ae. triuncialis*

43693; Near of Mermera village, cultivated
land, road side, Alt. 605m.

Site No. Acc. No.

- 58 1 *T. turgidum* (white and
hairy glume, black awned)
- 2 *H. spontaneum*
- 4 *Ae. triuncialis*
- 5 *Ae. triuncialis*

43694; Direction of Mermera to Kisla, road
side of waste area, Alt. 615m.

Site No. Acc. No.

- 59 1 *T. durum* (mixed)
- 2 *T. boeo.* (white head)
- 4 *T. boeo.* (black head)
- 5 *Secale* sp.

43695; N. of Kisla village, protected area,
field border, Alt. 585m.

Site No. Acc. No.

- 18 1 *Ae. spelt. ligustica*
- 2 *Ae. spelt. ligustica*
- 3 *Ae. spelt. ligustica*
- 5 *Avena* sp.
- 8 *Ae. umbellulata*

- 9 *Ae. biuncialis*
- 16 *Ae. spelt. aucheri*
- 17 *H. bulbosum*
- 19 *Ae. spelt. ligustica*
- 20 *Ae. oiuncialis*
- 22 *Ae. columnaris*
- 24 *Ae. triuncialis* (no seed)
- 25 *Ae. spelt. ligustica* (no seed)

43701; Samsat to Adiyaman road, near of Cayli
village Ziyaret river, field of mixed
wheat and barley, Alt. 485m.

Site No. Acc. No.

- 19 1 *Ae. spelt. auc.* (no seed)
- 2 *Ae. spelt. lig.* (no seed)
- 3 *T. boeo.* (no seed)
- 4 *T. durum* (mixed)
- 5 *H. vulgare* (6 rows)
- 6 *H. bulbosum*
- 7 *Avena* sp.
- 8 *Ae. triuncialis*
- 10 *Avena* sp.
- 12 *T. boeoticum*
- 13 *Ae. spelt. lig. + auc.*
- 14 *Ae. triuncialis*

June 12, 1987, 43832; Adiyaman to Samsat
road. Disbudak village, Ziyaret riverbank,
Alt. 515m.

Site No. Acc. No.

- 61 1 *T. boeo.* (white head)
- 2 *T. boeo.* (black head)
- 3 *Ae. triuncialis*
- 6 *T. boeo.* (mixed)
- 15 *Ae. umbellulata*

43838; Adiyaman to Samsat road, near mermera village, Alt. 480m.

Site No.	Acc. No.	
62	1	<i>Avena</i> sp. (no seed)
	3	<i>Ae. culumnaris</i>
	4	<i>T. durum</i> (mixed)
	8	<i>Avena</i> sp. (tall and large spike)
	10	<i>H. bulbosum</i>
	11	<i>Ae. triuncialis</i>

43858; W. of Samsat, near of Kantara vill. hilly area, Alt. 485m.

Site No.	Acc. No.	
63	1	<i>Aegilops</i> sp. (mixed)

43861; 3 km to Samsat, Near of Kantara, Field of mixed barley, Alt. 455m.

Site No.	Acc. No.	
64	1	<i>H. spontaneum</i>
	3	<i>H. bulbosum</i>
	4	<i>H. vulgare</i> (2 rows)
	5	<i>Ae. triuncialis</i>
	6	<i>A. sterilis</i>
	7	<i>H. murinum</i>
	9	<i>Ae. biuncialis</i>

43862; W. of Kantara, road side Alt. 455m.

Site No.	Acc. No.	
6	1	<i>H. spontaneum</i>
	2	<i>He. triun. + biun.</i>
	7	<i>Ae. cylindrica</i>

43867; 9 km to Samsat, near of Kumluca village, road side Alt. 470m.

Site No. Acc. No.

65	1	<i>Ae. spelt.auc.</i>
	3	<i>Avena</i> sp.
	4	<i>T. compactum</i> (red head)
	5	<i>T. comp.</i> (white head)
	6	<i>Ae. tiuncialis</i>
	7	<i>H. bulbosum</i>
	8	<i>Ae. umbellulata</i>
	9	<i>H. spontaneum</i>
	10	<i>Ae.spelt.ligustica</i>
	11	<i>Ae.biun. + umbell.</i>

43871; 13 km to Samsat, cultivaland, field of mixed wheat, Alt. 505m.

Site No.	Acc. No.	
66	1	<i>T. durum</i>
	2	<i>T. durum</i>
	3	<i>T. durum</i> (Dicle-74)

43872; 14 km to Samsat, direction of Kumluca to Bizberyan village, range area, field of mixed wheat, Alt. 595m.

Site No.	Acc. No.	
5	2	<i>Ae. biuncialis</i>
	5	<i>Ae. umbellulata</i>
	7	<i>H. vulgare</i> (2 rows)
	8	<i>H. vulgare</i> (6 rows)
	12	<i>Ae. biuncialis</i>
	14	<i>T. durum</i>
	18	<i>Ae. triuncialis</i>
	19	<i>T. aestivum</i>
	20	<i>T. aestivum</i>
	21	<i>T. aestivum</i>
	22	<i>T. compactum</i>
	23	<i>Aegilops</i> sp.

June 13, 1987; 44001, Atatürk-Dam to Adiyaman, 10 km to Adiyaman, road side, Alt. 570m.

Site No.	Acc. No.	
67	1	<i>T. boeoticum</i>
	2	<i>T. boeo.</i> (big head)

44043; Adiyaman to Samsat, 30 km to Adiyaman, field of mixed wheat, road side, Alt. 540m.

Site No.	Acc. No.	
68	1	<i>T. durum</i>
	2	<i>T. durum</i>
	3	<i>T. boeo.</i> (red awned)
	4	<i>T. boeo.</i> (black awned)
	10	<i>Ae. triuncialis</i>
	11	<i>T. boeo.</i> + <i>Avena</i> sp.
	12	<i>A. sterilis</i>
	13	<i>T. boeo.</i> (black+white awned)
	14	<i>T. boeo.</i> (white awned)

44050; 3 km to Samsat, hilly area range land, Alt. 560m.

Site No.	Acc. No.	
69	1	<i>Ae. spelt. aucheri</i>
	2	<i>Ae. spelt. ligustica</i>
	5	<i>Aegilops</i> sp.

44056; 3 km E. of the Samsat. between Kilisan to Havliyan road side, Alt. 410m.

Site No.	Acc. No.	
70	1	<i>T. durum</i>
	2	<i>T. aestivum</i>
	13	<i>Ae. triun. + biun.</i>
	14	<i>H. murinum</i>
	15	<i>H. bulbosum</i>

44059; 6 km E. of the Samsat, road side Alt. 450m.

Site No.	Acc. No.	
8	2	<i>Ae. triuncialis</i>
	3	<i>Ae. spelt. auc.</i> (no seed)
	4	<i>Ae. biuncialis</i>

44063; Near of Tepeönü village, roadside field of mixed wheat, Alt. 460m.

Site No.	Acc. No.	
71	1	<i>Ae. spelt. aucheri</i>
	2	<i>H. bulbosum</i>
	3	<i>Ae. columnaris</i>
	5	<i>T. durum</i>
	14	<i>Avena</i> sp.

44067; 14 km N.E. of Samsat, between Tepeönü to Beloren villages, road side range land, Alt. 645m.

Site No.	Acc. No.	
10	1	<i>T. boeoticum</i>
	2	<i>Ae. spelt. aucheri</i> (tip awned)
	3	<i>Ae. spelt. ligustica</i>
	4	<i>Ae. spelt. aucheri</i> (awned, no seed)
	5	<i>Ae. biuncialis</i>
	6	<i>Ae. triuncialis</i>
	7	<i>Ae. umbellulata</i>
	8	<i>Ae. speltoides</i>
	9	<i>Ae. triun. + biun.</i>
	10	<i>Ae. umbellulata</i>

44081; 25 km E. of Samsat, between Alaköprü to Göcao villages, field of mixed wheat. Alt. 495m.

Site No.	Acc. No.	
12	4	<i>T. aestivum</i>
	5	<i>T. aestivum</i> (mixed)

- 7 *Ae. colum. + umbell.*
- 8 *H. bulbosum*
- 9 *Ae. triuncialis*
- 10 *Ae. biuncialis*
- 11 *Secale cereale*

- 3 *Ae. triuncialis*
- 5 *A. sterilis*
- 6 *T. durum*
- 8 *Ae. biuncialis*
- 11 *H. murinum*
- 12 *H. spontaneum*

June 14, 1987-44276; Near of Kahta bridge,
field of mixed wheat, Alt. 530m.

Site No. Acc. No.

- 73 1 *Ae. columnaris*
- 2 *Ae. triuncialis*
- 3 *T. durum* (mixed)
- 4 *T. aestivum* (awnless)
- 18 *H. bulbosum*

44280; Crossing of Kahta to Gerger counties,
fields of lentil and chickpea, Alt.
575m.

Site No. Acc. No.

- 74 3 *T. boeoticum*
- 6 *Ae. columnaris*
- 7 *Ae. triuncialis*
- 9 *A. sterilis*
- 10 *T. boeoticum*

44302; S. of Kahta, between Geldibuldu
to Tepecik villages, road side Alt.
455m.

Site No. Acc. No.

- 75 1 *H. spontaneum*
- 7 *Ae. speltoides*
- 9 *H. bulbosum*

44303; S. of Geldibuldu village, field of
mixed wheat, Alt. 450m.

Site No. Acc. No.

- 76 1 *T. aestivum* (mixed)

44305; S. of Tepecik village, road side, Alt.
485m.

Site No. Acc. No.

- 77 1 *T. durum*
- 2 *Ae. spelt. aucheri*
- 3 *H. spontaneum*

44306; between Tepecik to Karatepe villages,
cultivated land, field of mixed wheat,
Alt. 570m.

Site No. Acc. No.

- 78 2 *T. durum*
- 3 *T. aestivum*

44312; S.E. of Kahta, near of Karatepe village,
field border of road side, Alt. 610m.

Site No. Acc. No.

- 79 3 *T. aestivum*
- 4 *Ae. triuncialis*
- 5 *H. bulbosum*
- 7 *T. durum*
- 9 *Ae. spelt. aucheri*
- 10 *Ae. spelt. lig.* (no seed)

44314; S. of Kahta, near of Merdi village,
cultivated land, Alt. 515m.

Site No. Acc. No.

- 80 1 *T. durum*

44317; Between Merdi to Ulupinar villages,
road side, Alt. 620m.

23 *Avena* sp.
26 *H. bulbosum*

Site No. Acc. No.

81 2 *Ae. spelt. aucheri*
4 *Ae. triuncialis*

44543; N. of kahta county. junction of
Yaprakli ti lkizce villages, road side,
Alt. 655m.

44327; Junction of Besele village to
Adiyaman highway, field of
wheat, Alt. 600m.

Site No. Acc. No.

85 6 *Ae. columnaris*
10 *T. boeoticum*
13 *Ae. umbellulata*
15 *T. urartu*
16 *A. sterilis*
17 *Ae. columnaris*
18 *T. urartu*
19 *T. boeoticum*
21 *Ae. triun.* (no seed)
24 *Ae. spelt. lig.* (no seed)

Site No. Acc. No.

82 5 *Ae. triun.* (no seed)
8 *Ae. spelt. lig.* (no seed)
9 *T. boeoticum*
10 *T. durum*

June 15, 1987-44526; E. of Durak village
road side of range land Alt. 590m.

Site No. Acc. No.

83 1 *Ae. triun. + biun.*
2 *Ae. biuncialis*
3 *Ae. spelt. aucheri*
7 *H. bulbosum*

44543; N. of Kahta county, cultivated land
road side, field of mixed wheat, Alt.
645m.

Site No. Acc. No.

86 2 *T. durum* (brown and
hairy head)
3 *T. durum* (black awned)
5 *T. durum* (mixed)
6 *Avena* sp.
7 *Ae. triuncialis*

44541; Between Akincilar to Yaprakli
villages, field of mixed wheat and
threshing place of wheat, Alt. 665m.

Site No. Acc. No.

84 1 *Triticum* sp.
3 *Ae. triuncialis*
5 *T. durum* (threshing
place)
6 *T. durum* (")
7 *T. durum* (")
11 *T. aestivum* (red head)
12 *T. durum* (mixed)
13 *T. aestivum* (white
head)
14 *T. durum* (black awned)

44555; N.E. of kahta, near of Bostanli village ,
field of durum wheat, Alt. 830m.

Site No. Acc. No.

87 2 *T. durum*
3 *Ae. triuncialis*
4 *T. urartu*
6 *T. boeoticum*
7 *Ae. umbellulata*
8 *T. boeoticum*
9 *T. urartu*

44588; E of Kahta, near of Geldibuldu village, road side of range land, Alt. 475m.

Site No. Acc. No.

20	13	<i>Ae. columnaris</i>
	15	<i>H. spontaneum</i>
	16	<i>Ae. speltoides</i>
	17	<i>Ae. biuncialis</i>
	18	<i>Ae. triuncialis</i>
	19	<i>Ae. umbellulata</i>
	23	<i>H. bulbosum</i>

44598; Adiyaman province, Gerger county, N.E. of Geldibuldu village, near of Asurge village, field of mixed wheat, vineyard Alt. 570m.

Site No. Acc. No.

22	1	<i>T. urartu</i> (vineyard)
	2	<i>T. boeo.</i> (vineyard)
	8	<i>T. boeoticum</i>
	9	<i>T. urartu</i> (field border)
	10	<i>T. urartu</i>
	11	<i>Ae. spelt. ligustica</i>

June 16, 1987-44832; Urfa province, Siverek county, Near of Geldibuldu village, Firat Bridge, opposite of A.Kirca vill. N. of Adiyaman to Siverek highway, field of mixed wheat, field border, Alt. 460m

Site No. Acc. No.

88	1	<i>T. aest. + durum</i> (redawned)
	2	<i>T. aest.</i> (awnless+white glume)
	3	<i>T. aest. + durum</i> (white awned)
	4	<i>H. vulgare</i> (2 rows)
	5	<i>Hordeum</i> sp.
	10	<i>Ae. spelt. aucheri</i>

11	<i>Ae. triuncialis</i>
12	<i>H. bulbosum</i>
13	<i>T. aest.</i> (awnless + red glume)
14	<i>H. spontaneum</i>
24	<i>Ae. triuncialis</i>
25	<i>A. sterilis</i>

44835; Village of Y. Kirca, near of First river, range area, Alt. 475m.

Site No. Acc. No.

89	1	<i>Ae. triuncialis</i>
	2	<i>Ae. columnaris</i>
	3	<i>Ae. umbellulata</i>
	4	<i>H. bulbosum</i>
	17	<i>Ae. umbellulata</i>
	18	<i>Ae. biuncialis</i>

44836; Opposite of Y. Kirca, range area, Alt. 455m.

Site No. Acc. No.

23	6	<i>Ae. columnaris</i>
	7	<i>Ae. spelt. aucheri</i>

44837; S. of Y.Kirca village, roadside waste area, Alt. 530m.

Site No. Acc. No.

90	2	<i>Ae. spelt. aucheri</i>
	3	<i>T. boeo.</i> (black glume)

44838; Junction of Akyaka to Tasaül near of Adiyaman to Siverek highway, field of mixed wheat, vineyard, Alt. 580m.

Site No. Acc. No.

24	5	<i>Hordeum</i> sp.
	6	<i>T. aestivum</i> (mixed)
	9	<i>H. spontaneum</i>

10	<i>Ae. triuncialis</i>	8	<i>T. durum</i> (mixed)
11	<i>Ae. columnaris</i>	9	<i>T. dicoccoides</i>
12	<i>T. aest.</i> (awnless+red glume)	11	<i>T. boeoticum</i>
13	<i>A. sterilis</i>	12	<i>T. boeoticum</i>
15	<i>T. urartu</i> (vineyard)	14	<i>T. dicoccoides</i>
16	<i>T. boeo.</i> (vineyard)	15	<i>H. bulbosum</i>
17	<i>T. boeo.</i> (vineyard)	16	<i>Ae. columnaris</i>
18	<i>H. bulbosum</i>		
19	<i>T. boeo.</i> (black partially awned)		
20	<i>T. boeo.</i> (black awned+ white awned)		
21	<i>Ae. spelt. ligustica</i>		
22	<i>T. boeoticum</i>		

June 17, 1987-45040; S.E. of Bozova county,
road side, Alt. 710m.

Site No.	Acc. No.	
93	1	<i>T. urartu</i>
	2	<i>T. boeoticum</i>
	3	<i>T. dicoccoides</i>

44848; Direction of Söoütlü to Bürümcek
villages, field of mixed wheat, road
side, Alt. 590m.

Site No.	Acc. No.	
91	2	<i>T. durum</i>
	3	<i>T. aestivum</i>
	4	<i>T. boeoticum</i>

45100; N. of Hilvan county, opposite to
Hilvan, direction of Hilvan to Falk
village, road side, field of wheat, Alt.
600m.

Site No.	Acc. No.	
94	1	<i>T. urartu</i>
	2	<i>T. boeoticum</i>
	3	<i>Ae. triuncialis</i>
	4	<i>T. boeoticum</i>
	6	<i>Avena</i> sp.
	7	<i>T. durum</i>

44854; N. of Siyerek county, near of
sepetoren village, field of mixed
wheat, Alt. 620m.

Site No.	Acc. No.	
92	2	<i>T. durum</i> (mixed)
	3	<i>T. aest.</i> (white head and awned)
	4	<i>T. aestivum</i> (awnless)

45102; N. of Hilvan near to Eaik village
cultivated area, Alt. 575m.

Site No.	Acc. No.	
26	1	<i>T. durum</i> (red head)
	2	<i>T. aest.</i> (white head)
	3	<i>Triticum</i> sp.
	4	<i>Ae. caudata</i>
	5	<i>Ae. spelt. aucheri</i>
	6	<i>Ae. umbellulata</i>
	7	<i>Ae. spelt. ligustica</i>
	8	<i>Ae. triuncialis</i>

44860; road of Bürümcek village, site of
two bridges, cultivated hilly area,
field of mixed wheat, Alt. 580m.

Site No.	Acc. No.	
25	6	<i>T. aestivum</i> (mixed)
	7	<i>Ae. triuncialis</i>

9	<i>H. bulbosum</i>	Site No.	Acc. No.	
10	<i>Ae. caudata</i>	95	1	<i>T. durum</i> (mixed)
17	<i>Ae. caudata</i>		3	<i>Ae. speltoides</i> (mixed)
18	<i>Ae. umbellulata</i>		4	<i>T. boeoticum</i>
			5	<i>A. sterilis</i>
45113; Near of Olgulu village meadow, Alt. 485m.			6	<i>T. boeo.</i> (red head)
			7	<i>T. boeo.</i> (big head)
			8	<i>T. boeo.</i> (white head)
Site No.	Acc. No.		10	<i>T. boeo.</i> (big head)
29	4		11	<i>T. boeo.</i> (mixed)
	11		12	<i>Ae. triuncialis</i> (mixed)
	12			
	13			
	14	45144; Near of Ugra village, range land, Alt. 550m.		
	15			
	18	Site No.	Acc. No.	
	19	31	2	<i>Ae. umbellulata</i>
	20		3	<i>Ae. biuncialis</i>
	21		5	<i>T. durum</i> (mixed)
	22		7	<i>Ae. triuncialis</i>
	23		8	<i>H. bulbosum</i>
			11	<i>Ae. spelt. aucheri</i>
45143; Direction of Hilvan to Ovacik near of Ulyazi to Ugara villages, cultivated land, Alt. 575m.			25	<i>T. durum</i> (mixed)

Summary of collections classified according to species

Species	Collection Nos.
<i>Aegilops biuncialis</i> Vis.	48/1, 2/5, 13/5, 2/6, 4/8, 5/10, 9/10, 10/12, 21/13, 64/13, 65/13, 10/14, 9/18, 20/18, 17/20, 11/29, 3/31, 13/47, 9/48, 9/64, 11/65, 13/70, 8/76, 1/83, 2/83, 18/89,
<i>Aegilops caudata</i> L.	4/26, 10/26, 17/26, 15/29, 20/29.
<i>Aegilops columnaris</i> Zhuk.	7/12, 15/13, 31/13, 53/13, 59/13, 61/13, 67/13, 68/13, 12/14, 22/18, 13/20, 6/23, 11/24, 16/25, 18/29, 6/41, 11/47, 3/62, 3/71, 1/73, 6/74, 6/85, 17/85, 2/89.
<i>Ae. spelt.</i> var. <i>ligustica</i> (Savignone) Coss.	3/10, 1/18, 2/18, 3/18, 19/18, 25/18, 2/19, 13/19, 11/22, 21/24, 7/26, 14/48, 4/55, 10/65, 2/69, 10/79, 8/82, 24/85.

<i>Ae. spelt.</i> var. <i>aucheri</i> Tauch.	4/1, 6/1, 3/8, 2/10, 4/10, 8/10, 3/15, 16/18, 1/19, 13/19, 16/20, 7/23, 5/26, 22/29, 11/31, 14/41, 3/45, 6/46, 9/57, 14/48, 1/54, 3/55, 5/55, 1/65, 1/69, 1/71, 7/75, 2/77, 9/79, 2/81, 3/83, 10/88, 2/90, 3/95.
<i>Aegilops triuncialis</i> L.	5/1, 9/1, 27/1, 47/1, 18/5, 2/6, 2/8, 6/10, 9/10, 9/12, 2/13, 30/13, 60/13, 66/13, 24/18, 8/19, 14/19, 18/20, 10/24, 7/15, 8/26, 2/54, 4/58, 5/58, 3/61, 11/62, 5/64, 6/65, 10/68, 13/70, 2/73, 7/74, 3/76, 4/79, 4/81, 5/82, 1/83, 3/84, 21/85, 7/86, 3/87, 11/88, 24/88, 1/89, 3/94, 12/95.
<i>Aegilops umbellulata</i> Zhuk.	5/5, 7/10, 10/10, 7/12, 8/18, 19/20, 6/26, 13/29, 18/29, 2/31, 15/41, 12/47, 3/48, 4/48, 7/48, 2/55, 15/61, 8/65, 11/65, 13/85, 7/87, 3/89, 17/89.
<i>Aegilops cylindrica</i> (Host.) Gram.	7/6, 18/26.
<i>Aegilops juvenalis</i> Morris & Sears	46/1.
<i>Aegilops</i> sp.L.	32/1, 23/5, 37/13, 17/47, 1/63, 5/69.
<i>Triticum boeoticum</i> Boiss.	1/10, 3/19, 12/19, 2/22, 8/22, 16/24, 17/24, 19/24, 22/24, 11/25, 12/25, 4/29, 4/50, 5/50, 6/50, 7/50, 8/50, 2/59, 3/59, 1/61, 2/61, 1/67, 2/67, 3/68, 4/68, 11/68, 14/68, 3/74, 10/74, 9/82, 10/85, 19/85, 6/87, 8/87, 3/90, 4/91, 2/93, 2/94, 4/94, 4/95, 6/95, 7/95, 8/95, 10/95, 11/95.
<i>Triticum urartu</i> Tum.	1/22, 9/22, 15/24, 15/85, 18/85, 4/87, 9/87, 1/93, 1/94.
<i>Triticum dicoccoides</i> (Koern.) Koern.	9/25, 14/25, 3/93.
<i>Triticum durum</i> Desf.	14/5, 21/5, 15/14, 16/14, 17/14, 18/14, 19/14, 4/19, 10/22, 8/25, 1/26, 3/26, 5/31, 25/31, 3/40, 5/41, 1/42, 3/44, 4/44, 10/45, 9/46, 1/47, 2/47, 3/47, 4/47, 1/50, 2/50, 1/52, 2/52, 1/56, 2/56, 3/56, 1/59, 4/62, 1/66, 3/66, 1/68, 2/68, 1/70, 5/71, 3/73, 6/76, 1/77, 2/78, 7/79, 1/80, 10/82, 5/84, 6/84, 7/84, 12/84, 14/84, 2/86, 3/86, 5/86, 2/87, 1/88, 3/88, 2/91, 2/92, 7/94, 1/95.
<i>Triticum turgidum</i> L.	1/58.
<i>Triticum aestivum</i> L.	19/5, 20/5, 4/12, 5/12, 15/14, 16/14, 17/14, 18/14, 19/14, 6/24, 12/24, 6/25, 2/26, 3/26, 1/40, 4/40, 4/41, 2/42, 3/42, 1/44, 2/44, 8/44, 5/45, 6/45, 9/45, 9/46, 5/47, 6/47, 7/47, 2/49, 3/49, 4/49, 3/50, 3/52, 4/52, 5/52, 6/52, 3/54, 4/54, 2/70, 4/73, 1/76, 3/78, 3/79, 11/84, 13/84, 1/88, 2/88, 3/88, 3/91, 3/92, 4/92.
<i>Triticum aestivum</i> L. <i>compactum</i>	22/5, 4/65, 5/65.
<i>Triticum</i> sp.L.	1/84.
<i>Secale</i> sp. L.	37/1, 5/59.

<i>Secale cereale</i> L.	11/12.
<i>Hordeum bulbosum</i> L.	1/6, 8/12, 1/13, 11/14, 7/18, 6/19, 23/20, 18/24, 15/25, 9/26, 23/29, 8/31, 5/44, 26/47, 7/52, 7/54, 10/62, 2/64, 7/65, 15/70, 2/71, 18/73, 9/75, 5/79, 7/83, 26/84, 12/88, 4/89.
<i>Hordeum murinum</i> L.	34/1, 7/15, 7/64, 14/70, 11/76.
<i>Hordeum spontaneum</i> C.Koch.	14/13, 17/13, 24/13, 62/13, 9/24, 19/29, 28/47, 5/56, 2/ 58, 1/64, 9/65, 1/75, 12/76, 3/77, 14/88.
<i>Hordeum vulgare</i> L. var. <i>distichon</i>	16/1, 7/5, 5/24, 20/40, 3/41, 1/45, 8/46, 10/48, 1/53, 4/64, 4/88, 5/88.
<i>Hordeum vulgare</i> L. var. <i>hexastichon</i>	16/1, 8/5, 69/13, 5/19, 5/24, 2/45, 1/53, 5/88.
<i>Avena</i> sp. L.	18/1, 44/13, 5/18, 7/19, 10/19, 2/43, 14/50, 4/56, 1/62, 8/62, 11/68, 14/71, 23/84, 6/86, 6/94.
<i>Avena eriantha</i> Durieu.	20/14.
<i>Avena sterilis</i> L.	13/1, 4/14, 13/24, 10/41, 13/45, 14/47, 6/54, 10/56, 6/64, 12/68, 9/74, 16/85, 25/88, 5/95.



III. Gene Symbol

Catalogue of gene symbols for wheat (1990 supplement)

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The most recent edition of the Catalogue appears in the Proceedings of the 7th International Wheat Genetics Symposium held at Cambridge, England, in 1988 (pp. 1225–1323). A limited number of reprints are available from the first author. As annual updates are made, changes and additions will be incorporated into the master files. New references added during updates will be integrated into an alphabetical listing only periodically. However, references held in the data base can be arranged by author at any time.

The Catalogue is available in Microsoft Word for IBM and Apple Macintosh personal computers. Those persons with access to word processing programs can request disks.

Reference numbers in Supplements produced from 1989 continue from the 1988 edition. This Supplement has been offered to the editors of Annual Wheat Newsletter, Cereal Research Communications and Wheat Information Service for inclusion in their respective journals.

To comply with the new designations for chromosomes 4A (VIII) and 4B (IV) as agreed at the 7th IWGS in 1988, the new designations are written 4A* and 4B*, respectively, and symbols including these designations are altered accordingly. Alpha in alpha–Amy is entered as A–Amy and beta in beta–Amy is entered as B–Amy.

Additions to Symbols List.

<i>Ba</i>	Blue aleurone.
<i>Fbp</i>	Fructose–1,6–bisphosphatase.
<i>Fr</i>	Frost resistance.
<i>Gapd1</i>	Chloroplast glyceraldehyde phosphate dehydrogenase.
<i>Gapd2</i>	Cytosolic glyceraldehyde phosphate dehydrogenase.
<i>Glo</i>	Salt–soluble globulins.
<i>Pgk1</i>	Chloroplast phosphoglycerate kinase.
<i>Pgk2</i>	Cytosolic phosphoglycerate kinase.

<i>Ppdk</i>	Pyruvate orthophosphate dikinase.
<i>Prk</i>	Phosphoribulokinase.
<i>Rbcs</i>	Ribulose-1,5 bisphosphate carboxylase small sub-unit.
<i>Rkn</i>	Reaction to <i>Meloidogyne</i> spp.
<i>Wsp</i>	Water-soluble proteins.
<i>Xpsr</i>	DNA markers of unknown function — Institute of Plant Science Research, Cambridge Laboratory, UK
<i>Xksu</i>	DNA markers of unknown function — Kansas State University, Manhattan, Kansas, USA.

Levy and Feldman (1068) studied the inheritance of more than 20 morphological and biochemical traits in crosses of four *T. dicocoides* lines and *T. durum*. The symbols applied to the characters examined are not being reserved and listed in the Catalogue. However this work should serve as a basis for future studies.

Blue Aleurone

Ba (1051). 4B* [4AL.4e1₂ (1051)]. v: UC 66049B.
Ba was introgressed to wheat from *Elytrigia pontica* (2n = 70).

DNA Markers

Group 1L

XPgk1-1A,B,D (976). P7 (977).
XPpdk-1A,B,D (976). PPDK4 (911).

Group 2S

XRbcs-2A,B,D (976). pW9 (979).

Group 2L

XGapd1-2A,B,D (976). pZm57 (980).

Group 3S

Xksu22-3A,B,D (990). pHv22.

Group 4S (4AL*:4BS*:4DS)

Substitute:

<i>XNra-4A*</i> [919].	[<i>XNra-4B</i> (933, 919)].	bNRp10 (918).
<i>Xpsr119-4A*</i> [919].	[<i>Xpsr119-4B</i> (933,919)].	PSR119.
<i>Xpsr144-4A*,B*,D</i> (975).	[<i>Xpsr144-B,A</i> (932)].	PSR144.
<i>Xpsr160-4A*</i> [919].	[<i>Xpsr160-4B</i> (933,919)].	PSR160.
<i>Xwx-4A*</i> [919].	[<i>Xwx-4B</i> (933, 919)].	pcwx27 (907).

Group 4L (4AS*:4BL*:4DL)

Substitute:

*XB-Amy-B1**,D1 [934]. [*BI*: PSR1-4A (934) *XB-Amy-A1* (939). D1: PSR1-4D (934)].
pcBC51 (935).

*Xpsr163-4A**,*B**,*D* (975). [*Xpsr163-4B,A* (932)]. PSR163.
*XFbp-4A**,*B**,*D* (976). F16 (981).

Group 5L

Substitute:

XB-Amy-A1 [934]. [PSR1-5A(934),*XB-Amy-B1*(939). pcBC51 (935).

Xksu8-5A,B,D (990). pHv8, pHv75.

Xksu24-5(1)A,B,D (990). pHv24.

Xksu24-5(2)A,B,D (990). pHv24.

Xksu26-5A,B,D (990). pHv26, pHv29.

Xksu58-5A,B,D (990). pHv58.

Group 6S

XPgk2-6A,B,D (976). p20 (977).

Group 6L

XP4k-6A,B,D (976). F6 (982).

Group 7L

XGapd2-7A,B,D (976). pZm9 (980).

Elsewhere, replace reference 932 with 975.

Crossability with Rye and *Hordeum* spp.

Evidence for allelic variation of dominant suppressors (1065).

Frost Resistance

Fr1 (1070). 5AL (1070). v: Hobbit.

In recombinant lines of Hobbit (*T. spelta* 5A)/Hobbit there was no recombination between *Fr1* and *Vrn1* (1070).

Gibberellic Acid Response

Gibberellic Acid Insensitivity

Gai2 v: Ai-Bian 1 (1044).

Height

Reduced Height

Rht1

v: List in 1062.

Rht2

v: List in 1062.

Rht10 Probably allelic with *Rht2* (1044).

Herbicide Response

1. Difenzoquat Insensitivity

Busch et al. (1038) separated a single dominant gene for tolerance in Era and Marshall compared with the susceptibility of Eureka and Waldren, but its relationship to *Dfq1* is unknown.

2. Chlortoluron Insensitivity

A single dominant gene for tolerance to isoproturon was found in tetraploid wheats derived from a tolerant *T. monococcum* source (1052). This gene is presumably different from *Su1*.

Hybrid Weakness

1. Hybrid Necrosis

Ne1s

v: C306 (1042).

Ne2m

v: Sonalika (1042).

Lists appear in 1041, 1042, 1066.

2. Hybrid Chorosis

Lists appear in 1041, 1042, 1066.

Nucleolus Organiser Regions

Nor-B1a-(1049). A derivative allele of *Nor-B1a* with a significantly reduced amount of spacer.

v: Condor 64-1 (1049);
Sonora 64-1 (1049).

Nor-B1c-(1049).

v: Rosella (1049).

Nor-B1d-(1049).

v: Maris Huntsman (1049).

Nor-B2a-(1049).

v: Blueboy (1049); Sonora
64-1 (1049).

<i>Nor-B2d</i> -(1049).	v : Kite (1049); Harrier (1049).
<i>Nor-B2g</i> -(1049).	v : Falcon; Gluclub; La Prevision.
<i>Nor-B2h</i> -(1049).	v : Yaktana.
<i>Nor-B2i</i> -(1049).	v : Maris Huntsman; Thatcher.

More detailed listings for allelic variation at *Nor-B1* and *Nor-B2* are given in 451, 1049.

Proteins 2. Enzymes

I. Acid Phosphatase

Delete *AcpH-A1* and *-B1* entries and insert:

<i>AcpH-A1</i> * [233].	[<i>AcpH2</i> , <i>AcpH3</i> (245), 4AS* (233,245), <i>AcpH-B1</i> (938)]	v : CS.
<i>AcpH-B1</i> * [233].	[<i>AcpH4</i> , <i>AcpH8</i> (245), 4BL* (233,245), <i>AcpH-A1</i> (938)]	v : CS.

II. Alcohol dehydrogenase (Aliphatic)

Delete *Adh-A1* and *-B1* entries and insert the following:

<i>Adh-A1</i> * [231].	[<i>Adh_B</i> (231), <i>Adh-B1</i> (233)] . 4A* (231), 4AL* (233,245)	v : CS.
<i>Adh-B1</i> * [230,231].	[<i>Adh₁</i> (230), <i>Adh_A</i> (231), 4B* (231), 4BS* (233, 245) <i>Adh-A1</i> (233)].	v : CS.
<i>Adh-B1a</i> * [751].	[<i>Adh₁₁</i> (230), <i>Adh-A1a</i> (751)].	v : CS.
		tv : PI226951 (230), Malavika (751).
<i>Adh-B1b</i> * [751].	[<i>Adh₁₂</i> (230), <i>Adh-A1b</i> (751)].	tv : CI4013(230), Bijaga Yellow (751).
		v : Rageni derivative (752).

*Adh-B1b** was the only variant *Adh-I* allele detected in study of a large number of *T. aestivum* and *T. turgidum* accessions (232).

<i>Adh-M^v1</i> (940).	4M ^v (940).	tr : H-93-33.
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Add (941) as a second reference for *Adh-V1*.

III. Aminopeptidase

<i>Amp-B1c</i> (991).	v : <i>T. spelta</i> (IPSR1220017).
<i>Amp-D1a</i> (991).	v : CS.
<i>Amp-D1b</i> (991).	v : Sears' Synthetic (IPSR 1190903).

<i>Amp-Ag</i> ¹ 1 (991).	6Ag ¹ (991).	ad : Vilmorin 27/ <i>Ag. intermedium</i> .
<i>Amp-A2</i> (991).	4AL* (991).	v : CS.
<i>Amp-A2a</i> (991).		v : CS.
<i>Amp-A2b</i> (991).		v : <i>T. spelta</i> (IPSR1220017).
<i>Amp-B2</i> (991).	4BS* (991).	v : CS.
<i>Amp-B2a</i> (991).		v : CS.
<i>Amp-B2b</i> (991).		v : Timstein.
<i>Amp-B2c</i> (991).		v : Hope.
<i>Amp-D2</i> (991).	4DS (991).	v : CS.
<i>Amp-D2a</i> (991).		v : CS.
<i>Amp-D2b</i> (991).		v : Sears' Synthetic (IPSR1190903).
<i>Amp-D2c</i> (991).		v : Bersee.
<i>Amp-Ag</i> ¹ 2 (991).	4Ag ¹ (991).	v : Vilmorin 27/ <i>Ag. intermedium</i> .
<i>Amp-E2</i> (991).	4E (991).	ad : CS/ <i>E. elongata</i> .
<i>Amp-H2</i> (991).	4H (991).	ad : CS/Betzes.
<i>Amp-H</i> ^{ch} 2 (991).	4H ^{ch} (991).	ad : CS/ <i>H. chilense</i> .
<i>Amp-J2</i> (991).	4J (991).	ad : CS/ <i>Ag. junceum</i> .
<i>Amp-R2</i> (991).	4RL (991).	ad : CS/Imperial.
<i>Amp-S</i> ¹ 2 (991).	4S ¹ L (991).	ad : CS/ <i>Ae. sharonensis</i> (919).
<i>Amp-V2</i> (991).	4V (991).	tr : 4DS.4DL-4S ¹ L (992).
<i>Amp-A3</i> (991).	7AS (991).	ad : CS/ <i>D. villosum</i> .
<i>Amp-A3a</i> (991).		v : CS.
<i>Amp-A3b</i> (991).		v : CS.
<i>Amp-H3</i> (991).	7H (991).	v : Timstein.
		ad : CS/Betzes.

V. B-Amylase (Beta-Amylase)

Delete *B-Amy-A1* and *-B1* entries and insert:

<i>B-Amy-A1</i> * [6,118].	[<i>B-Amy-A2</i> (6), <i>B-Amy-B1</i> (682)].	5AL (6,118). v : CS (6).
		s : CS/Federation (118).
<i>B-Amy-A1a</i> * [6].	[<i>B-Amy-A2a</i> (6), <i>-B1a</i> (938)].	v : CS.
<i>B-Amy-A1b</i> * [6].	[<i>B-Amy-A2b</i> (6), <i>-B1b</i> (938)].	v : Koga II.
<i>B-Amy-A1c</i> * [6].	[<i>B-Amy-A2c</i> (6), <i>-B1c</i> (938)].	v : <i>T. macha</i> (IPSR124005).

<i>B-Amy-A1d*</i> [6].	[<i>B-Amy-A2d</i> (6),- <i>B1d</i> (938)].	v : Holdfast.
<i>B-Amy-A1e*</i> [6].	[<i>B-Amy-A2e</i> (6),- <i>B1e</i> (938)].	v : Bezostaya I.
<i>B-Amy-B1*</i> [318].	[<i>B-Amy-A1</i> (6)]. 4BL* (318, 6).	v : CS.
<i>B-Amy-B1a*</i> [934].	[<i>B-Amy-A1a</i> (6, 934)].	v : CS.
<i>B-Amy-B1b*</i> [934].	[<i>B-Amy-A1b</i> (6, 934)].	v : Sears' Synthetic (IPSR 1190903).
<i>B-Amy-B1c*</i> [934].	[<i>B-Amy-A1b</i> (6),- <i>A1c</i> (934)].	v : Ciano 67.
<i>B-Amy-B1d*</i> [934].	[<i>B-Amy-A1c</i> (934, 999)].	v : Manella.

Remove former alleles *B-Amy-D1d* and *e*, and add: 'Previously listed alleles *B-Amy-D1d* and *e* were found to be *B-Amy-B1** alleles (999).'

VII. Esterase

<i>Est-A5b</i> (7).	v : Kalyansona (7), <i>T. compactum</i> (AUS12084) (989).
<i>Est-D5e</i> [989].	v : <i>T. macha</i> (WJR 38548).

Add 'Three alleles at *Est-D5[†]* (in *T. tauschii*) are reported in 989.'

Add after *Est-5*:

'EST-6 are dimeric isozymes extractable from mature grain endosperm tissue (986).'

<i>Est-A6</i> (986).	2AS (986).	v : CS.
<i>Est-A6a</i> (986).		v : CS.
<i>Est-A6b</i> (986).		v : Ceska Previvka.
<i>Est-B6</i> (986).	2BS (986).	v : CS.
<i>Est-B6a</i> (986).		v : CS.
<i>Est-B6b</i> (986).		v : Hope.
<i>Est-D6</i> (986).	2DS (986).	v : CS.
<i>Est-D6a</i> (986).		v : CS.
<i>Est-D6b</i> (986).		v : Sears' Synthetic (IPSR 1190903).

IX. Glutamic oxaloacetic transaminase

Add (941) as a reference for *Got-V2* and -*V3*.

X. Hexokinase

<i>Hk-A2</i> (985).	3A (985).	su : CS (Sears' Synthetic 3A).
<i>Hk-A2a</i> (985).		v : CS.

Hk-A2b (985).

v: Sears' Synthetic (IPSR
1190903).

Hk-D2 (985).

3DS (985).

v: CS.

Hk-D2a (985).

v: CS.

Hk-D2b (985).

v: Sears' Synthetic (IPSR
1190903).

Also add 985 to 3BS location for *Hk-B2*, ie '3BS (4,985).'

XI. Lipoxygenase

Delete *Lpx-A1* and *-B1* entries and insert:

*Lpx-A1** [245].

[*Lpx-B1* (245)]. 4AL*.

v: CS.

*Lpx-B1** [245].

[*Lpx-A1* (245)]. 4BS*.

v: CS.

*Lpx-B1a** [807].

[*Lpx-A1a*(938)].

v: CS.

*Lpx-B1b** [807].

[*Lpx-A1b*(938)].

v: Bosanka (807).

Lpx-V2 (941).

5V.

ad: CS/*D. villosum*.

XII. Mdh-3

Change all references from 929 or 930 to 983. Delete reference 930.

XIII. Peroxidase

Add general preamble and preamble to each *Per* set.

Peroxidase (EC 1.11.1.7.) isozymes have high tissue specificity. Staining and electrophoretic systems are reviewed in 68. PER-1, -2, -3, -4 and -5 are all reported in 978.

PER-1 is expressed in leaf (9) and coleoptile (978) tissue.

PER-2 is expressed in young leaf (68), coleoptile and root (978) tissue.

Per-A2a (978).

v: CS.

Per-A2b (978).

v: Timstein.

Per-B2a (978).

v: CS.

Per-B2b (978).

v: Sears' Synthetic (IPSR
1190903).

PER-3 is expressed in embryo (69, 978) and scuteller (69) tissue.

Per-A3a (978).

v: CS.

Per-A3b (978).

v: Timstein.

<i>Per-A3c</i> (978).	v: Hobbit 'S'.
<i>Per-B3a</i> (978).	v: CS.
<i>Per-B3b</i> (978).	v: Hope.
<i>Per-B3c</i> (978).	v: <i>T. macha</i> (IPSR1230005).
<i>Per-B3d</i> (978).	v: Timstein.
<i>Per-B3e</i> (978).	v: Sears' Synthetic (IPSR 1190903).
<i>Per-D3a</i> (978).	v: CS.
<i>Per-D3b</i> (978).	v: Hope.
<i>Per-D3c</i> (978).	v: Timstein.
<i>Per-D3d</i> (978).	v: <i>T. macha</i> (IPSR1240005).
<i>Per-D3e</i> (978).	v: Sava.
<i>Per-D3f</i> (978).	v: Cheyenne.
<i>Per-D3g</i> (978).	v: Sears' Synthetic (IPSR 1190903).

Add note at bottom of *Per-3*, 'Varietal variation for *Per-3* was reported in 987.'

PER-4 is expressed in endosperm tissue (56,69).

<i>Per-A4a</i> (978).	v: CS.	
<i>Per-A4b</i> (978).	v: Hope.	
<i>Per-A4c</i> (978).	v: Sicco.	
<i>Per-B4*</i> [353], (69).	4A* (353), 4AL* (352,56,69).	v: CS.
<i>Per-B4a</i> (978).	v: CS.	
<i>Per-B4b</i> (978).	v: Hope.	
<i>Per-B4c</i> (978).	v: Thatcher.	
<i>Per-D4a</i> (978).	v: CS.	
<i>Per-D4b</i> (978).	v: Thatcher.	

Add note at bottom of *Per-4*, 'Varietal variation for *Per-4* was reported in 987.'

PER-5 is expressed in roots (978).

<i>Per-D5</i> (978).	2DS (978).	CS.
<i>Per-S¹5</i> (978).	2S ¹ (978).	CS/ <i>Ae. longissima</i> .

XVI. Phosphoglucomutase

Delete *Pgm-B1* entry and insert:

*Pgm-A1** [54]. [*Pgm-B1* (54)]. 4AL* (54). v: CS.

XXI. Aconitase

For *Aco-B2* and *-D2*, change 5BL (105) and 5DL (105) to 4BL (942) and 4DL (942), respectively.

XXII. NADH dehydrogenase

*Ndh-A1** [243]. [*Ndh-B1* (243)]. 4AL* (243). v: CS.
Ndh-A1a [807]. [*Ndh-B1a* (938)]. v: CS.
Ndh-A1b [807]; [*Ndh-B1b* (938)]. v: Sutjeska.
Ndh-A1c [807]. [*Ndh-B1c* (938)]. v: Fruskogorka.
*Ndh-B1** [243]. [*Ndh-A1* (243)]; 4BS* (243). v: CS.

3. Endosperm Storage Proteins

I. Glutenins

Delete the last two sentences of the preamble, which begin respectively, "Although alleles at each gene" and "An attempt will be made" and substitute:

'A list cross-referencing *Glu-1* alleles, *Glu-1-1* and *Glu-1-2* component alleles and the glutenin subunit identifiers is in preparation. The preliminary list below has been compiled by W.J. Rogers, Institute of Plant Science Research, Cambridge Laboratory; subunit identifiers, with references, are placed in the 3rd column. The subunit nomenclature used is that devised in 567; however, an alternative system based upon molecular weight has been proposed in 996. Also, a system of naming the *Glu-A1-1*, *Glu-A1-2*, *Glu-B1-1* and *Glu-B1-2* alleles in *T. turgidum* var. *dicoccoides* is given in 970.

Duplications and inconsistencies (identified below each *Glu* list) will be rationalized next year. Authors wishing to assign new gene symbols or protein subunit designations before the next Gene Catalogue supplement is published next year are urged to contact the authors of the Catalogue beforehand so that future duplications can be avoided.

Because the *Glu-A1*, *-B1*, and *-D1* sections have been extensively enlarged and revised, they are listed below in their entirety.

Glu-A1 [395], (565). [*Glt-A1*, *Glt-A2* (199), *Glu 1A* (728)]. 1A (395), 1AL (396,565).
s: CS/Hope (565). v: CS(395,396); various (199).
Glu-A1a (567). 1 (567). v: Hope.
Glu-A1b (567). 2* (567). v: Bezostaya 1.

<i>Glu-A1c</i> (567).	null (567).	v: CS.
<i>Glu-A1d</i> (808).		v: V74, Spain (557).
<i>Glu-A1e</i> (808).		v: 132c, Poland (557).
<i>Glu-A1f</i> (808).		v: 112-29, Sudan (557).
<i>Glu-A1g</i> (808).		v: Landrace 1600.
<i>Glu-A1h</i> [803]. [<i>GLU-AI-1</i> (803)];		tv: PI 94683, USSR, <i>T. dicoccum</i> .
<i>Glu-A1i</i> [803]. [<i>GLU-AI-II</i> (803)].		tv: CI 12213, India, <i>T. dicoccum</i> .
<i>Glu-A1j</i> [803]. [<i>GLU-AI-III</i> (803)].	1' (995).	tv: PI 352359, Germany, <i>T. dicoccum</i> ; Lambro (925).
<i>Glu-A1k</i> (220).	26 (220).	v: BT-2288 (220).
<i>Glu-A1l</i> (924).		tv: Chinook, Canada, <i>T. durum</i> .
<i>Glu-A1m</i> (971).		tv: Nugget Biotype 1, Canada, <i>T. durum</i> .
<i>Glu-A1n</i> [926]. [<i>Glu-AI-IV</i> (926), <i>Glu-A1m</i> (939)].	1'' (995).	tv: Corado, Portugal, <i>T. durum</i> (926).
<i>Glu-A1o</i> [926,995]. [<i>Glu-AI-V</i> (926,995), <i>Glu-A1n</i> (939)].	2*** (995).	tv: PI 61189, USSR, <i>T. durum</i> (998); Aric 581/1 (995).
<i>Glu-A1p</i> [972].	3* (972).	v: David 1.
<i>Glu-A1q</i> [995]. [<i>GluA1VI</i> (995)].	2*** (995).	tv: Melianopus 1528, <i>T. durum</i> .

There is a possibility that *Glu-AI* alleles *i*, *j* (803) and *k* (220) correspond to alleles *d*, *e*, *f* or *g* (808) that were published shortly earlier. *Glu-A1m* [926] has been changed to *n*, because the *m* allele in 971 has precedence. Allele *n* [926] has been changed to *o*. An earlier reference to an allele designated *Glu-A1d* (994) has been withdrawn (997). There appears to be a minor band associated with subunit 2* encoded by *Glu-A1b* (974); this may be the same as a band named A5 in 199.

Six combinations involving 5 HMW subunits [1A (u-z)] are listed in 199, from a study of 109 genotypes including representatives of botanical varieties. A number of alleles in *T. turgidum* var. *dicoccoides* populations were described, 12 at *Glu-AI-1* and 3 at *Glu-AI-2* (404).

<i>Glu-B1</i> [65], (565), [<i>Glt-B1</i> , - <i>B2</i> , - <i>B3</i> (199), <i>Glu 1B</i> (728)].	1BL (65,395,565).	v: CS.
<i>Glu-B1a</i> (567).	7 (567).	v: Flinor.
<i>Glu-B1b</i> (567).	7+8 (567).	v: CS.
<i>Glu-B1c</i> (567).	7+9 (567).	v: Bezostaya 1.
<i>Glu-B1d</i> (567).	6+8 (567).	v: Hope.
<i>Glu-B1e</i> (567).	20 (567).	v: Federation.
<i>Glu-B1f</i> (567).	13+16 (567).	v: Lancota (rare).
<i>Glu-B1g</i> (567).	3+19 (567).	v: NS 335 (rare).
<i>Glu-B1h</i> (567).	14+15 (567).	v: Sappo (rare).
<i>Glu-B1i</i> (567).	17+18 (567).	v: Gabo.

<i>Glu-B1j</i> (567).	21 (567).	v: Dunav (rare).
<i>Glu-B1k</i> (567).	22 (567).	v: Serbian (rare).
<i>Glu-B1l</i> (393).	23+24 (393).	v: Spica D.
<i>Glu-B1m</i> [803].	[<i>GLU-B1-I</i> (803)].	tv: PI 94640, Iran, <i>T. dicoccum</i> .
<i>Glu-B1n</i> [803].	[<i>GLU-B1-II</i> (803)].	tv: PI 355505, Germany, <i>T. dicoccum</i> .
<i>Glu-B1o</i> [803].	[<i>GLU-B1-III</i> (803)].	tv: PI 352354, Ethiopia, <i>T. dicoccum</i> .
<i>Glu-B1p</i> [803].	[<i>GLU-B1-IV</i> (803)].	23+18 (995). tv: PI 94655, Ethiopia, <i>T. dicoccum</i> (803); Dritto (925).
<i>Glu-B1q</i> [803].	[<i>GLU-B1-V</i> (803)].	tv: PI 94633, Morocco, <i>T. dicoccum</i> .
<i>Glu-B1r</i> [803].	[<i>GLU-B1-VI</i> (803)].	tv: PI 946669, Bulgaria, <i>T. dicoccum</i> (803). Lambro (925).
<i>Glu-B1s</i> (220).	7+11 (220).	v: BT-2288.
<i>Glu-B1t</i> (924).		v: Supreza, Canada.
<i>Glu-B1u</i> (971).	7*+8 (972).	v: Norstar (971); Fiorello(972).
<i>Glu-B1v</i> (971).		v: Mondor.
<i>Glu-B1w</i> (971).	6*+8* (972).	v: Dawbull (971); Sieve (972).
<i>Glu-B1x</i> [926].	[<i>Glu-B1-VII</i> (926), <i>Glu-B1t</i> (939)].	tv: Canoco de Grao Escuro, Portugal, <i>T. turgidum</i> .
<i>Glu-B1y</i> [926].	[<i>Glu-B1-VIII</i> (926), <i>Glu-B1u</i> (939)].	tv: Tremez Mollez, Portugal, <i>T. durum</i> .
<i>Glu-B1z</i> [925].	[<i>Glu-B1-IX</i> (925), <i>Glu-B1v</i> (939)]	7+15(995). tv: Roccia,Italy, <i>T. durum</i> (925,995).
<i>Glu-B1aa</i> [925].	[<i>Glu-B1-X</i> (925), <i>Glu-B1w</i> (939)]	tv: Quaduro, Italy, <i>T. durum</i> .
<i>Glu-B1ab</i> [925].	[<i>Glu-B1-XI</i> (925), <i>Glu-B1x</i> (939)].	tv: Athena, Italy, <i>T. durum</i> .
<i>Glu-B1ac</i> [995].	[<i>Glu-B1XIII</i> (995)].	6+16 (995). tv: Espanhol 8914, <i>T. durum</i> .
<i>Glu-B1ad</i> [995].	[<i>Glu B1XIV</i> (995)].	23+22(995). tv: Greece 20, <i>T. durum</i> .
<i>Glu-B1ae</i> [972].	18* (972).	v: David.
<i>Glu-B1af</i> [972].	26+27 (972).	v: Colonia 1.
<i>Glu-B1ag</i> [972].	28+29 (972).	v: Forlani.
<i>Glu-B1ah</i> [969].	null (969).	v: Olympic mutant.
<i>Glu-B1ai</i> [966].	7 [?] (966).	v: Adonis.
<i>Glu-B1aj</i> [967].	8 (967).	v: AUS 14444, Afghanistan.

The alleles formerly designed *t* to *x* in 939 have been renamed *x* to *ab* since allele *t* in 924 and alleles *u,v* and *w* in 971 have precedence. Subunit 8 of *Glu-B1b* (7+8) is more acidic in isoelectric focusing than subunit 8 of *Glu-B1d* (6+8) (993). Variation in the mobility of subunits designated 7 has been observed (560), which accords with more recent observations (966, 971).

The subunit encoded by *Glu-B1v* (971) has the same mobility as subunit 7 of *Glu-B1c* (7+9); it could be the same subunit as 7' encoded by *Glu-B1ai* [966]. Variation in the staining intensity of subunit 7 in different varieties has also been observed (971); possible low gene expression at *Glu-B1* has been noted for *Glu-B1w*, where subunits 6*+8* stain very faintly (972). One of the *Glu-B1af* subunits has been numbered 26 in 972; 26 was previously used to number the subunit encoded by *Glu-A1k* (220). Subunit 28 of *Glu-B1ag* (28+29) (972) is referred to as subunit 19* in 996. Subunit 23 of *Glu-B1p* (23+18) and *Glu-B1ad* (23+22) (995) may not be the same subunit as that numbered 23 of *Glu-B1l* (23+24) (393). *Glu-B1z* carried by Roccia was numbered 7 + 15 and named *Glu-B1XII* in 995; however, the earlier name, *Glu-B1-IX* (925), has precedence; also 925 states that the *Glu-B1-IX* subunit of faster mobility is slightly slower than subunit 15. Subunit 11 of *Glu-B1s* (7+11) was so numbered in 220 since its mobility is the same as one of the subunits encoded by a *Glu-D1* allele (2+11) described in 968.

Fifteen combinations involving 12 HMW subunits [1B (a-o)] are listed in 199. Eight alleles at *Glu-B1-1* and 10 alleles at *Glu-B1-2* have been described in *T. turgidum* var. *dicoccoides* populations (404).

Glu-D1 [548], (565). [*Glt-D1*, *Glt-D2* (199), *Glu 1D* (728)]. 1DL (548,65,93,395,565). v: CS.

<i>Glu-D1a</i> (567).	2+12 (567).	v: CS.
<i>Glu-D1b</i> (567).	3+12 (567).	v: Hobbit.
<i>Glu-D1c</i> (567).	4+12 (567).	v: Champlein.
<i>Glu-D1d</i> (567).	5+10 (567).	v: Hope.
<i>Glu-D1e</i> (567).	2+10 (567).	v: Flinor (rare).
<i>Glu-D1f</i> (567).	2.2+12 (567).	v: Danchi (rare).
<i>Glu-D1g</i> (220).	5+9 (220)	v: BT-2288.
<i>Glu-D1h</i> [973].	5+12 (973).	v: Fiorello, Italy.
<i>Glu-D1i</i> [65].	null (65).	v: Nap Hal, Nepal.
<i>Glu-D1j</i> [972].	2+12* (972).	v: Tudest.
<i>Glu-D1k</i> [965].	2.	s: CS/Timstein (965).
<i>Glu-D1l</i> [967].	12 (967).	v: AUS 10037, Afghanistan.
<i>Glu-D1m</i> [967].	10 (967).	v: AUS 13673, Afghanistan.
<i>Glu-D1n</i> [967].	2.1+10 (967).	v: AUS 14653, Afghanistan.
<i>Glu-D1o</i> [968].	2.1+13 (968).	v: AUS 14519, <i>T. macha</i> .

Glu-D1k [965] appears to have arisen as the result of a deficiency of subunit 12 from *Glu-D1a* (2+12); subunits 2 and 12 are referred to as D1 and D5 in 965. One of the *Glu-D1o* subunits has been numbered 13 in 968; 13 was previously used to number a subunit encoded by *Glu-B1f* (13+16) and *Glu-B1g* (13+19) (567). Subunit 9 of *Glu-D1g* (5+9) was so numbered in 220 since its mobility is the same as one of the subunits encoded by *Glu-B1c* (7+9).

Five combinations involving 6 HMW subunits [1D. (p-t)] are listed in 199. Eleven additional *Glu-D1* alleles in *T. tauschii* have been described (968).

Add (941) as a reference for *Glu-VI*.

5. Other Proteins

IV. Water soluble proteins

WSP-1 are monomeric grain endosperm proteins identified by their high pI's (984).

<i>Wsp-A1</i> (984).	7AL (984).	v : CS.
<i>Wsp-A1a</i> (984).		v : CS.
<i>Wsp-A1b</i> (984).		v : Huntsman.
<i>Wsp-A1c</i> (984).		v : Hope.
<i>Wsp-A1d</i> (984).		v : Sicco.
<i>Wsp-A1e</i> (984).		v : Condor.
<i>Wsp-B1</i> (984).	7BL (984).	v : CS.
<i>Wsp-B1a</i> (984).		v : CS.
<i>Wsp-B1b</i> (984).		v : Hope.
<i>Wsp-B1c</i> (984).		v : Condor.
<i>Wsp-D1</i> (984).	7DL (984).	v : CS.
<i>Wsp-D1a</i> (984).		v : CS.
<i>Wsp-D1b</i> (984).		v : Sears' Synthetic (IPSR 1190903).
<i>Wsp-E1</i> (984).	7E (984).	CS/ <i>E. elongata</i> .
<i>Wsp-H1</i> (984).	7H (984).	CS/Betzes.
<i>Wsp-H^{ch}1</i> (984).	7H ^{ch} (984).	CS/ <i>H. chilense</i> .
<i>Wsp-S¹1</i> (984).	7S (984).	CS/ <i>Ae. sharonensis</i> .
<i>Wsp-V1</i> (984).	7V (984).	CS/ <i>D. villosum</i> .

IV? Salt soluble globulins

GLO-1 are endosperm proteins (23-26 kDa) soluble in salt but not in water (988).

<i>Glo-A1</i> (988).	1AS (988).	v : CS.
<i>Glo-B1</i> (988).	1BS (988).	v : CS.
<i>Glo-D1</i> (988).	1DS (988).	v : CS.
<i>Glo-E1</i> (988).	1ES (988).	ad : CS/ <i>E. elongata</i> .
<i>Glo-R1</i> (988).	1RS (988).	ad : CS/Imperial. su : 1B/1R Salzmunde.

Red Grain Colour

R-VI (905). 3VL (905). *tvad* : Creso/*T. villosum*.

Response to Vernalization

Vrn1 v : Koga II (1048).

Vrn4 v : Mara (1048).

Reaction to *Erysiphe graminis*

Pm14 6B (1034). v : Akabozu *Pm15* (1034); Kokeshi-komugi *Pm15* (1034); Norin 10 *Pm15* (1034).

Pm15 7DS(1034). v : Norin 4 *Pm10* (1034); Norin 26 *Pm10* (1034); Shin-chunaga *Pm10* (1034); *T. macha subletschumicum Pm10* (1034). Chinese Spring *Pm11* (1034); *T. compactum* No. 44 *Pm11* (1034). Akabozu *Pm14* (1034); Kokeshi-komugi *Pm14* (1034); Norin 10 *Pm14* (1034).

Pm14 and *Pm15* were detected using hybrids between *E.g. tritici* and *E.g. agropyri* cultures.

Pm16 (1058). 4A* (1058). v : *T. dicoccoides* derivatives (1058).

Pm17 (1060). 1AL-1RS (1061). v : Amigo.

Reaction to *Mayetiola destructor*

H7 5D (1063).

H20 (1036). 2B (1086). Jori (1036).

Reaction to *Meloidogyne spp.*

Disease: Root rot nematode, root knot eelworm

Rkn (1059). *dv*: *Aegilops squarrosa* G3489.

v: Prosquare, a synthetic hexaploid of *Produra/Aegilops squarrosa* G3489 (679).

Reaction to *Pseudocercospora herpotrichoides*

Pch 7D (1064). s: Courtot*/Roazon 7D (1064) v: H-93-70 (1045).

Delibes et al (1945) concluded that *Pch* was not located in chromosome 7D whereas Law et al (1957) found that H-93-70 possessed a unique allele, *Ep-D1b*, in common with VPM1 and its derivatives.

Reaction to *Puccinia graminis*

- Sr5* v: Viginta (1053).
Sr11 v: Sylvia (1053).
Sr24 v: Cody (1039).
Sr29 v: Hana (1053).
Sr36 v: Maris Fundin (1047).

Reaction to *Puccinia recondita*

- Lr1* v: Glenlea (1040).
Lr2a v: Alex *Lr10* (1040); Guard *Lr10* (1040); James *Lr10* (1040); Len *Lr10* (1040); Marshall *Lr10* (1040).
Lr10 v: Sinton (1037). Alex *Lr2a* (1040); Guard *Lr2a* (1040); James *Lr2a* (1040); Len *Lr2a* (1040); Marshall *Lr2a* (1040).
Lr13 v: Napayp (1047).
Lr24 v: Cody (1039).

Complex genotypes: Benito *Lr1 Lr2a Lr12 Lr13* (1037); Era *Lr10 Lr13 Lr34* (1067); MN7529 *Lr1 Lr2a Lr10 Lr16* (1040).

Reaction to *Puccinia striiformis*

- Yr2* v: Hana (1053). Odra (1053); Slavia (1053). Viginta *Yr3a, Yr4a* (1053).

Yr2 originally referred to a gene in Heines VII conferring resistance to European pathotypes. However, Heines VII possess an additional resistance gene (1056) which can be detected with a geographically wider range of pathogen isolates. *Yr2* is present in Kalyansona (1056) and presumably a range of other spring wheats distributed by CIMMYT.

- Yr3a* v: Zdar *Yr4a* (1053). Viginta *Yr2 Yr4a* (1053).
Yr4a v: Zdar *Yr3a* (1053). Viginta *Yr2 Yr3a* (1053).
Yr6 v: Pavon 76 *Yr7* (1069).
Yr7 v: Pavon 76 *Yr6* (1069). Pakistan 81 = Veery #5 *Yr9* (1069).
Yr8 v: Chromosome 2A/2M and 2D/2M translocation is Hobbit Sib and Maris Widgeon (1043).

Yr9 v: Sarhad 82 (1069). Pakistan 81 = Veery #5 *Yr7* (1069).

Sources of additional genes for seedling (designated "12") and adult plant resistances ("13", "14", "15") are listed in 1055.

Reaction to *Tilletia* spp.

B14 v: Oveson (1035).

Genetic Linkages

Chromosome

1A	<i>Gli-A1</i>	—	<i>Glu-A1</i>	42%	1046
1BS	<i>Gli-B1</i>	—	centromere	I	1054
	<i>Gli</i>	—	<i>Glu-B1</i>	41%	1046
1BL	centromere	—	<i>Glu-B1</i>	14.1%	1054
1D	<i>Gli-D1</i>	—	<i>Glu-D1</i>	42%	1046
2BS	<i>ppd2</i>	—	<i>Dfq1</i>	I	1047
2BL	<i>Sr9g/Yr7</i>	—	<i>Dfq1</i>	6cM	1047
	<i>Dfq1</i>	—	<i>Sr16</i>	I	1047
	centromere	—	<i>Dfq1</i>	30cM	1047

4DS Gibberellic insensitivity in Ai-Bian 1 possessing *Rht10* was allelic with *Rht2* (1044). It is therefore likely that *Rht10* and *Rht12* are allelic.

5D	Xksu24-5(1)	—	Xksu24-5(2)	17.3 ± 4.0	990
	Xksu24-5(1)	—	Xksu8-53	3.6 ± 5.6	990
	Xksu24-5(2)	—	Xksu8-52	9.5 ± 5.4	990
	Xksu8-5	—	Xksu58-5	11.7 ± 3.1	990
	Xksu8-5	—	Xksu26-5	12.7 ± 3.3	990
	Xksu58-5	—	Xksu26-5	4.5 ± 1.9	990
6BS	<i>Xpsr106</i>	—	<i>Xpsr167</i>	29.1 ± 6.1%	917
	<i>Xpsr106</i>	—	<i>Xnral</i>	32.1 ± 6.2%	917
	<i>Xpsr106</i>	—	<i>XA-Amy-1/Nor-B2</i>	I	917
	<i>Xpsr167</i>	—	<i>Xnra 1</i>	5.4 ± 3.1%	917
	<i>Xpsr167</i>	—	<i>Nor-B2</i>	13.2 ± 4.6%	917

	<i>Xpsr167</i>	—	<i>XA-Amy1</i>	14.6 ± 5.1%	917
	<i>Xpsr167</i>	—	<i>Xpsr149</i>	18.2 ± 5.2%	917
	<i>Xnra 1</i>	—	<i>Nor-B2</i>	11.1 ± 4.3%	917
	<i>Xnra 1</i>	—	<i>XA-Amy-1</i>	12.5 ± 4.8%	917
	<i>Xnra 1</i>	—	<i>Xpsr149</i>	16.4 ± 5.0%	917
	<i>Nor-B2</i>	—	<i>XA-Amy-1</i>	0 ± 2.5%	917
	<i>Nor-B2</i>	—	<i>Xpsr149</i>	3.7 ± 2.6%	917
6BL	<i>XA-Amy-1</i>	—	<i>Xpsr149</i>	4.2 ± 2.9%	917
7AS	<i>Xpsr119</i>	—	<i>Xpsr160</i>	4 cM	933
	<i>Xnra</i>	—	<i>XWx</i>	10 cM	933
	<i>XNra</i>	—	<i>Per-A4</i>	23.3 ± 6.4	978
	<i>XNra</i>	—	<i>Per-A4</i>	20.1 ± 6.5	978
	<i>Amp-A1</i>	—	<i>Xpepc</i>	24 cM	933
7BS	<i>Xpsr65</i>	—	<i>Xpst150/152</i>	4	933
	<i>Xpsr150/152</i>	—	<i>Xpsr165</i>	6	933
7BL	<i>Xpsr165</i>	—	<i>Xpepc</i>	8	933
	<i>Xpepc</i>	—	<i>XA-Amy</i>	7	933
	<i>XA-Amy</i>	—	<i>Xpsr72(1)</i>	9	933
	<i>Xpsr72(1)</i>	—	<i>Xpsr72(2)</i>	9	933
	<i>Xpsr72(2)</i>	—	<i>Xpsr117</i>	50	933
	<i>Xpsr117</i>	—	<i>Xpsr129</i>	47	933
	<i>Xpsr121</i>	—	<i>Wsp-81</i>	16.6 ± 6.9	984
	<i>Xpsr129</i>	—	<i>Ep-B1</i>	>50	933
	<i>Ep-B1</i>	—	<i>Xpsr121</i>	9	933
	<i>Ep-B1</i>	—	<i>Wsp-B1</i>	31.6 ± 12.1	984
7DS	<i>Xpsr119</i>	—	<i>Xpsr160</i>	11	933
	<i>Xpsr65</i>	—	<i>Xpsr150</i>	2	933
	<i>Xpsr104</i>	—	<i>Xpsr150</i>	2	933

Homoeology of Chromosome Arms

2AS = 2BS = 2DS	<i>Xpsr135</i>	932
	<i>Xpsr108, Xpsr109, Xpsr122</i>	937
	<i>Xpsr126, Xpsr130, Xpsr131</i>	
2AB = 2BL = 2DL	<i>Xpsr101</i>	932
	<i>Xpsr102, Xpsr112</i>	937

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IV. Editorial Remarks

Announcement for Future Issues

WIS No. 71 will be planned for publication in September, 1990, respectively. Manuscripts for No. 71 will be accepted anytime not later than July 1990. Lists of genetic stocks and records of genetic resources are mostly welcome.

Manuscripts should be typewritten (double-space) in English, and submitted with duplicates. One article should not exceed five printed pages (about 10 typewriting pages). Lists of stocks are exempted from this page limit.

Off-prints could be printed by order at cost price. Back numbers are available by order at cost price.

Acknowledgment

The cost of the publication has been defrayed by a contribution from Kihama Memorial Yokohama Foundation for the Advancement of Life Sciences. We wish to express our sincere thanks to the organization.

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Explanation of the Picture on the Cover

Native habitat of a wild tetraploid wheat, *Triticum araraticum*, in the mountain areas near Amadiya (1122m alt.), Iraq. Botanical Expedition of Kyoto University to the Northern Highland of Mesopotamia (BEM) in 1970. (M. Tanaka).

WIS No.70

編集 国際小麦研究連絡会議

田中正武

発行所 木原記念 横浜生命科学振興財団
〒232 横浜市南区六ッ川3-122-20
Tel. (045) 721-0751

発行日 1990年3月1日

印刷 株式会社野毛印刷
Tel. (045) 252-2511

Wheat Information Service No. 70

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