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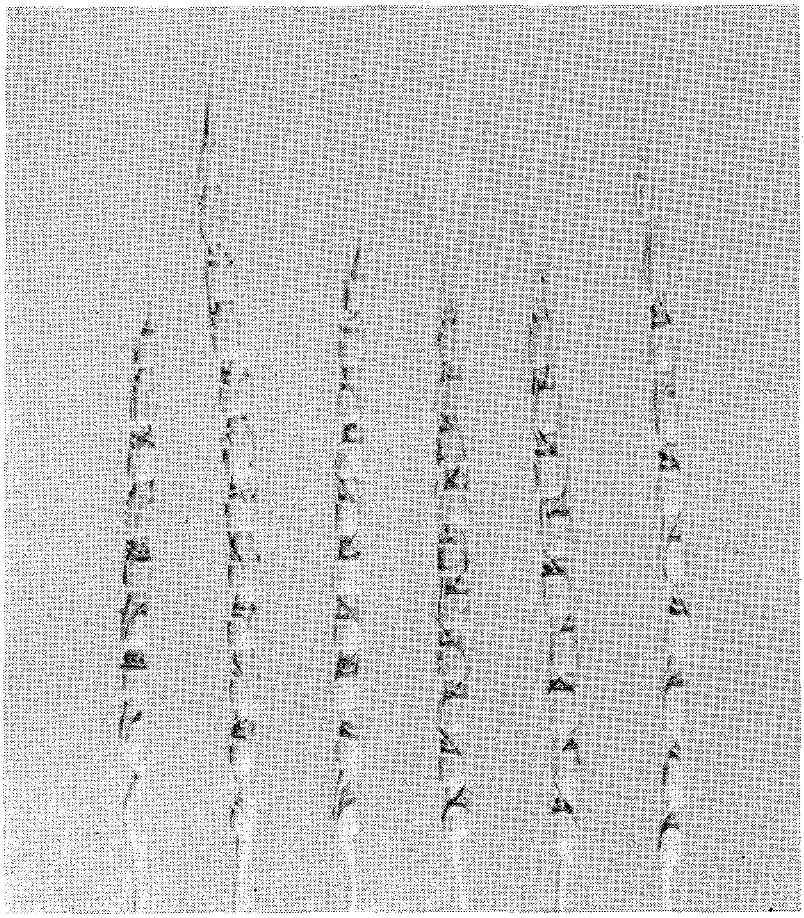

Nos. 19, 20 March 1965

Wheat Information Service
Biological Laboratory, Kyoto University
Kyoto, Japan

IV. Editorial Remarks

Explanation of the Figure on the cover

Radiation in *Aegilops squarrosa* collected by the Kyoto University Scientific Expedition to Karakorum Hindukush, 1955

Announcement for further issues

WIS Nos. 21 and 22 will be published during the fiscal year from April 1965 to March 1966. Manuscripts for those issues are accepted any time, and they will go to press in sequence as soon as they cover the planned pages of each number. WIS is open to all contributions regarding methods, materials and stocks, ideas and research results related to genetics and cytology of *Triticum*, *Aegilops*, *Agropyon*, *Secale* and *Haynaldia*.

The manuscripts should not exceed 3 printed pages. List of stocks is exempted from this page limit. No illustrations are accepted for this publication.

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Nos. 19, 20

WIS

March 1965

1. RESEARCH NOTES

Aegilops taiuncialis from Afghanistan and Iran

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a. Collected materials and geographical distribution

After EIG (1929) *Ae. triuncialis* L. ($2n = 28$, genome symbol CCC^uC^u after KIHARA), a tetraploid species, is divided into two subspecies, namely ssp. *eu-triuncialis* EIG and ssp. *orientalis* EIG.

Ssp. *eu-triuncialis* has 2 varieties, *typica* and *constantinopolitana,* while ssp. *orientalis* has 3 varieties, *assyriaca, persica* and *anathera.*

After EIG (1929), the geographical distribution of *Ae. triuncialis* is very wide. But it does not occur in the south. Fig. 17 in EIG (1929) shows that var. *typica* covers the whole area of the distribution of this species, while var. *constantinopolitana* is found in a very limited area. Three varieties of ssp. *orientalis* are found only in the Orient. Among those three varieties, *persica,* has the largest area extending from Iran to Afghanistan, while var. *assyriaca* has a very limited distribution in Assyria in eastern Turkey.

Var. *typica* was collected in the Pul-i-Khumri, Tehran and Tabriz regions and also in a very small area of the Gorgan region, but was not found in the coastal area of the Caspian Sea.

Var. *anathera* was not collected in any region.

Var. *persica* was found only in the Maimana region, where var. *typica* was not found. Var. *assyriaca* was also found unexpectedly in this region.

Two habitats gave the pure populations of var. *persica*, two habitats the mixed populations of vars. *persica,* and *assyriaca,* and six habitats the pure populations of var. *assyriaca.* The populations of var. *persica* were smaller than expected while ssp. *orientalis* occurred abundantly in this region.

b. Morphological characters

Ssp. *eu-triuncialis* EIG.

Both sterile and outer glumes of apical spikelet have 2 - 3 awns, and also sterile glumes of all lateral spikelets are awned. Articulation of the ear is umbrella type with no exception.

Ssp. *orientalis* EIG.

In apical spikelet sterile glume has 1 - 3 awns, while outer glume has none. Disarticulation of the ear is umbrella type or sometimes barrel type.

Var. *assyriaca* EIG has one long and slender awn in lateral spikelet. It was observed that vars. *assyriaca* and *persica* occur side by side in common populations in the Maimana region. There would be a possibility of hybridization between the two varieties. Probably for this reason, there exist wide and continuous variations between the two varieties and it has been difficult to give a clear cut classification between vars. *assyriaca* and *persica* based on the morphological differences.

According to MATSUMURA and KONDO (1942) the awned type is incompletely dominant over the non-awned in *Ae. triuncialis*.

[i] Height of culm: The plants were classified under 4 classes by their height, namely less than 35, 35-45, 45-55 and 55-65 cm. Many tall plants were found in the Tabriz region, Iran and in the Maimana regions, Afghanistan.

[ii] Waxiness: Among 47 localities, 30 were the pure non-waxy populations and 4 were the pure waxy populations and the rest were the mixed ones. In many habitats the ratio of non-waxy vs. waxy was 4.4 : 1. In the Maimana region waxy plants occurred in a majority.

Since non-waxy is dominant over waxy, non-waxy plants should be either homozygous or heterozygous. Actually all waxy plants gave all waxy progenies, while 3 non-waxy plants segregated waxy progenies, indicating the hybridization occurred between waxy and non-waxy in nature.

[iii] Glume pubescence: In almost all *Aegilops* species, both pubescent and glabrous types are found, pubescent being dominant over glabrous.

Among 47 habitats, all the strains from 25 habitats were pubescent and all the strains from 14 habitats were glabrous, while both pubescent and glabrous strains were collected from 8 habitats.

The glabrous type is probably a mutation from the pubescent type. However, it is note-worthy that the glabrous plants occurred in an overwhelming majority in the Pul-i-Khumri region, Afghanistan.

c. Physiological characters

[i] Shooting date: Early, intermediate and late shooting types were found in the strains of *Ae. triuncialis.*

There was a marked tendency to late shooting in the strains from Iran, while early shooting types were found more often in the strains from Afghanistan.

[ii] Seed fertility: The fertility of the samples from the original habitat in 1955 was much higher than that of those from the cultivation in the experimental field in Kyoto in 1956. The low fertility of the latter is probably due to the influence of the rain condition during the flowering time.

[iii] Growing habit: 65 strains collected in 33 habitats from the different regions have been studied for growing habits in the experimental field in Kyoto. They were classified into 29 spring types, 23 intermediate types, and 13 winter types. 18 out of 22 strains from the Tehran region were perfect spring types, and 15 out of 19 strains from the Maimana region were intermediate or spring types, while, 7 out of 11 strains from the Tabriz region were winter types.

However, mixed populations of spring and winter types were also found in the habitats near Tabriz in the Tabriz region, Iran, and also near Haibak in the Pul-i-Khumri region, Afghanistan. It is thought that the spring type is a natural mutation from the winter type.

d. Origin of ssp. ***eu-triuncialis*** **and ssp.** ***orientalis.***

The origin of *Ae. triuncialis* presents one of the most puzzling problems. Ssp. *eu-triuncialis* is represented sp. var. *typica,* and ssp. *orientalis* by var. *persica.* Ssp. *orientalis* is distinguished by the characteristic such as barrel type disarticulation of ears.

The studies of the karyotype of *Ae. triuncialis* were published by SENJANINOVA - KORCZAGINA (1932), and CHENNAVEERAIAH (1960). SENJANINOVA - KORCZAGINA established *Ae. persica* as an independent sub-species, based on her karyomorphological findings that var. *persica* had a karyotype composed of C^u-genome of *Ae. umbellulata* and C-genome of *Ae. caudata,* while ssp. *eu-triuncialis* had the karyotype composed of C^u-genome and one genome which is not identical with that of *Ae. caudata.*

According to CHENNAVEERAIAH, however, ssp. *persica* has one set of chromosomes which corresponds to the C^u-genome, and the second set resembles C-genome. In ssp. *eu-triuncialis* he found also one set of chromosomes corresponding to C^u-genome, but he thought that the second set differs not only from the typical C-genome of *Ae. caudata,* but also from that of *persica.* Therefore, he concluded that there are C^u and C in the *triuncialis* complex. The barrel type disarticulation in a form of ssp. *persica* will be explained as the introgression from *Ae. crassa,* as suggested by ZOHARY and FELDMAN (1962).

KIHARA and KONDO (1943) succeeded in synthesizing *Ae. triuncialis* as an amphidiploid CCC^uC^u, from *caudata* × *umbellulata*, which resembled var. *typica* morphologically. They found also that the ears of the synthesized one (*caudata* × *umbellulata*) disarticulate in the barrel type like those of *Ae. squarrosa* and *crassa*. Based on the observations on chromosome conjugation and fertility in F_1 and F_2 hybrids between var. *typica*, or var. *persica* and the synthesized one, they concluded that the genomes of them the two varieties are identical or almost identical.

However, further observations revealed that always one or more multivalents and certain number of univalents occur in almost all PMC's in the hybrid of var. *typica* as one parent. Ssp. *orientalis* was collected in the Maimana region in Afghanistan by KUSE (1955), but the majority of the collection by BMUK (1959) were ssp. *eu-triuncialis*, and a few specimens collected from Konya-Akseki in south–western Turkey were ssp. *orientalis* var. *assyriaca*.

Since ssp. *orientalis* was found only in the Maimana region, it was thought that ssp. *orientalis* was derived from ssp. *eu-triuncialis* there. But it was not clear if it was originated by mutation of one or more genes concerning the awning and disarticulation, or if it was the product of introgressive hybridization of *eu-triuncialis* × *crassa* as proposed by ZOHARY and FELDMAN (1962).

However, it was interesting to know that ssp. *orientalis* was found from Konya-Akseki in Turkey where it was presumed to be the centre of the distribution of *Ae. triuncialis*, and where awned form of *Ae. caudata* var. *polyathera*, having C-genome, occurred widely.

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1) The Kyoto University Scientific Expedition to the Karakoram and Hindukush, 1955

2) The Botanical Mission of the University of Kyoto to the Eastern Mediterranean Countries, 1959

Morphological, physiological, genetical and cytological studies in *Aegilops* and *Triticum* collected from Pakistan, Afghanistan and Iran[1])

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Since *Aegilops squarrosa* L. was found to be one of the ancestors of common wheat (McFADDEN and SEARS 1944, 1946, KIHARA 1944, KIHARA and LILIENFELD 1949), it became our main concern to investigate this species from various points of view. Accordingly, the Kyoto University organized the Scientific Expedition to the Karakoram and Hindukush, in 1955, in which KIHARA was the leader and YAMASHITA one of the members. They started from Quetta (Pakistan) toward the end of May, and travelled through Afghanistan as far as Azerbaizyan, Iran. The collecting tour ended on the 30th of July at Tabriz, Iran.

According to geographical as well as ecological conditions, the whole area has been divided into 9 regions: namely Quetta, Kabul, Pul-i-Khumri, Maimana, Tehran, Isfahan, Gorgan, Pahlavi and Tabriz. In the Isfahan region not a single species of *Aegilops* was found, but in all the other regions many *Triticum* and *Aegilops* species were collected.

I. *Aegilops*

Species collected were *Ae. squarrosa*, *Ae. crassa*, *Ae. cylindrica*, *Ae. triuncialis* and *Ae. columnaris*.

1) Geographical distributions:

(a) *Ae. squarrosa*: Three varieties of ssp. *squarrosa* were collected, namely *typica*, *anathera* and *meyeri*. Many intermediate types between the first two were found almost everywhere. *Meyeri* occurred solely on the west coast of the Caspian Sea. Ssp. *strangulata* was found only in a localized region on the south east coast of the Caspian Sea (Gorgan). Its occurrence along the route was estimated to cover 320 km.

(b) *Ae. crassa* included 4x and 6x forms. All strains from Iran and the south-eastern province of Afghanistan were 4x, while in the northern stretch of the Hindukush Range, the Pul-i-Khumri and Maimana regions 4x and 6x were found mixed. Accordingly, it is thought that 6x *crassa* originated in this district from the hybridization between 4x *crassa* and *squarrosa*.

(c) *Ae. cylindrica* was found in the Tehran region which is supposed to be the eastern limit of its distribution.

(d) *Ae. triuncialis* included 2 subspecies, ssp. *eu-triuncialis* and ssp. *orientalis*. Ssp. *eu-triuncialis* was found in all parts of Iran, except for the coastal area of the Caspian Sea; it was also found in the Pul-i-Khumri region of Afghanistan. However, ssp. *orientalis* was found only in the Maimana region.

(e) *Ae. columnaris* was found in the Tabriz and Tehran regions. This is a new discovery for its geographical distribution.

2) Morphological characters: The morphological characters such as plant height, tillering habit (procumbent or erect), waxiness (waxy or non-waxy) of leaves, colour of seedlings, color of ears, hairiness (pubescent or glabrous) of glumes, and awnedness of glumes, etc. were studied. Wide variations were found especially in *Ae. squarrosa* and *Ae. triuncialis*. For instance, tall plants with erect culms and large grains were found in *Ae. squarrosa* strains collected from wheat fields, while variations were slight in *Ae. cylindrica*.

Ae. crassa with awnless ear was found in the south-eastern province of Afghanistan. This will be a new variety.

3) Physiological characters: Earliness, seed-fertility, winter or spring habit, and also resistance to rusts. Some strains of *Ae. squarrosa* collected in the south eastern provinces of Afghanistan had spring habit, while all other *Ae. squarrosa* strains exhibited winter habit.

Some strains of var. *meyeri* and *strangulata* of *Ae. squarrosa* have been found to be resistant to certain rust strains.

4) Hybrids of inter- and intraregional cross-combinations were raised among *Ae. squarrosa* strains. Fertility of those F_1 hybrids was normal in most cases, but it was low in some combinations. The sterility of the intra-species hybrids seemed to depend mainly on genotype difference between parents (due to a complementary gene system for hybrid sterility) and partly on environmental conditions.

5) Based on cytological studies, a reciprocal translocation was ascertained in one strain of *Ae. squarrosa* and two strains of *Ae. columnaris* found in Iran.

II. *Triticum*

T. vulgare, *T. compactum*, *T. turgidum* and *T. durum* were collected from the whole area along the expedition route. They were classified according to the classification systems of KOERNICKE (1885), PERCIVAL (1921) and MANSFELD (1951). 29 groups - 51 varieties were found in *T. vulgare*, also one in *T. compactum*, 5 in *T. durum* and one in *T. turgidum*.

With respect to 4 principal and morphological characters in *T. vulgare*, strains from the Tehran, Isfahan and Kabul regions showed wide variations, while the strains from the Gorgan and Tabriz regions were less variable. Three new varieties were found in the collection.

The *vulgare* strains from the Isfahan region are characterized by inflated and awnless ear. Wheat with pubescent chaff has been found among the Isfahan materials. Many varieties, including those with inflated short awned ear, were found in the Tehran region.

T. compactum was found mainly in the mountaineous area in the Kabul region and in Ardabil in the Pahlavi region. The Afghan strains were characterized by slight square-headedness, while the Iranian ones were normal.

Five varieties of *T. durum* were found in the Gorgan region. *Ae. squarrosa* was found there in or along the borders of *durum*-wheat fields.

T. turgidum with branched ear was found in the Isfahan region. This variety seems to have been introduced recently from Russia.

A sample obtained by the courtesy of Dr. M. ATAI, University of Tehran, carrying the name *T. monococcum*, revealed to be $2n=28$. It could be a new variety of *T. polonicum* from the morphological and cytological observations. According to HESLOT (1959) this variety is a new species, *T. ispahanicum*.

III. Artificially synthesized hexaploid wheats

New hexaploid wheats synthesized from hybrids between emmer wheats and *Ae. squarrosa* including three varieties, var. *typica*, var. *meyeri* and var. *strangulata*. In general, the cross combination of *T. persicum* × *Ae. squarrosa*, *strangulata* or *meyeri* gave high percentages of pollen- and seed-fertility in F_1 hybrids. This result favors the view that *T. persicum* may be considered one of the ancestors of our hexaploid wheats. The amphidiploid ABD No. 22 synthesized from *T. persicum* and a leaf rust resistant strain of *Ae. squarrosa*, showed fair resistance.

IV. General conclusion

a) The present expedition covered the wide area from Pakistan, through Afghanistan to Iran, and a number of species and varieties of *Aegilops* and *Triticum* were collected.

b) The amphidiploids obtained from hybrids between varieties of emmer wheats and those of *Ae. squarrosa* could possibly be utilized for breeding resistant varieties of bread wheats.

c) The chromosome pairings in PMC's of synthesized hexaploids have been observed for generations, but it has been found that it was not yet stable after 20 years of experimenting from the time they were first synthesized (KIHARA 1965). For the completion of stabilization or diploidization, it would take such a large number of generations that have led to the establishment of the already existing hexaploid wheats.

d) The authors are of the opinion that our bread wheat arose under cultivation of certain species of emmer wheats, most probably *T. persicum*, through amphidiploidization of its hybrids with *Ae. squarrosa*, which grew as weed in or around the fields. However, *T. persicum*, a Persian wheat, was not found anywhere in Iran (or ancient Persia). According to certain information this species probably occurs in the north-eastern district of Asia Minor and also in the Caucasus regions where probably the origin of most of emmer wheat has to be sought.

In 1959, Kyoto University has organized the second expedition of hunting for *Aegilops* and wheat to the Eastern Mediterranean regions (YAMASHITA was the leader and TANAKA was a member). *Ae. mutica* and species and varieties of the Sitopsis section were collected by the expedition. They also found *T. dicoccoides*, a wild emmer, at the foot of Mount Hermon.

The authors are eager to have an opportunity of extending the botanical exploration to the Caucasus and neighbouring regions in not far future.

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1) Summary of the paper with the same title in "Cultivated Plants and their Relatives" KUSE Vol. 1, 1965. 1. Report of the Kyoto University Scientific Expedition to the Karakoram and Hindukush, 1955

Aneuploidy and fertility in amphidiploid wheat-rye hybrids

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[I] Investigations on aneuploidy and fertility of octoploid wheat-rye amphidiploids gave the following results:

1. Populaion plants out of 35 different lines of amphidiploid wheat - rye showed a frequency of aneuploidy on an average of 83.3%.

2. A selection of highfertile single plants decreased the percentage of aneuploids in the offspring to an average value of 60.6%.

3. The most effective method of selection was to select highfertile single plants from progenies with highest fertility. The percentage of aneuploids in the offspring of these plants could be diminished to an average value of 40.3%,

4. It was not possible to select an amphidiploid wheat-rye line which was completely constant in the chromosome number. The best line showed even now 36.4% aneuploids in the offspring.

5. In relation to the fluctuation of the chromosome number in the offspring *triticale* lines with relative low variation in the chromosome number were found to be very little influenced by the genetic constitution of the amphidiploids. The progenies of single plants with highly different genetical origin showed nearly the same proportion of aneuploids.

6. In the offspring of the most plants the distribution of somatic chromosome numbers showed a tendency to revert to lower chromosome numbers. In populations the proportions of plants reverted to chromosome numbers of wheat was found on the average of 2.6%.

7. Between somatic chromosome number and fertility an intimate correlation could be observed. Hypo- and hyper-aneuploids with 55 respectively 57 chromosomes showed already a reduction in fertility of on an average 11 resp. 15%.

8. Between euploid and aneuploid plants the differences in plant height were lower than the differences in fertility. Aneuploid plants with 55 chromosomes showed a reduction in plant height on an average of 4%. Aneuploids with 57 coromosomes showed a reduction of 7%.

9. With increasing aneuploidy a further reduction in fertility and plant height seems to take place.

10. In relation to the values of fertility and plant height obtained from euploid standard plants the average values of the offspring of those plants came to 5% resp. 2% lower. The difference between the highest possible values of the euploid plants and the average values of the offspring was found to be larger when the proportion of euploid plants in the offspring is smaller.

11. The incomplete fertility and the variability in plant height of octoploid wheat-rye amphidiploids is caused in the main by an unusual proportion of aneuploids in the offspring of these amphidiploids.

[II] Studies on aneuploidy and fertility resp. plant height of the octoploid wheat-rye amphidiploid "Trc 220" gave the following results:

1. With increasing aneuploidy fertility of cytologically examined aneuploids was not only reduced when chromosomes were lost but also when the chromosome number surpassed the euploid level. In the range of the chromosome numbers 56 to 49 fertility was diminished on an average of 11.4% when chromosome was lost (euploid plants=100%). Fertility of aneuploids with chromosome numbers between 49 and 45 to the contrary varied only unimportantly. The smallest seed setting came to about 14% of euploid seed setting.

Aneuploids with less than 45 chomosomes were on an average more fertile than euploid plants and reached partly about 25% better seed setting.

Because of this otherwise behaviour and in cosideration to the more or less strong resemblance to wheat aneuploids with chromosome numbers between 44 and 40 were comprehended in a special group and called "backregulated amphidiploids".

2. Plant height was also dependent on chromosome number. In the range of the chromosome numbers 56 to 49 reduction came to an average of 6.4% when one chomosome was lost whilst plant height of aneuploids with chomosome numbers between 49 and 45 varied unimportantly. Backregulated amphidiploids with 44 to 40 chromosomes reached 85% of the euploid plant height.

3. In relation to reduction of fertility and plant height in two different years and under different conditions of cultivation nearly the same results were obtained. An influence of possible cross-fertilization under open flowering conditions could not be observed.

4. In cytological examinations of progenies a considerable variation of chromosome number and a strong tendency to backregulating was observed. The progenies had a mean-chromosome number that was on an average one chromosome smaller than the chromosome number of the mother plant. This tendency

of backregulating seems probably to be caused by irregular meiosis and variable fitness of the different haploid gametes.

5. Studies on fertility and plant height of progenies indicated further that not only fertility and plant height of single plants but also mean fertility and mean plant height of the offspring is correlated to the chromosome number. The relations were the same as in studies on single plants. There was only a shifting in relation to the maximal values. The offspring of plants with 57 chromosomes had better fertility and plant height than the offspring of euploid plants. This shifting was expected because dependent upon the tendency of backregulating plants with 57 chromesomes produced the most euploid offspring.

6. It was further observed that the offspring of mother plants with quite the same chromosome number partly differed significantly in mean values for fertility and plant height. It is possible that these differences are caused by genotypical differences between the mother plants. A reliable evidence could not be established because the progenies were only small and other reasons had to be taken into consideration too.

7. The aneuploid composition of the offspring was also found to be influenced by environmental conditions. Progenies of aneuploids with different chromosome number had different survival rates and especially in progenies of aneuploids with low chromosome numbers (50 resp. 49 chromosomes) a great deal of plants died before reaching maturity.

8. In relation to aneuploid composition of later generations of "Trc 220" the present studies indicate that 3 points are of decisive importance:

1. Tendency to backregulating,
2. Differences in fertility and fitness of aneuploids with different chromosome number and
3. Selection environment and elimination of plants with low fitness.

F_1 Monosomic analysis of resistance in common wheat to the greenbug

(*Schizaphis graminum* Rond.)

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The specific chromosome carrying the recessive greenbug resistant gene *gb*, was not determined in repeated tests of monosomic analysis. In tests conducted in 1957 and repeated in 1964, the F_1 plants between DS28A, C.I. 13833, a greenbug resistant hard red spring wheat, crossed with the 21 different Chinese Spring monosomics (greenbug susceptible), were susceptible (killed) while the DS28A parent showed good resistance.

One explanation for failure to locate the chromosome carrying the greenbug resistant trait is that the recessive resistant gene may be ineffective in a single dose. Such hemizygous ineffective genes are knownin wheat (viz. SEAR's *sphaerococcum* gene). In each of the F_1 populations about 75 percent of the plants should have been monosomic. Thus, in the critical chromosome family about 75 percent of the plants should have been resistant had a single dose of the *gb* gene been effective.

Another explanation is that resistance may be conditioned by more than one gene pair. The latter alternative is difficult to accept because the authors have found that the resistant trait responded like a simple recessive in a large number of F_1, F_2, F_3, and backcross populations that involved several susceptible wheat varieties. In addition, if more than one gene pair conditions resistance there should have been different degrees of resistance among resistant progenies. This has not been the case. All resistant F_2 plants as well as subsequent selections from these plants have proved to have resistance equal to that of DS28A.

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Colchicine-induced tetraploids of *Aegilops speltoides*

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In the last years there were several publications which deal with artificial polyploids in the genus *Aegilops*. The representatives of the Sitopsis section have got special interest in being the possible donors of the B-genome in the tetra- and hexaploid wheats. In "WIS" some reports are given on autotetraploids of *Ae. bicornis* ($S^bS^bS^bS^b$), *Ae. longissima* and *Ae. sharonensis* (both $S^lS^lS^lS^l$) resp.. For crossing experiments it seemed to be important to have polyploid types of *Ae. speltoides* (S S S S) too. The present author could not find any information in literature about autotetraploid *Ae. speltoides*.

After several attempts we got two tetraploid individuals of *Ae. speltoides* in C_2-generation by colchicine treatment with an aqueous solution of 0.05% for 10^h with pre-soaked seeds of var. *ligustica*.

The tetraploid plants were raised in pots and showed normal growth. There were only slight differences in the seedling stage between diploid control plants and the tetraploids. Later on the morphological differences became more evident. The culms of the polyploids were somewhat thickened and tillering was considerably reduced. While the diploids (measured on 4 plants) had an average number of 36 (32 - 45) tillers / plant, the tetraploids showed a corresponding value of 24 (21 and 28 resp.). The date of ear emergence was something delayed in the tetraploids. The plant heights of the two tetraploid individuals were decreased markedly. The average height of the diploids at flowering stage was found to be 66 cm (65 - 68) compared with 50 cm (48 and 53 resp.) in the tetraploids. Regarding ear characters the following differences were observed between 2n- and 4n-types: Length of the ear in cm; 9.8 (9.7 - 10.0) vs. 8.0 (7.9 and 8.2 resp.). Average number of spikelets / ear; 12.2 (11.5 - 12.7) vs. 11.0 (10.9 and 11.0 resp.). Average number of seeds / spikelet; 2.61 (2.44 - 2.76) vs. 0.54 (0.51 and 0.58 resp.). The lengths of the spikelets and of the awns were reduced markedly, while the number of florets / spikelet remained unaffected. The seed size of the tetraploids was somewhat increased.

More intensive investigations will be carried out the next time to support these preliminary data.

Radiation-induced mutants in a Japanese wheat variety, Shinchunaga

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Irradiation with 10 to 40 kr of gamma rays from ^{60}Co on the dry seeds of Shinchunaga, a Japanese variety of common wheat, induced 248 kinds of mutants. For convenience' sake, these mutants were classified into six groups, speltoid, compactoid, squareheaded, lax-spiked, dense-spiked, and other mutants from the spike shapes, but other mutant characters were observed always in combination with the above mutants. Cytogenetical investigations have been performed on these mutants up to the X_8 generation.

Speltoids were caused by a loss of gene, called *Q*, on the long arm of 5A chromosome. Namely, they have deficiencies of various sizes on the long arm, or are missing the whole arm or the whole chromosome. Only one speltoid mutant was considered to be near to the A-type speltoid of gene mutation type. Most compactoids, sub-compactoids and the related squareheadeds were due to an increase of the *Q* gene. Namely, the increase of the whole arm and of the whole chromosome occasionally accompanied with the decrease of the homoeologous chromosome were observed in these mutants. Besides, the sub-compactoid and squareheaded mutants of a strain were considered to be pentasomic and tetrasomic for either of 5B or 5D chromosomes, respectively. Some of squareheadeds which do not segregate compactoids were caused by a loss of the short arm of 5A chromosome or by deficiencies on the arm. Several lax-spiked mutants were certified to be missing 6D chromosome or the homoeologous chromosomes or one of the arms of these chromosomes. Some other lax-spikeds were also missing a chromosome of different homoeologous group. A part of dense-spikeds were nullisomic for the chromosomes of homoeologous group 3, or were missing one of the arms of these chromosomes. Among many other mutants too, various chromosomal aberrations were observed.

It is conclusive from the present investigations that the majority of radiation-induced mutants are caused by deficiencies or other chromosomal aberrations rather than by gene mutations, in contrast with spontaneous mutants.

Dosage effect of 5A chromosome or the long arm in a Japanese wheat variety, Shinchunaga

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In the progenies of gamma-ray irradiated Shinchunaga, a Japanese variety of common wheat, numerous kinds of mutants were found. Among these radiation-induced mutants, many speltoid and compactoid mutants were included. Through the cytogenetical analyses on the speltoid and compactoid mutants, it has been proved that there are several speltoid mutants which are missing the whole or the long arm of 5A chromosome, and that some compactoid mutants have 5A chromosome or the long arm excessively. The dosage effect of 5A chromosome or the long arm observed in the present case, however, differs from that in Chinese Spring ever reported. Namely, zero, one, two, three, four, and five dosages of 5A or the long arm made the plants homozygous speltoid, heterozygous speltoid, normal, squareheaded, sub-compactoid, and compactoid, respectively, in Shinchunaga wheat. On the other hand, it has been shown by several authors that disomics, trisomics, and tetrasomics of 5A chromosome in Chinese Spring are squareheaded, sub-compactoid, and compactoid, respectively.

This difference may be attributable to the different genetic effects of the *Q* gene locating on the long arm of 5A chromosome and/or the allelic genes on 5B and 5D chromosomes, or it may relate to a gene on the short arm of 5A, loss of which makes the plants squareheaded. Actually, the spikes of normal Shinchunaga are non-squareheaded, whereas those of normal Chinese Spring are squareheaded. At any rate, this difference is a new evidence of the differentiation accomplished between these two varieties.

Effect of radioactive cobalt on characters of some wheat varieties

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In 1960, dry seeds of Tosson, Giza 144, Giza 150 (*Triticum vulgare*), Baladi Bahtim (*T. durum*), Baladi 116 (*T. pyramidale*) and Einkorn (*T. monococcum*) were exposed to Co^{60} at the Exhibition of the American Atomic Energy Establishment in Cairo. Doses were 5000 r, 10000 r, 20000 r, and 30000 r. Treated seeds and untreated seeds were planted at the Bahtim Experiment Station both under greenhouse and field conditions. In the field studies, treatments were randomized and each treatment was replicated 4 times.

Under greenhouse conditions, it was found that seedling emergence was delayed by radiation effect; differences between treatments were significant at 1% level. The delay was proportional with radiation dose. Also germination percentage, in general, decreased with the increase of the radiation dose. In studying plant height, lower doses of 5000 r and 10000 r generally activate seedling length while higher doses had a diminishing effect.

In the field, studies were conducted during the growing seasons 1960/61 (R_1) and 1961/62 (R_2). Seedling emergence was delayed by radiation effect which agreed with results obtained in the greenhouse. None of the treated seeds of the two wheat varieties, Giza 144 and Baladi 116 germinated under field conditions while very few seeds of these two wheat varieties germinated under greenhouse conditions. Further notes were recorded periodically each week in R_1 only and indicated that percentage of seedling survival decreased with the increase in radiation dose. In case of Einkorn, seedling survival was favored by lower doses of radiation i. e. 5000 r and 10000 r.

For adult plant characters, it was found that the increase of radiation dose was accompanied by an increase in the heading period, and consequently the heading was delayed. Also, radiation was found to affect number of ears per plant, number of spikelets per ear, number of grains per ear, seed set per spikelet and grain yield per plant. Infection with stem rust also increased with the increase of radiation dose, with the exception of the variety Einkorn in which it decreased. Characters such as plant height, number of tillers per plant, ear length and grain weight (weight of 100 seeds) were not affected by radiation both in R_1 and R_2.

In R_2 (season of 1961/62), some macromutations were observed and selected. These mutations were: 1. a tipped awned ear from Tosson (an awned wheat variety) isolated from the 30000 r treatment, 2. erected ears mutant from Tosson, selected from the 30000 r treatment, 3. slender straw from Tosson, isolated from the 20000 r treatment, 4. delayed ear emergence mutant from Tosson isolated trom the 20000 r treatment, 5. long ear mutant from Baladi Bahtim isolated from the 20000 r treatment, 6. compacted ears from Giza 150 isolated from the 30000 r treatment and 7. short straw from Einkorn isolated from the 10000 r treatment.

These mutants were studied during the seasons 1961 / 62, 62 / 63 and 63 / 64. Descendants of the tipped awned ear mutant from Tosson seemed to be of economic value as certain plants in the R_4 were resistant to one or more of the 3 wheat rusts (The parent Tosson is susceptible to the 3 wheat rusts). Few other plants were resistant to the 3 rusts. Most of these plants were awned. Some will be included in the wheat breeding program at the Bahtim Agricultural Experiment Station.

Purple grain in hexaploid wheat

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A stable hexaploid wheat with purple grain colour has been obtained from the cross *Triticum dicoccum* var. *Arraseita* Perc. × *Triticum aestivum* L.. Caporn, J. of Genetics Vol. 7, 1917-18 and Sharman, Nature Vol. 181, 1958 have described crosses made between purple grained wheats and other tetraploids.

Three wheats with purple grain colour, originally from Abyssinia, were obtained from the Plant Breeding Institute, Cambridge, England, in 1930, and have been maintained at the Crop Research Division as part of the Wheat Collection. Crosses were made between all three of these wheats and several commercial hexaploid varieties, but only one purple variety, Stn. No. E450, produced viable seed after the second backcross. Only the cross with the white-grained variety Arawa produced lines maintaining the purple colour after the third backcross. Additional backcrosses to Arawa were made but there was a progressive weakening of the purple colour in the plants following each backcross.

After three further backcrosses, however, using the red-grained commercial variety Hilgendorf as the recurrent parent we have obtained dark-purple-grained hexaploid wheat plants, (E 450 × 3 Arawa) × 3 Hilgendorf, which are stable in F5.

Lines of this material, in which the colour is as intense as in the original tetraploid wheat, have been sown in a field trial for the assessment of yield and baking quality.

International wheat rust testing centre -- Njoro, Kenya

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The wheats of Kenya are bombarded annually by a particularly wide range of stem rust races, some of which are exceptionally virulent. The rate of appearance of new races of rust has been alarming — particularly during the past two decades. Screening of international nurseries and other collections of wheat has revealed the paucity of material resistant to the races of stem rust occurring in Kenya.

In 1961 the Rockefeller Foundation granted special funds to increase the staff and facilities at the Plant Breeding Station, Njoro, in order to try to exploit the rust situation in Kenya in the search for resistance to stem rust. Therefore, a screening program was designed not only to augment the existing wheat breeding program at Njoro, but also to make available to wheat breeders everywhere any resistant material that would be discussed.

To date, approximately 11,000 entries from the World Wheat Collection of Beltsville, Maryland, U.S.A., have been screened. Selections from the International Wheat Nurseries and F.A.O. nurseries have been made for many years. In addition, thousands of lines from individual breeders in many countries have been tested. Very fruitful sources of material have been the Rockefeller wheat projects in Mexico and South America. Some of the selections from these various sources have been tested for several years. Although seeds from this station have been sent to many wheat breeders, it is felt that much wider use of the collections could be usefully made. In order to facilitate requests for material and distribution of seed, the collections made by the wheat breeders at Njoro and those derived from this scheme will be arranged in the form of small nurseries. The emphasis will be on rust resistance but several other categories will also be included (paragraph 1 below).

The following paragraphs set the kinds of material we have available for distribution and some of our plans to further the search for rust resistance.

1. **Nurseries.** For distribution to interested wheat breeders.
   (a) Parental rust resistant collection. A collection of 88 wheat varieties which incorporate resistance to various races of stem rust and also exhibit many good agronomic characteristics.
   (b) Rust Testing Centre Collections. The number will vary with pro-

gress. Many will have little but resistance to recommend them. To be used in breeding work.

   (i) Stem rust
   (ii) Brown leaf rust
   (iii) Yellow stripe rust

(c) Durum wheat. Resistance and other agronomic features.

(d) Earliness.

(e) Dwarf. Norin 10 and other sources of the dwarf characteristic.

(f) Blotch.

(g) Species collection.

2. **Further Screening.** This will be continued to the extent that wheat breeders can be induced to contribute material for testing. Everything is welcome.

3. **Rust Resistance Studies.** An attempt will be made to discover the races to which the collected material is resistant and the amount of duplication that exists. Field resistance nurseries and seedling tests will be used.

4. **Male-Sterility.** *Triticum timopheevi* type of male-sterility will be used to induce as much intercrossing as possible, using a mixture of the various sources of rust resistance as the recurrent parent.

5. **Chemical mutagen.** The chemical, ethyl methanesulphonate (EMS) will be used to try to induce rust resistance in otherwise good varieties. The severe rust conditions at Njoro may enhance the chances of success.

Summary report -- 1963 of the international wheat rust testing centre Njoro, Kenya

by

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Plant Breeding Station, Njoro, Kenya

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General

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Appendix C — Performance of collections of wheat lines and varieties contributed by individuals.

Appendix D — Retesting of the best material tested in 1962.

Appendix E — Durum wheats from Dr. K. L. LEBSOCK.

General

Wheat rust infections in the main wheat growing area of Kenya were not particularly severe in the 1963 growing season. However, the rust nursery at Njoro was surrounded and interlaced with susceptible varieties which were sprayed with a mixture of the following races of stem rust: 11, 15, 21, 34, 40A, 40C, 40D, 40E, 40F, 40G, 40T, 117, 143, 184, 295, 296 and 297. (In Kenya race 40 is divided into biotypes A to G and T on the basis of supplemental variety reactions in addition to the standard set of differentials.) Samples taken from various parts of the Njoro experimental area showed that the following races became established: 21, 34, 40C, 40E, 40F, 40T, 117, 184, 295 and 296. The level of infection in the nursery was excellent. Many entries received scores of 80-100% and a few entries succumbed entirely.

The infections of brown leaf rust and stripe rust were due to naturally occurring inocculum. Both of these species of rust are generally present at Njoro, with stripe rust especially becoming more severe in the higher altitudes. The race picture for leaf and stripe rust is not known since the main concern is stem rust.

The scoring for rust follows the established system used for the International Spring Wheat Nursery, as defined by Dr. W. Q. LOEGERING, U.S.D.A., Beltsville, Maryland. The severity of attack is denoted by the percentages 0, trace (t), 2, 5, 10 and by 10's up to 100. Reaction type is denoted by the letters VR, R, MR, MS, S and VS. Most of the entries were scored for stem, leaf and stripe rust.

Four thousand selections from the World Collection of Wheat, Beltsville, Maryland, U.S.A., were tested for rust reaction in 1963. These lines and varieties were taken from the range of P. I. numbers 166,260 to 193,936. Several hundred of these lines proved to be winter wheat, so that their stem rust scores were probably not very meaningful. The list of entries in Appendix A includes only spring wheat. Of the 4,000 entries tested, less than 30 (not counting duplicates) had infection levels for stem rust of 10% or less. Seven entries had trace infections only but with a susceptible reaction type in each case.

Appendix A shows a list of 185 lines and varieties which exhibited stem rust infections of 30% or less. The latter portion of the appendix (below the solid line) includes an additional 30 selections which had trace or zero scores for both brown leaf rust and stripe rust. The number of entries with trace or zero scores for leaf and stripe rust was considerably greater than the number of entries with low stem rust scores.

Appendix B shows a selection of the resistant lines selected from the Colombian breeding material. The total number of lines tested was over 1600, 59 of which are listed. Many of these are dwarf types and have other good agronomic characteristics. Their general adaptability to Kenya conditions is quite good. They are being grown again in 1964 and more data on their performance will be reported next year.

Appendix C includes a number of smaller collections of wheat received from individuals. These collections generally exhibited less stem rust resistance than desirable. However, a number have good resistance to both leaf and stripe rust. The collection from Dr. N. E. Borlaug is an exception in that it displayed very good stem rust resistance.

Appendix D lists the varieties that have been tested in both 1962 and 1963. The comparison between the scores of varieties for the two years shows that infection levels do change from year to year. However, this list includes much material with good levels of resistance as well as agronomic characteristics.

Appendix E presents a list of the most resistant varieties of durum wheats received from Dr. K. L. Lebsock. The level of resistance to stem rust among these varieties is excellent. Many of them, however, fall down on resistance to leaf and stripe rust.

We have tested most of the World Wheat Collection and have been testing the International Spring Wheat, Oats and Barley Rust Nurseries, as well as the F.A.O. wheat nursery, for many years (reported elsewhere). Many large and small collections from individuals and institutions have also been tested. In addition to rust records, we have a certain amount of agronomic data for some of the tested material. If any of the reported lines or varieties appear useful to our readers, we will be happy to supply seed, further information or suggest where seed is available. Comments and criticisms on the usefulness of this work would be appreciated.

In order to continue the present scope of this work, may we issue another call for new wheats to test for stem rust resistance in particular. The types of material that could be useful are:

1. Lines and varieties used in crossing programs.
2. Lines from breeding programs; segregating or advanced generations or bulks of early generations.
3. New releases and the ones that didn't quite make it.
4. Interspecific or intergeneric derivatives.
5. New material from mutation breeding work.

In addition to wheat, we would also appreciate receiving small samples of oats and barley lines and varieties falling into the above categories.

Acknowledgements

The continued support of the Rockefeller Foundation is gratefully acknowledged.

Special thanks are due to all donors of collections of material for testing.

We appreciate the efforts of the Pathology section of this station, Dr. E. J. GUTHRIE, Mr. N. K. PATEL and staff. We appreciate the efforts of Mr. V. P. PATEL and our field assistants who did the plot work and much of the recording.

Gramineae collected by the KUSE (1955) from Pakistan, Afghanistan and Iran

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Species	Collection number	Source		Chromosome number (2n)	Figure number		
					Spike	Spikelet	Chromosome
Agropyron intermedium (HOST) P. BEAUV.?	7011	Tehran-Kraj,	Iran	–			
”	7012	Tehran-Sari,	”	–			
”	7013	”	”	–			
”	7014	Tabriz-Ardabil,	”	56			
A. trichophorum (LINK) RICHT	7021	Tehran-Sari,	”	–			
”	7022	”	”	–			
”	7023	”	”	42	1, 2		68
”	7024	Laman-Herat,	Afghanistan	42	3		
A. sp. probably *A. repens* (LINN.) P. BEAUV. or *A. intermedium*	7001	Kandahar-Ghazni,	”	–			
”	7002	”	”	–			
”	7003	”	”	–	4		
”	7004	”	”	–			
”	7005	”	”	–			
”	7007	”	”	56			
”	7008	Tehran-Sari,	Iran	–			
Alopecurus mysuroides HUDS.	7006	Isfahan-Damaneh,	”	14	18		69
”	7261	”	”	–			
Brachypodium sylvaticum (HUDS.) P. BEAUV.	7111	Sari-Gorgan,	”	18	19		70a, 70b

Brachypodium sylvaticum (HUDS.) P. BEAUV.	7112	Pahlavi-Ardabil,	Iran	–	20		
„	7113	„	„	–			
Bromus brizaeformis FISCH. et MEYER	7121	Astara,	„	14	15	23	71a, 71b
B. Commutatus SCHRADER	7133	Sari,	„	14			
„	7134	Sari-Gorgan,	„	14	16	24	
„	7141	Mahabad-Khoy,	„	14			
B. Danthoniae (DESF.) TRIN.	7161	Chaman,	Pakistan	14	10	28	
„	7163	Isfahan,	Iran	14			
„	7165	Tehran,	„	14	11	30	
„	7166	Tabriz,	„	14		31	
„	7167	Mahabad-Rezaiyeh,	„	14			
„	7170	Pul-i-Khumri,	Afghanistan	14			
„	7171	Tashkurgan-Acchah,	„	14			
B. macrostachys DESF.	7144	Pul-i-Khumri,	„	28	13	29	
„	7145	„	„	28			
B. madritensis LINN.	7151	Isfahan,	Iran	–			
„	7152	„	„	14	12	27	
B. racemosus HUDS.	7136	Pahlavi-Astara,	„	14			72
„	7137	„	„	14			
„	7138	„	„	14	14	25	
„	7139	„	„	14			
„	7140	„	„	14			
B. secalinus LINN.	7132	Pul-i-Khumi,	Afghanistan	–	17	26	
Cynodon dactylon (LINN.). BERS.	7321	Ramser-Rasht,	Iran	–	62		

Cynosurus echinatus Linn.	7221	Astara-Ardabil,	Iran	16	54		73
Dactylis glomerata Linn.	7211	Behshahr,	„	28			
„	7212	Sari-Behshahr,	„	–	55		
„	7213	Ardabil-Sarab,	„	–			
Elumus dahuricus Turcz.	7066	Hopar,	Afghanistan	42	5		
Eragrostis sp.	7202	Kandahar-Ghazni,	„	–	63		
Eremopyrum buonapartis (Spreng.) Nevski var. *buonapartis*	7033	Chaman,	Pakistan	28			
„	7035	Isfahan,	Iran	14	35	44	77a, 77b
„	7036	Isfahan-Damanch,	„	28	36	45	
„	7038	Tabriz-Ardabil,	„	28	37	46	80
„	7042	Meshed,	„	28	38	47	
„	7043	Kandahar,	Afghanistan	28	39	48	
„	7044	Kandahar-Ghazni,	„	–			
E. buonapartis (Spreng.) Nevski var. *sublanuginosum* (Drob.) Melderis	7032	Quetta-Chaman,	Pakistan	28	40	49	
„	7034	Kabul-Jalabad,	Afghanistan	28	41	50	
E. distans (C. Koch) Nevski	7041	Pul-i-Khumri,	„	14	42	51	81
E. orientale (Linn.) Jaub. et Spach.	7031	Quetta-Chaman,	Pakistan	28	52	78	79
„	7037	Ardabil-Tabriz,	Iran	28	43	53	
Festuca elatior Linn.	7181	Isfahan,	„	42			
„	7182	Tehran-Sari,	„	14	6		
F. Myuros Linn.	7183	Pahlavi-Astara,	„	–	7		
Henrardia persica (Boiss.) C. B. Hubbard var. *persica*	7331	Tehran-Ghazvin,	„	14			
„	7333	Ardabil-Tabriz,	„	14	8		
„	7338	Tabriz,	„	–			

„	7339	Dept. Agr. Tehran, Iran	14			82
„	7340	„ „	–			
„	7341	„ „	–			
H. persica (Boiss.) C. E. Hubbard var. *glaberrima* (Hausskn.) C. E. Hubbard	7334	Ardabil-Tabriz, „	14	9		
„	7335	„ „	14			
„	7336	„ „	–			
„	7337	„ „	–			
Heteranthelium piliferum (Banks et Seland.) Hochst	7051	Tehran, „	14	56		
,	7052	Mahabad, „	14	57		
„	7053	„ „	–			
„	7054	„ „	–			
„	7055	Pul-i-Khumri, Afghanistan	14		32	75
Koeleria phleoides (Vill.) Pers.	7191	„ „	–			
„	7192	„ „	26	58		76
„	7232	Pahlavi-Astara, Iran	–			
Paspalum distichum Linn.	7291	Rasht-Pahlavi, „	–	64		
Phalaris minor Retz.	7271	Pul-i-Khumri, Afghanistan	28	59		
„	7272	Tashkurgan-Acchah, „	–			
„	7273	Kandahar, „	28	60		
Phleum baniculatum Huds.	7241	Behahakr-Gorgan, Iran	–			
„	7242	Tehran-Sari, „	–			
„	7243	Astara, „	–			
„	7244	„ „	–	65		
„	7245	Astara-Ardabil „	–			

Polypogon monospeliensis (LINN.) DESF.	7251	Kandahar,	Afghanistan	28	61		
Setaria verticillata (LINN.) P. BEAUV.	7281	Sari-Gorgan,	Iran	–	66		
Sorghum halepense (LINN.) PERS.	7311	Kabul-Charikar,	Afghanistan	–	67		
Taeniatherum asperum NEVSKI	7061	Hazar Gandi,	Pakistan	–			
"	7062	"	"	–			
"	7063	"	"	–			
"	7065	Pul-i-Khumri,	Afghanistan	14	21	34	83
T. crinitum (SCHREB.) NEVSKI	7064	Karaj,	Iran	14	22	33	84

List of *Triticum* collected by the KUSE (1955)[1] from Pakistan, Afghanistan and Iran

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Culture No.	Stock No.	Species	Variety	Locality or Source	
3001	3001- 3	*T. durum* Desf.	var. *hordeiforme* (Host) Körn.	Quetta region: Fruit Exp. Station,	Pak.
3002	3003- 2	*T. polonicum* L.	var. *chrysospermum* Körn.	″	″
3003	3003- 1	*T. vulgare* Vill.	var. *barbarossa* Alef.	″	″
3004	3004- 2	*T. sphaerococcum* Perc.	var. *rubiginosum* Perc.	″	″
3005	3005- 3	*T. vulgare* Vill.	var. *suberythroleucon* Vav.	″	″
3006	3007- 1	″	var. *graecum* Körn.	Hudda (suburbs of Quetta),	″
3007	3010- 4	″	var. *erythroleucon-compactoides* Kob.	″	″
3008	3013- 6	″	var. *erythroleucon* Körn.	″	″
3009	3015- 1	″	var. ″	″	″
3010	3017- 2	″	var. *lut-inflatum* Vav.	Suburbs of Quetta,	″
3011	3025- 3	″	var. *graecum* Körn.	Agr. Exp. Station, Quetta,	″
3012	3026- 1	″	var. *hostianum-compactoides* Gökg.	″	″
3013	3027- 1	″	var. *erythroleucon* Körn.	″	″
3014	3028- 3	″	var. *erythrospermum* Körn.	″	″
3015	3030- 2	″	var. *velutinum-compactoides* Zhuk.	″	″
3016	3031- 1	″	var. *lutescens-compactoides* Kob.	″	″
3017	3032- 5	″	var. ″	″	″

3018	3034- 1	*T. vulgare* VILL.	var. *graecum* KÖRN.	Agr. Exp. Station, Quetta,	Pak.
3019	3035- 1	„	var. *erythrosperum* KÖRN.	„	„
3020	3036-10	„	var. *ferrugineum* ALEF.	„	„
3021	3037- 9	„	var. *erythroleucon-compactoides* KOB.	„	„
3022	3038- 6	„	var. *meridionale* KÖRN.	„	„
3023	3040- 1	„	var. *hostianum-compactoides* GÖKG.	„	„
3024	3044- 1	„	var. *lutescens-compatoides* KOB.	„	„
3025	3045- 2	„	var. „	„	„
3026	3047- 1	„	var. „	„	„
3027	3048- 1	„	var. *velutinum-compactodes* ZHUK.	„	„
3028	3050- 3	„	var. *meridionale* KÖRN.	„	„
3029	3052 1	„	var. *graecum* KÖRN.	Kabul region: Quetta – Chaman,	„
3030	3053- 1	„	var. *suberythrospermum* VAV.	„	„
3031	3056- 1	„	var. *erythrospermum* KÖRN.	„	„
3032	3058- 1	„	var. *subferrugineum* VAV.	„	„
3033	3059- 1	„	var. *subferrugineum-compactoides* GÖKG.	„	„
3034	3060- 1	„	var. *ferrugineum* ALEF.	„	„
3035	3061- 1	„	var. *suberythrospermum* VAV.	„	„
3036	3063- 2	„	var. „	„	„
3037	3064- 2	„	var. *subgraecum* VAV.	Suburbs of Chaman,	„
3038	3065- 9	„	var. „	„	„
3039	3068- 8	„	var. *subferrugineum* VAV.	„	„
3040	3069-10	„	var. *subgraecum* VAV.	„	„

3041	3070- 1	*T. vulgare* VILL.	var. *suberythrospermum* VAV.	Suburbs of Chaman,	Pak.
3042	3072- 1	„	var. *submeridionale* VAV.	„	„
3043	3073- 1	„	var. *erythrospermum-compactoides* KOB.	„	„
3044	3074- 1	„	var. *ferrugineum* AELF.	„	„
3045	3075- 1	„	var. *meridionale* KÖRN.	Suburbs of Kandahar,	Afghanistan
3046	3076- 4	„	var. *submeridionale* VAV.	„	„
3047	3078-10	„	var. „	Kandahar - Jaldak,	„
3048	3079- 2	„	var. *submeridionale-inflatum* PALM.	„	„
3049	3080- 1	„	var. *meridionale-compactoides* GÖKG.	„	„
3050	3081- 3	„	var. *graecum* KÖRN.	„	„
3051	3082- 2	„	var. „	„	„
3052	3083- 1	„	var. *erythrospermum* KÖRN.	„	„
3053	3084-10	„	var. *submeridionale-inflatum* PALM.	„	„
3054	3085- 8	„	var. *hostianum- compactoides* GÖKG.	Jaldak,	„
3055	3086- 7	„	var. *graecum-compactoides* KOB.	„	„
3056	3087- 1	„	var. *erythrospermum* KÖRN.	Jaldak - Ghazni,	„
3057	3089- 6	„	var. *graecum* KÖRN.	„	„
3058	3091- 6	„	var. *submeridionale* VAV.	„	„
3059	3092- 9	„	var. *hostianum-compactoides* GÖKG.	„	„
3060	3093- 1	„	var. *graecum* KÖRN.	„	„
3061	3096- 2	„	var. *ferrugineum* ALEF.	Kabul,	„
3062	3097-10	„	var. *subtrcicum* VAV.	„	„
3063	3098- 9	*T. compactum* HOST	var. *erinaceum* KÖRN.	„	„
3064	3099- 5	*T. vulgare* VILL	var. *ferrugineum* ALEF.	„	„

3065	3100-13	*T. compactum* Host	var. *erinaceum* Körn.	Kabul,	Afghanistan
3066	3101- 9	*T. vulgare* Vill.	var. *ferrugineum* Alef.	„	„
3067	3102- 4	„	var. *tricicum-compactoides* Zhuk.	„	„
3068	3103- 3	„	var. *barbarossa-compactoides* Gökg.	„	„
3069	3105- 1	„	var. *barbarossa* Alef.	„	„
3070	3106- 9	„	var. *ferrugineum* Alef.	„	„
3071	3107- 1	„	var. *erythrospermum* Körn.	„	„
3072	3108- 3	*T. compactum* Host	var. *erinaceum* Körn.	„	„
3073	3109-10	*T. vulgare* Vill.	var. *ferrugineum* Alef.	„	„
3074	8110-10	„	var. *barbarossa-compactoides* Gökg.	„	„
3075	3111- 5	„	var. *ferrugineum* Alef.	„	„
3076	3112- 3	„	var. *erythrospermum-compactoides* Kob.	„	„
3077	3114- 6	„	var. *ferruginum* Alef.	„	„
3078	3117- 1	„	var. *meridionale* Körn.	unknown	„
3079	3118- 4	„	var. *erythroleucon* Körn.	„	„
3080	3121- 6	„	var. *subferrugineum* Vav.	Kabul - Pul-i-Khumri,	„
3081	3123- 1	„	vav. *hostianum* Clem.	„	„
3082	3124- 1	„	var. *barbarossa* Alef.	„	„
3083	3125- 2	„	var. *erythroleucon* Körn.	Pul-i-Khumri region: Kabul - Pul-i-Khumri,	„
3084	3126-10	„	var. *ferrugineum* Alef.	„	„
3085	3127- 4	„	var. *tricicum* Körn.	Maimana region: Andkhui - Maimana,	„
3086	3128- 1	„	var. *erthyrospermum* Körn.	„	„
3087	3129- 6	„	var. *tricicum* Körn.	„	„

3088	3130- 3	*T. vulgare* VILL.	var. *griseum* VAV.	Andkhui - Maimana,	Afghanistan
3089	3131- 4	„	var. *ferrugineum-compactoides* KOB.	Maimana,	„
3090	3132- 6	„	var. *subbarbarossa-inflatum* PALM.	„	„
3091	3133-10	„	var. „	„	„
3092	3134- 1	„	var. „	„	„
3093	3136- 9	„	var. *tricicum* KÖRN.	Herat, Afghanistan - Meshhad,	Iran
3094	3137- 4	„	var. *erythroleucon* KÖRN.	„	„
3095	3138-10	„	var. *tricicum* KÖRN.	„	„
3096	3139- 8	„	var. *erythroleucon* KÖRN.	Tehran region: Herat, Afghanistan - Meshhad,	„
3097	3140- 2	„	var. *erythrospermum* KÖRN.	„	„
3098	3141- 1	„	var. *subferrugineum-inflatum* PALM.	„	„
3099	3143- 9	„	var. *erytherospermum* KÖRN.	„	„
3100	3144- 5	„	var. *subferrugineum-inflatum* PALM.	„	„
3101	3145- 1	„	var. „	Mashhad - Sharud,	„
3102	3146- 1	„	var. *erythrospermum* KÖRN.	„	„
3103	3147- 7	„	var. *subbarbarossa-inflatum* PALM.	„	„
3104	3148-10	„	var. *ferrugineum* ALEF.	„	„
8105	3149- 2	„	var. *subferruginum-inflatum* PALM.	„	„
3106	3150- 2	„	var. *erythrospermum* KÖRN.	„	„
3107	3151- 3	„	var. *barbarossa* ALEF.	„	„
3108	3152- 8	„	var. *suberythroleucon-compactoides* GÖKG.	„	„
3109	3153- 3	„	var. *subferrugineum-compactoides* GÖKG.	„	„
3110	3154-10	„	var. *erythroleucon* KÖRN	„	„

3111	3155- 1	*T. vulgare* VILL.	var. *murinum* FLAKSB.	Mashhad – Sharud,	Iran
3112	3156- 4	„	var. *ferrugineum-compactoides* KOB.	„	„
3113	3157- 6	„	var. *graecum* KÖRN	„	„
3114	3158 -2	„	var. *hostianum* CLEM.	„	„
3115	3159- 1	„	var. *suberythroleucon-inflatum* FRENK.	„	„
3116	3160-10	„	var. „	„	„
3117	3161- 8	„	var. *erythrospermum* KÖRN.	„	„
3118	3162- 1	„	var. *suberythrospermum-inflatum* PALM.	„	„
3119	3163- 4	„	var. *erythroleucon* KÖRN.	Sharud – Saman,	„
3120	3164- 1	„	var. „	„	„
3121	3165- 3	„	var. *khorossanicum* VAV.	Isfahan region; Suburbs of Isfahan,	„
3122	3166-10	„	var. *subgraecum* VAV.	„	„
3123	3167- 1	„	var. *khorossanibum* VAV.	„	„
3124	3168- 7	„	var. *subrubromurinum* GÖKG.	„	„
3125	3169-10	„	var. *khorossanicum* VAV.	Isfahan – Saman,	„
3126	3171- 5	„	var. *nigromeridionale* GÖKG.	„	„
3127	3272- 5	„	var. *lut-inflatum* VAV.	„	„
3128	3273- 3	„	var. *subferrugineum-compactoides* GÖKG.	„	„
3129	3174- 3	„	var. „	„	„
3130	3175- 2	„	var. *erythrospermum compactoides* KOB.	Suburbs of Saman,	„
3131	3176- 1	„	var. *erythrospermum* KÖRN.	Suburbs of Shar-Kord,	„
3132	3177- 6	„	var. *subgraecum* VAV.	„	„
3133	3178- 2	„	var. *subnigroturcicum* GÖKG.	„	„

3134	3179-10	*T. vulgare* VILL.	var. *subbarbarossa-inflatum* PALM. with yellow grains (*Novo*)	Shar-Kord – Isfahan,	Iran
3135	3180-10	„	var. *subrubromurinum* GÖKG.	„	„
3136	3181- 1	„	var. *lut-inflatum* VAV.	„	„
3137	3182- 3	„	var. *suberythrospermum* VAV.	„	„
3138	3184- 1	„	var. *lut-inflatum* VAV.	„	„
3139	3185- 1	„	var. *khorossanicum* VAV.	„	„
3140	3186- 1	„	var. *subgraecum* VAV.	„	„
3141	3187- 6	„	var. *turcomanicum* KOB.	Isfahan – Kamanch,	„
3142	3188- 1	„	var. „	„	„
3143	3189- 4	„	var. *alb-inflatum* VAV.	„	„
3144	3190- 9	„	var. *khorossanicum* VAV.	„	„
3145	3192- 1	„	var. „	„	„
3146	3194- 1	„	var. *subechinodes-inflatum*	„	„
3147	3195- 6	„	var. *lut-inflatum* VAV.	„	„
3148	3196- 6	*T. turgidum* L.	var. *Linnaeanum* KÖRN.	„	„
3149	3199- 1	„	var. „	„	„
3150	3200- 1	*T. vulgare* VILL.	var. *subferrugineum-inflatum* PALM.	„	„
3151	3201- 4	„	var. *alb-inflatum* VAV.	„	„
3152	3202- 4	„	var. *subferrugineum* VAV.	„	„
3153	3203- 8	„	var. *suberythrospesmum-inflatum* PALM.	„	„
3154	3204- 2	„	var. *suberythrospermum* VAV.	„	„
3155	3205- 2	„	var. *hostianum* KÖRN.	„	„
3156	3206- 7	„	var. *hostianum-compactoides* GÖKG.	„	„
3157	3207- 1	„	var. *erythrospermum* KÖRN.	„	„

3158	3208- 5	*T. turgidum* L.	var. *Linnaeanum* KÖRN.	Abad – Isfahan,	Iran
3159	3210- 8	*T. vulgare* VILL.	var. *heraticum* KOB.	,,	,,
3160	3211- 9	,,	var. *erythroleucon* KÖRN.	Tehran region: Tehran – Ghazvin,	,,
3161	3213- 3	,,	var. ,,	,,	,,
3162	3214- 1	,,	var. *echnodesininflatum* VAV. with lax ear (*Novo*)	Karaj (suburbs of Tehran),	,,
3163	3215- 1	,,	var. *subbarbarossa-inflatum* PALM.	,,	,,
3164	3217-10	,,	,,	,,	,,
3165	3219- 1	,,	var. *erythroleucon-compactoides* KOB.	,,	,,
3166	3220- 7	,,	var. *subbarossa-inflatum* PALM.	,,	,,
3167	3221- 6	,,	var. *hostianum* KÖRN.	,,	,,
3168	3223- 1	,,	var. *tricicum* KÖRN.	,,	,,
3169	3225- 5	,,	var. *barbarossa* ALEF.	,,	,,
3170	3226- 1	,,	var. *suberythroleucon-compactoides* GÖKG.	,,	,,
3171	3226-10	,,	var. ,,	,,	,,
3172	3227- 2	*T. spelta* L.	var. *vulpinum* KÖRN.	Agr. Exp. Station, Tehran,	,,
3173	3228- 8	*T. orientale* PERC.	var. *insigne* PERC.	,,	,,
3174	3229- 5	*T. spelta* L.	var. *Arduini* KÖRN.	,, Isfahan,	,,
3175	3230- 3	*T. vulgare* VILL.	var. *subferrugineum* VAV.	,,	,,
3176	3231-10	,,	var. *subbarbarossa-inflatum* PALM	,,	,,
3177	3232- 3	*T. polonicum* L.	new variety (*Novo*)	,, (near Isfahan),	,,
3178	3233- 8	*T. durum* DESF.	var. *hordeiforme* KÖRN.	Gorgan region: Sari – Behshahr,	,,
3179	3234- 7	*T. vulgare* VILL.	var. *ferrugineum* ALEF.	,,	,,
3180	3235- 8	,,	var. *erythrospermum* KÖRN.	,,	,,

3181	3236- 2	*T. vulgare* Vill.	var. *ferrugineum* Alef.	Sari - Behshahr,	Iran
3182	3236- 7	„	var. „	„	„
3183	3237- 3	„	var. *erythrospermum* Körn.	„	„
3184	3238- 2	„	var. *erythrospermum-compactoides* Kob.	„	„
3185	3241- 1	„	var. *erythrospermum* Körn.	„	„
3186	3242- 4	„	var. „	„	„
3187	3243- 8	„	var. „	„	„
3188	3244- 1	„	var. „	„	„
3189	3245- 4	„	var. *erythrospermum-compactoides* Kob.	Suburbs of Gorgan,	„
3190	3246- 3	„	var. „	Gorgan - Khoshyailagh,	„
3191	3248- 2	„	var. „	„	„
3192	3249- 3	*T. durum* Desf.	var. *obscurum* Körn.	„	„
3193	3253- 4	*T. vulgare* Vill.	var. *erythrospermum* Körn.	„	„
3194	3254- 1	„	var. „	„	„
3195	3255- 6	*T. durum* Desf.	var. *murciense* Körn.	„	„
3196	3256- 1	„	var. „	„	„
3197	3257- 1	*T. vulgare* Vill.	var. *barbarossa* Alef.	Tehran region: Khoshyailagh,	„
3198	3258- 6	„	var. *erythrospermum* Körn.	„	„
3199	3259- 1	„	var. *subbarbarossa-inflatum* Palm. with yellow grains (*Novo*)	Khoshyailagh - Shahrud,	„
3200	3260- 8	„	var. *erythroleucon-inflatum* Frenk.	„	„
3201	3261- 1	„	var. *tricicum* Körn.	Suburbs of Tehran,	„
3202	3262-10	„	var. *ferrugineum* Alef.	„	„
3203	3263- 2	„	var. *erythrospermum* Körn.	„	„

3204	3264- 8	*T. vulgare* VILL.	var. *ferrugineum* ALEF.	Suburbs of Tehran,	Iran
3205	3265- 1	"	var. *meridionale* KÖRN.	"	"
3206	3267- 1	"	var. *erythroleucon* KÖRN.	Tehran – Firuzkun,	"
3207	3269- 6	"	var. *ferrugineum* ALEF.	"	"
3208	3270- 2	*T. durum* DESF.	var. *Valenciae* KÖRN.	"	"
3209	3271- 8	"	var. "	"	"
3210	3272- 9	*T. vulgare* VILL.	var. *graecum-compactoides* KOB.	"	"
3211	3273- 2	"	var. "	"	"
3212	3274- 5	"	var. "	"	"
3213	3276-10	"	var. *subbarbarossa-inflatum* PALM. with yellow grains (*Novo*)	Suburbs of Firuzkun,	"
3214	3277- 6	"	var. *subferrugineum* VAV.	"	"
3215	3278- 1	"	var. *suberythrospermum-inflatum* PALM.	"	"
3216	3279- 2	"	var. *graecum* KÖRN	"	"
3217	3280- 3	"	var. *erythroleucon* KÖRN.	"	"
3218	3281-10	"	var. *subbarbarossa-inflatum* PALM. with yellow grains (*Novo*)	"	"
3219	3282- 2	"	var. "	"	"
3220	3283- 1	"	var. "	"	"
3221	3284- 1	"	var. *transcaspicum* VAV.	"	"
3222	3285- 8	"	var. *suberythrospermum* VAV.	"	"
3223	3286- 1	"	var. *alborubrum-inflatum* VAV.	"	"
3224	3287- 3	"	var. *subbarbarossa-inflatum* PALM. with yellow grains (*Novo*)	"	"
3225	3288- 8	"	var. *erythrospermum* KÖRN.	"	"
3226	3289- 9	"	var. *ferrugineum* ALEF.	Firuzkun – Sari,	"
3227	3290- 9	"	var. "	"	"

3228	3291- 1	*T. durum* Desf.	var. *provinciale* Körn.	Gorgan region: Suburbs of Sari,	Iran
3229	3292- 2	*T. vulgare* Vill.	var. *erythrospermum* Körn.	Sari – Behshahr,	„
3230	3294- 1	„	var. *ferrugineum* Alef.	„	„
3231	3245- 6	„	var. *erythrospermum-compactoides* Kob.	Suburbs of Behshahr,	„
3232	3296- 7	„	var. *erythrospermum* Körn.	Pahlavi region: Suburbs of Chalus,	„
3233	3296-12	„	var. „	„	„
3234	3297- 9	„	var. *erythrospermum-compactoides* Kob.	„	„
3235	3299- 1	„	var. *erythrospermum* Körn.	Suburbs of Pahlavi,	„
3236	3302- 3	„	var. *erythrospermum-compactoides* Kob.	Astara – Ardabil,	„
3237	3303- 4	„	var. *ferrugineum-compactoides* Kob.	„	„
3238	3304- 3	*T. compactum* Host	var. *erinaceum* Körn.	„	„
3239	3305- 1	*T. vulgare* Vill.	var. *barbarossa* Alef.	„	„
3240	3306- 2	*T. compactum* Host	var. *erinaceum* Körn.	„	„
3241	3307- 9	*T. vulgare* Vill.	var. *ferrugineum-compactoides* Kob.	Suburbs of Ardabil,	„
3242	3308- 4	*T. compactum* Host	var. *erinaceum* Körn.	„	„
3243	3309- 6	*T. vulgare* Vill.	var. *ferrugineum-compactoides* Kob.	„	„
3244	3310- 4	„	var. *ferrugineum* Alef.	„	„
3245	3311- 1	*T. compactum* Host	var. *ferrugineum-compactoides* Kob.	„	„
3246	4312- 6	*T. vulgare* Vill.	var. *erythrospermum-compactoides* Kob.	„	„
3247	3313- 7	„	var. *meridionale* Körn.	Ardabil – Sarab,	„
3248	3314- 2	„	var. *erythroleucon* Körn.	„	„
3249	3315- 1	„	var. „	„	„
3250	3316- 2	„	var. *meridionale* Körn.	„	„

3251	3316- 9	*T. vulgare* VILL.	var. *meridionale* KÖRN.	Ardabil - Sarab,	Iran
3252	3317- 5	„	var. *ferrugineum* ALEF.	„	„
3253	3318- 1	„	var. *erythroleucon* KÖRN.	„	„
3254	3319-10	„	var. *ferrugineum* ALEF.	„	„
3255	3320- 8	„	var. „	„	„
3256	3321- 7	„	var. *erythrospermum* KÖRN.	„	„
3257	3322- 1	„	var. *ferrugineum* ALEF.	„	„
3258	3323- 4	„	var; *meridional* KÖRN.	„	„
3259	3324- 3	„	var. *ferrugineum* ALEF.	„	„
3260	3325- 5	„	var. *erythrospermum* KÖRN.	„	„
3261	3326- 1	„	var. *meridionale-compactoides* GÖKG.	„	„
3262	3327- 1	„	var. *fulvocinereum* FLAKSB.	„	„
3263	3328- 2	„	var. *ferrugineum* ALEF	„	„
3264	3329- 1	„	var. *barbarossa* ALEF.	Suburbs of Sarab,	„
3265	3331- 8	„	var. *meridionalc* KÖRN.	„	„
3266	3332- 1	„	var. *nigromeridionale* GÖKG. with brown grains (*Novo*)	„	„
3267	3333- 4	„	var. *meridionale* KÖRN.	Sarab - Tabriz,	„
3268	3335- 3	„	var. *ferrugineum* ALEF.	„	„
3269	3357- 7	„	var. *fulvorinereum* FLAKSB.	„	„
3270	3338- 6	„	var. *erythrospermum* KÖRN.	„	„
3271	3339- 2	„	var. *hostianum* KÖRN.	„	„
3272	3341- 1	„	var. „	Tabriz region: Sarab - Tabriz,	„
3273	3342- 2	„	var. *erythrospermum* KÖRN.	„	„

3274	3343-10	*T. vulgare* Vill.	var. *meridionale* Körn.	Suburbs of Tabriz,	Iran
3275	3344- 7	„	var. *erythrospermum-compactoides* Körn.	„	„
3276	3345- 5	„	var. *hostianum* Körn.	„	„
3277	3346- 8	„	var. *meridionale* Körn.	„	„
3278	3347- 2	„	var. „	„	„
3279	3348- 5	„	var. *erythrospermum* Körn.	„	„
3280	3349- 1	„	var. *meridionale* Körn.	„	„
3281	3350- 3	„	var. *hostianum* Körn.	Tabriz – Mahabad,	„
3282	3351- 1	„	var. „	„	„
3283	3352- 3	„	var. *ferrugineum* Alef.	„	„
3284	3353- 2	„	var. „	„	„
3285	3354- 2	„	var. *erythrospermum* Körn.	„	„
3286	3355- 3	„	var. *nigrocyanorubrum* Gökg.	Suburbs of Mahabad,	„
3287	3356- 1	„	var. *ferrugineum* Alef.	„	„
3288	3360- 2	„	var. „	„	„
3289	3361- 2	„	var. *meridionale* Körn.	Suburbs of Rezaiye,	„
3290	3362-10	„	var. *velutinum* Körn.	Rezaiye – Khoy,	„
3291	3363- 2	„	var. *nigroturcicum* Gökg. wifh brown grains (*Novo*)	Khoy – Tabriz,	„
3292	3364- 2	„	var. *erythrospermum-compactoides* Kob.	„	„
3293	3365- 1	„	var. *meridionale* Körn.	„	„
3294	3367- 7	„	var. „	„	„
3595	3369- 4	„	var. *nigromeridionale* Gökg. with brown grains (*Novo*)	„	„
3296	3370- 9	„	var. *meridionale* Körn.	„	„
3297	3371- 2	„	var. *ferrugineum* Alef.	„	„
				Tehran region:	
3298	3374- 1	„	var. *subbarbarossa-inflatum* Palm.	Karaj (suburbs of Tehran)	„

Varieties of *T. vulgare* and *T. compactum* collected by the KUSE (1955)[1] from Pakistan, Afghanistan and Iran

H. Kihara, K. Yamashita and M. Tanaka

National Inst. of Genetics, Misima, and Kyoto University, Kyoto, Japan

Variety	Region									
	Quetta	Kabul	Pul-i-Khumri	Maimana	Tehran	Isfahan	Gorgan	Pahlavi	Tabriz	Total
T. vulgare Vill.										
long awned:										
var. *barbarossa*	(1)	2			3			2		8
var. *barbarossa-compactoides*		2								2
var. *turcicum*				4	2					6
var. *turcicum-compactoides*		1								1
var. *hostianum*		1			2	1		1	4	9
var. *hostianum-compactoides*	(2)	2				1				5
var. *murinum*					1					1
var. *meridionale*	(2)	2			1			6	8	19
var. *meridionale-compactoides*		1						1		2
var. *griseum*				1						1
var. *nigromeridionale*						1				1
var. *nigromeridionale* with brown grains (*Novo*)								1	1	2
var. *ferrugineum*	(1)	9	1		6		4	7	5	33
var. *ferrugineum-compactoides*				1	1			3		5
var. *erythroleucon*	2+(1)	1	1	1	8			3		17
var. *erythroleucon-compactoides*	1+(1)				1					3
var. *erythrospermum*	(2)	4		1	8	2	9	6	3	35
var. *erythrospermum-compactoides*		2				1	5	4	2	14
var. *fulvocinereum*								2		2
var. *graecum*	1+(2)	5			2					10
var. *graecum-compactoides*		1			3					4

short awned:										
var. *subrubromurinum*						1				1
var. *subturcicum*		1								1
var. *subnigroturcicum*						1				1
var. *submeridionale*		4								4
var. *subferrugineum*		3			1+(1)	1				6
var. *subferrugineum-compactoides*		1			1	2				4
var. *suberythroleucon*	(1)									1
var. *suberythroleucon-compactoides*					3					3
var. *suberythrospermum*		4			1	2				7
var. *subgraecum*		3				3				6
awnless:										
var. *nigrocyanorubrum*									1	1
var. *transcaspicum*									(1)	1
var. *velutinum*									1	1
var. *velutinum-compactoides*	(2)									2
var. *lutescens-compactoides*	(5)									5
inflatum										
long awned:										
var. *echinodesinflatum* with lax ear (*Novo*)					1					1
short awned:										
var. *subbarbarossa-inflatum*				3	4+(1)					8
var. *subbarbarossa* with yellow grains (*Novo*)					7	1				8
var. *subechinodes-inflatum*						1				1
var. *submerdional-inflatum*		2								2
var. *subferrugineum-inflatum*					4	1				5
var. *suberythroleucon-inflatum*					3					3
var. *suberythrospermum-inflatum*					2	1				3

awnless:										
var. *turcomanicum*						2				2
var. *transcaspicum*					1					1
var. *heraticum*						1				1
var. *alborubrum-inflatum*						1				1
var. *khorossanicum*						6				6
var. *lut-inflatum*	1					4				5
var. *alb-inflatum*						2				2
T. compactum Host										
var. *erinaceum*		3						4		7
Total	25	54	2	11	68	35	18	40	26	279

Strains in ( ) were provided by the courtesy of Department of Agriculture, or of the Agricultural Experimental Station in respective countries.

1) KUSE: Kyoto University Scientific Expedition to the Karakoram and Hindukush, 1955

Proposed plan for genetic studies of wheat under Japan - U. S. Scientific Cooperation Program

S. MATSUMURA
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Based on a joint statement of the Governments of Japan and U. S. A., the Japan-United States Committee on Scientific Cooperation was set up.

The cultivated wheat was originated in Central Asia, from where it was distributed to the whole world. The western boundary of its differentiation is North America, while Japan represents its eastern border. It is believed, therefore, that a comparative genetic study of cultivated wheat varieties in both those countries is of great importance for the elucidation of its phylogenetic differentiation. Therefore, I had proposed to the Committee a cooperative program on wheat genetics, under the heading "Genetic study on phylogenetic differentiation of cultivated wheat in the Pacific region". This proposal was recently approved by the Japanese Government. The outline of the Japanese program, in comparison with that of the U. S. A., is given in the following table.

Table 1. Proposed plan for genetic studies of wheat under Japan-U. S. Scientific Cooperation program

All numbers of the Japanese research group met at the National Institute of Genetics, Misima, and discussed, in detail, definite research plans for each subject. The present project is for a three year period, namely from September 1, 1964 to August 31, 1967.

Table 1. Proposed plan for genetic studies of wheat under Japan-U.S. Scientific Cooperation Program

Projects and principal investigators in Japan (MATUMURA's proposal)	Projects and principal investigators in U.S.A. (Rep. Wheat Genet. Planning Session, Kansas City)
1. Study from the biochemical standpoint. i. Nucleic acid level—quantitative analysis of DNA content (NISHIKAWA)	
ii. Protein level—analysis of species-specific proteins (MATSUMURA and coworkers)	Study of antigen effects in high protein level wheats (SCHMIDT, JOHNSON, MATERNE and HAUNOLD)
iii. Antigen level—variation in antigenic properties (MATSUMURA and coworkers)	
2. Study from the cytogenetic standpoint. i. Nucleic differentiation a. Gene level— distribution of genes controlling dwarfing, lethality, necrosis and diseases resistance (TANAKA, NISHIKAWA, MURAMATSU and TSUNEWAKI)	Distribution of genes controlling leaf rust, necrosis, stem rust, etc. (HEYNE)
b. Chromosome level — Differentiation of chromosome structure (OKAMOTO and SASAKI)	Differentiation of chromosome structure (SCHMIDT and MORRIS)
—Pairing between homoeologous chromosomes (OKAMOTO and MURAMATSU)	Study of homoelogous pairing (SEARS)
— Linkage analysis (YAMASHITA and TANAKA)	Construction of gene linkage maps (SEARS)
c. Genome level—production of aneuploid series of Japanese varieties and comparison between them and Americans (MOCHIZUKI)	
ii. Cytoplasmic differentiation—reciprocal nucleus substitution between American and Japanese varieties and its effect on the manifestation of their genomes (TSUNEWAKI)	Studies of cytoplasmic differentiation (HEYNE) Cytoplasmic differentiation (SCHMIDT)
3. Study from the radiological standpoint. Variation of radioresistance and analysis of pertinent genetic and physiological factors (MATSUMURA)	Study of radiation resistance and chemical mutagens(KONZAK)
4. Study from the morphological standpoint. Survey of morphological characters and analysis of genetic factors controlling them (YAMASHITA and TANAKA)	
5. Development of new communication systems for genetic information (MATSUMURA and YAMASHITA)	Development of new communication system for genetic information (KONZAK)

Location of genes for resistance to stem rust race 126-Anz-1 in four varieties of wheat

C.J. DRISCOLL[1] and E.P. BAKER
Department of Agriculture, University of Sydney, Australia

The genes for resistance to wheat stem rust (*Puccinia graminis tritici* ERIKSS.), race 126-Anz-1, of the four varieties of common wheat (*Triticum aestivum* L.), Eureka W 1325[2], Kenya W 744, Gabo W 1422 and Yalta W 1373, have been located as to specific chromosome by use of the Chinese Spring monosomic series. The stem rust reaction types of the four varieties, nomal Chinese Spring, the F_1's involving each of the four varieties × Chinese Spring and the resultant F_2's, as shown in Table 1, conform with those described by STAKMAN, LEVINE and LOEGERING (1944).

1. Eureka

All F_2 families, except that involving chomosome 2D, segregated in conformance with a 3 resistant (res.) : 1 susceptible (sus.) ratio. That involving 2D segregated 64 res. : 7 sus. identifying 2D as the bearer of the single dominant gene for resistance. This gene is either *Sr6* according to KNOTT's gene classification or possibly an allele of *Sr6* (WATSON and LUIG, 1963). Evidence for allelism is based on differential reaction types under altered environmental conditions of certain varieties carrying a gene at the *Sr6* locus (WATSON and LUIG, 1961; WATSON, pers. comm.).

2. Kenya 744

The F_2 family involving chomosome 2A segregated 53 res. : 6 sus., whereas all other twenty F_2 families segregated in conformance with 3 res. : 1 sus. This identifies 2A as the bearer of the single dominant gene for resistance. This gene is *Sr9b* (GREEN et *al.*, 1960).

3. Gabo and Yalta

Excluding chromosome 6B, the ratios of res. : sus. of the Gabo F_2 families ranged from 1.3 : 1 to 3.3 : 1, whereas those of the Yalta F_2 families ranged from 0.6 : 1 to 4.1 : 1. The F_2 families involving chomosome 6B segregated 77 res. : 8 sus. (i.e., 9.6 : 1) and 210 res. : 11 sus. (19.1 : 1) with Gabo and Yalta respectively.

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[2] W numbers refer to the varietal number in the University of Sydney Wheat Accession Register

Thus chromosome 6B of both varieties possesses a dominant gene, *Sr*11, for resistance. As no susceptible segregants were obtained in F_2 populations of crosses Gabo × Yalta, it is assumed that the same gene at the same position on the chromosome is involved in the two varieties.

The segregation ratios of the totals of the other twenty F_2 families were 1,220 res. : 561 sus. (i.e., 2.17 : 1) and 695 : 529 (1.31 : 1) for Gabo and Yalta respectively. The departures from a 3 res. : 1 sus. ratio and the difference in the ratios involving Gabo and Yalta may be the result of differential transmission rates of gametes as discussed by LUIG (1960, 1964), SEARS and LOEGERING (1961) and LOEGERING and SEARS (1961, 1963).

The wide range of reaction types in the resistant group of F_2 segregates compared with the reaction type of the resistant parent in crosses involving Kenya 744 and particularly Eureka is presumably due to segregation of modifying genes effecting reaction type.

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TABLE 1. Stem rust reaction types of the four varieties, normal Chinese Spring, F_1's, F_2's regarded as resistant, and F_2's regarded as susceptible

	Eureka	Kenya	Gabo	Yalta	Chinese Spring
Parental	"; "	"; 12" to "2"	"; " to "; 2^-"	" ;1^-"to "; 2"	" 3^c" to 4"
F_1	";1"	" ;1^+2"	";1^-"	" ;1^-"	
Resistant F_2	";" to "X^-"	";1^+" to "23^{-c}"	" ;" to "; 2^-"	" ;1" to " ;12^-"	
Susceptible F_2	"3^+"	"3^c" to "4"	" 3^c" to "3"	" 3" to "4"	

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