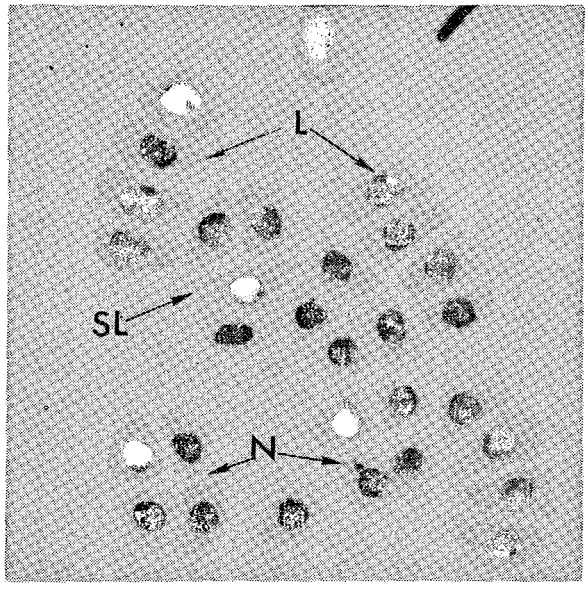
# WHEAT INFORMATION SERVICE

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*Explanation of the Figure on the Cover*

Various types of pollen tetrads, normal (N), semi-linear (SL) and linear (L). The tetrads were observed from anther squashes in 1% propiono-orcein. The anthers were pre-fixed in Carnoy's fluid (6:3:1) for 12 h.
(Cf. Fig. 1, p. 1, present issue of WIS., by H.S. DHALIWAL)

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## I. Research Notes

# Abnormal pollen tetrads in *Triticum urartu*

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In all the higher plants, the products of microsporogenesis, i.e. microspores, are normally arranged in the form of a tetrahedron (Fig. 1) while the products of megasporogenesis form a linear row of four megaspores. In *T. urartu* and its $F_1$ hybrids and amphiploids with other related species *T. boeoticum* and *Aegilops speltoides*, two types of abnormal pollen tetrads

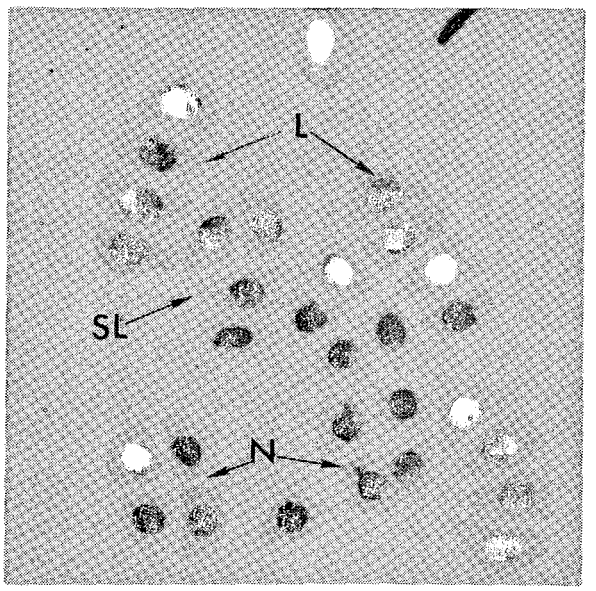


Fig. 1. Various types of pollen tetrads, normal (N), semi-linear (SL) and linear (L). The tetrads were observed from anther squashes in 1% propiono-orcein. The anthers were pre-fixed in Carnoy's fluid (6:3:1) for 12 h.

viz. semi-linear and linear (Fig. 1) were observed. The frequency of the abnormal tetrads was too high to be attributed to chance occurrence. Similar abnormal pollen tetrads have been observed in an autotetraploid barley by OKAMOTO (personal comm.). The linear and semi-linear pollen tetrads had an overall frequency of 5.44% in a total of 15,058 tetrads observed from 15 genotypes including *T. urartu*, the $F_1$ hybrids and amphiploids. The frequency of the abnormal tetrads among different genotypes was highly variable. A highest frequency of 25.60% was observed in one *boeoticum-urartu* amphiploid. The *T. boeoticum* and *Ae. speltoides* lines had no abnormal tetrads. Often the amphiploids involving same *urartu* but different *boeoticum* lines had different proportions of the abnormal tetrads indicating that different *boeoticum* lines interact differently during the development of the abnormal tetrads.

The frequency of the linear tetrads, in all the genotypes studied, was lower than that of the semi-linear tetrads suggesting that both types of abnormal tetrads presumably were the result of a one and the same phenomenon affecting the spindle orientation. The cell plate and furrowing invariably arise in the equatorial plane of the spindle apparatus perpendicular to the plane of cell division. Observation from the pollen mother cells during anaphase II indicated that the semilinear and linear tetrads were the result of abnormal spindle orientation, parallel to that of the metaphase I, in one or both the dyads, respectively. Obviously, factors identical to those regulating the development of linear tetrads in megasporogenesis are operating, however, only with a limited penetrance during microsporogenesis in *T. urartu* and its hybrids with other species. The abnormal tetrads usually occured in groups indicating that the factors affecting spindle orientation were localized at only a few spaces within the anther sacs. The nature and mode of action of the factors affecting the spindle orientation are, however, unknown. The abnormal spindle orientation in *T. urartu*, a parent of polyploid wheats (JOHNSON 1975, DHALIWAL and JOHNSON 1976) might be of some significance during the evolution of the polyploids.

## Literature Cited

DHALIWAL, H.S., and B.L. JOHNSON 1976. Anther morphology and the origin of the tetraploid wheats. Amer. J. Bot. **63**: 363–368.

JOHNSON, B.L. 1975. Identification of the apparent B genome donor of wheat. Can. J. Genet. Cytol. **17**: 21–39.

# Wild tetraploid wheats from Northern Iraq cytogenetically closely related to each other[1)]

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In 1970, the members of the Botanical Expedition of Kyoto University to the Northern Highlands of Mesopotamia found out a densely mixed stand of *Triticum dicoccoides* and *T. araraticum* near Amadiyah, Iraq (TANAKA and ISHII 1973). Samples belonging to each species were morphologically similar but could be clearly distinguished by hairiness of leaf surface; *araraticum* was hairy but *dicoccoides* was glabrous.

Materials used were two strains of *dicoccoides*, 8821A and 8821C, and four of *araraticum*, 8819, 8821B, 8822, and 8827. All were collected at a site 15.3 km ENE from Dohuk to Amadiyah, Iraq (alt. 780m). These strains were crossed to each other and chromosome associations of seven interspecific hybrids were observed (Table 1). All $F_1$ hybrids grown in the experimental field set no seeds when bagged.

Table 1. Chromosome associations of $F_1$ hybrids between *T. dicoccoides* and *T. araraticum* from a mixed stand near Amadiyah, Iraq

| Cross combination | No. PMC observed | Chromosome association* | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI |
| 8821A×8819 | 50 | 2.72 (0- 9) | 10.78 (7-14) | 1.00 (0-3) | 0.18 (0-1) | — | — |
| 8821A×8821B | 50 | 1.26 (0- 5) | 10.46 (8-13) | 1.46 (0-2) | 0.36 (0-2) | — | — |
| 8821A×8822 | 50 | 1.96 (0- 6) | 10.64 (8-13) | 1.28 (0-3) | 0.20 (0-1) | — | 0.02 (0-1) |
| 8821A×8827 | 50 | 3.42 (0- 8) | 9.72 (6-12) | 1.44 (0-3) | 0.18 (0-1) | 0.02 (0-1) | — |
| 8821C×8819 | 30** | 4.70 (0-10) | 11.00 (8-14) | 0.43 (0-2) | — | — | — |
| 8821C×8822 | 50 | 2.68 (0- 8) | 10.14 (7-13) | 1.36 (0-3) | 0.24 (0-1) | — | — |
| 8821C×8827 | 50 | 2.94 (0- 8) | 9.90 (7-13) | 1.46 (0-3) | 0.22 (0-1) | — | — |

* Values indicate means and ranges (in parentheses). Anthers were taken from the plants grown in a glasshouse.

** Anthers were taken in the field.

Chromosome associations of $F_1$ hybrids presented in Table 1 clearly show that the two wild tetraploid wheats collected at this site are cytogenetically more closely related to

1) Contribution No. 7 from the Plant Germ-plasm Institute, Faculty of Agriculture, Kyoto University.

each other than those reported so far. For example, RAWAL and HARLAN (1975) reported 5.2–6.0 univalents per cell in chromosome associations of $F_1$ hybrids between four Turkish collections of *dicoccoides* and *timopheevi*. Of these seven hybrids, 8821A×8821B gave extremely low frequency of univalents at meiosis. No univalent was found in 38 per cent of the PMCs. A hybrid 8821A×8822 also showed very good pairing and 20 per cent of the PMCs formed no univalent.

Morphological similarity of the two wild tetraploid wheats in Northeast Iraq and Western Iran was already pointed out by DAGAN and ZOHARY (1970) and TANAKA and ISHII (1973). The results of this study indicate that they have also close cytogenetical relationships to each other. Obviously, this similarity is very important in studying the evolution of tetraploid wheats and needs further analysis. A more detailed account and possible implications of this study will be published elsewhere.

## Literature Cited


DAGAN, J., and D. ZOHARY 1970. Wild tetraploid wheats from West Iran cytogenetically identical with Israeli *T. dicoccoides*. Wheat Inform. Serv. **31**: 15–17.

RAWAL, K. and J.R. HARLAN 1975. Cytogenetic analysis of wild emmer populations from Turkey and Israel. Euphytica **24**: 407–411.

TANAKA, M. and H. ISHII 1973. Cytogenetical evidence on the speciation of wild tetraploid wheats collected in Iraq, Turkey and Iran. Proc. 4th Intern. Wheat Genetics Symp. 115–121


## The effect of the D-genome on kernel set and viability in wheat × rye crosses


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The viability of the hybrid kernels resulting from crossing diploid and tetraploid wheats with diploid rye (*S. cereale*) is very poor and generally much lower than those obtained from crossing the hexaploid wheats with rye (OEHLER 1931; KATTERMANN 1941; KROWLOW 1970; LEIGHTY and SANDO 1928; PIENAAR 1973). Although the poor germinability of the hybrid kernels can to a certain extent be overcome by means of embryo culture methods (ROMMEL 1958, 1960; KRUSE 1974), it remains one of the major obstacles for the triticale breeder in the production of new primary triticale lines.

KROWLOW (1964, 1970, 1973) found that the viability of the hybrid kernels obtained by crossing *T. monococcum* and the tetraploid wheats with diploid *S. cereale* was 0% and

1.04% respectively. However, when he crossed the AAAABB autoallohexaploids (obtained by hybridising the tetraploid wheats *T. timopheevi*, *T. dicoccum*, *T. turgidum*, *T. durum* and *T. carthlicum*, with *T. monococcum* and doubling the chromosome number of the resulting hybrids) with diploid rye, kernels with a viability of 60.99% were produced. This figure agrees well with the 61.83% germinability of the hybrid kernels obtained from crossing the hexaploid bread wheats with rye. KROWLOW (1970) believed that the good germinability of the hybrid kernels produced by the latter cross was due to the hexaploid nature of the wheat parent which resulted from the addition of the D-genome to the primitive cultivated tetraploid wheats during the evolution of the bread wheats. KROWLOW (op. cit.) concluded that the higher viability of the hybrid kernels produced by 6x wheat×2x rye crosses, compared to 4x wheat×2x rye crosses does not result from the action of a specific genome, but is due to the increase of the number of wheat genomes relative to the rye genome.

KROWLOW (1973) crossed diploid (AA), tetraploid (AAAA and AABB) and hexaploid (AAAABB) wheats with both diploid and tetraploid rye, and obtained evidence which substantiated his belief that the relative amount of wheat and rye genomes in the $F_1$ kernels controls their viability; the best viability was obtained when the wheat parent was hexaploid and the rye diploid.

The present study was undertaken to determine the effect of the addition (by hybridisation and amphiploidy) of the D-genome of various *Ae. squarrosa* varieties to a number of tetraploid wheats on the crossability with rye and the germinability of the resulting kernels.

## Material and Methods

The material listed in Table 1 was used as female parents. All entries except the *T. aestivum* ssp. *vulgare* cv. Flameks and the *T. aestivum* ssp. *sphaerococcum* line listed, were kindly supplied by Dr. E.R. KERBER, Canada Department of Agriculture, Winnipeg, Manitoba, Canada. The rye cultivars Maroc and Weser, respectively introductions from Europe and the U.S.A., were used as pollen parents.

All crosses were made in a growth chamber with a dark/light period of 12/12 hours and dark/light temperature of 10/16°C. The kernels were germinated in Petri-dishes 2 to 3 months after the ripe ears were harvested.

## Results and Discussion

The total number of kernels and the number of filled kernels produced by each cross as well as their germinability are summarised in Table 2.

The various crosses between the *Ae. squarrosa* varieties and *S. cereale* cultivars produced 722 hybrid kernels (Table 2). In terms of florets pollinated this represents a kernal set of 55.28%, which agrees well with the findings of MELNYK and UNRAU (1959). These hybrid kernels were all inviable. The *Ae. squarrosa* kernels resulting from selfing were germinated soon after harvesting, but in spite of this a 77.38% germination was obtained. It is evident that the D-genome on its own does not suppress the crossability with rye very much, but

Table 1. Varieties of *Ae. squarrosa*, cultivars of tetraploid wheats and their allohexaploid derivatives, and cultivars of hexaploid bread wheats used as female parents

| Accession No. | Reference No. of Kerber & Rowland, 1974 | Species, variety, cultivar, and pedigree of amphiploids |
|---|---|---|
| A1297 | R L5003 | *Ae. squarrosa* |
| A1298 | R L5261 | 〃 var. *typica* |
| A1299 | R L5266 | 〃 〃 *ananthera* |
| A1300 | R L5271 | 〃 〃 *strangulata* strain 1 |
| A1301 | R L5288 | 〃 〃 〃 〃 2 |
| A1302 | R L5289 | 〃 〃 *meyeri* |
| A1303 | R L5422 | 〃 |
| A1296 | | Tetra-Canthatch (4x extraction from Canthatch) |
| A1304 | R L5401 | Tetra-Canthatch × *Ae. squarrosa* RL5003 |
| A1305 | R L5402 | 〃 × 〃 RL5261 |
| A1306 | R L5403 | 〃 × 〃 RL5266 |
| A1307 | R L5404 | 〃 × 〃 RL5271 |
| A1308 | R L5405 | 〃 × 〃 RL5288 |
| A1309 | R L5406 | 〃 × 〃 RL5289 |
| A1310 | R L5437 | 〃 × 〃 RL5422 |
| A1311 | R L5416 | *T. dicoccum* cv. Vernal |
| A1312 | R L5436 | *T. dicoccum* cv. Vernal × *Ae. squarrosa* RL5271 |
| A554 | | *T. durum* cv. Stewart |
| A1313 | R L5434 | *T. durum* cv. Stewart × *Ae. squarrosa* RL5271 |
| A592 | | *T. durum* cv. Hercules |
| A1314 | R L5435 | *T. durum* cv. Hercules × *Ae. squarrosa* RL5271 |
| A1315 | R L5415 | *T. carthlicum* |
| A1316 | R L5442 | *T. carthlicum* RL5415 × *Ae. squarrosa* RL5271 |
| A1317 | R L5320 | *T. carthlicum* |
| A1319 | R L5439 | *T. carthlicum* RL5320 × *Ae. squarrosa* RL5261 |
| A1318 | R L5440 | 〃 〃 × 〃 〃 RL5289 |
| A1320 | R L5414 | *T. carthlicum* |
| A1321 | R L5441 | *T. carthlicum* RL5414 × *Ae. squarrosa* RL5261 |
| A1322 | R L5202 | *T. carthlicum* |
| A1323 | R L5438 | *T. carthlicum* RL5205 × *Ae. squarrosa* RL5271 |
| A1295 | — | *T. aestivum* ssp. *vulgare* cv. Canthatch |
| — | — | 〃 〃 cv. Flameks |
| A550 | — | *T. aestivum* ssp. *sphaerococcum* |

its interaction with the R-genome results in the poor development of the endosperm and embryo which leads to kernel inviability. MELNYK and UNRAU (op. cit.) was able to grow one embryo in artificial culture into a hybrid plant.

The various tetraploid wheat × rye crosses produced 1209 hybrid kernels of which only 5, or 0.41%, germinated. In comparison their synthesised hexaploid derivatives (tetraploids to which the D-genome was added by hybridisation and amphiploidy) when crossed with rye produced 1237 hybrid kernels of which 454, or 36.7% germinated (Table 2). This difference is highly significant (at 1% level). It can thus be concluded that the addition of the D-genome to the A- and B-genomes of the tetraploid wheats produces a genetic interaction or cumulative genetic effect, similar to the addition of the A-genome reported by KROWLOW (1970, 1973), which renders the endosperm/embryo developmental barrier less effective in crosses with diploid rye.

Table 2. The effect of the D-genome on crossability, kernel filling and germinability in wheat × rye crosses. The rye parents used are indicated with the letters M (Maroc) and W (Weser)

| Wheat line | Rye parent | No. of florets pollinated | Kernels set | | Kernels set as % of pollin. florets | No. of kernels germinated | % Germ. of kernels set | % Florets bearing viable kernels |
|---|---|---|---|---|---|---|---|---|
| | | | filled | total | | | | |
| *Ae. squarroesa* × rye | | | | | | | | |
| A1297 | M | 265 | 0 | 103 | 38.87 | 0 | 0 | 0 |
| A1298 | M | 290 | 0 | 215 | 74.14 | 0 | 0 | 0 |
| A1300 | M/W | 198 | 0 | 127 | 64.14 | 0 | 0 | 0 |
| A1301 | M/W | 265 | 0 | 162 | 61.13 | 0 | 0 | 0 |
| A1303 | M | 288 | 0 | 115 | 39.93 | 0 | 0 | 0 |
| Total | | 1306 | 0 | 722 | 55.28 | 0 | 0 | 0 |
| Selfed control | | — | 84 | 84 | — | 65 | 77.38 | — |
| Tetraploid wheats × rye | | | | | | | | |
| (a) *T. vulgare* 4× derivative (Tetra-Canthatch) × rye | | | | | | | | |
| A1296 | M/W | 202 | 0 | 25 | 12.38 | 0 | 0 | 0 |
| (b) *T. dicoccum* × rye | | | | | | | | |
| A1311 | M/W | 282 | 0 | 128 | 45.39 | 0 | 0 | 0 |
| (c) *T. durum* × rye | | | | | | | | |
| Stewart | M | 347 | 7 | 151 | 42.52 | 3 | 1.99 | 0.86 |
| Hercules | M | 405 | 1 | 169 | 41.73 | 1 | 0.59 | 0.25 |
| Total | | 752 | 8 | 320 | 42.55 | 4 | 1.25 | 0.53 |
| (d) *T. carthlicum* × rye | | | | | | | | |
| A1315 | M/W | 364 | 2 | 222 | 60.99 | 0 | 0.00 | 0.00 |
| A1317 | M/W | 355 | 0 | 125 | 35.21 | 0 | 0.00 | 0.00 |
| A1320 | M/W | 242 | 1 | 82 | 33.88 | 0 | 0.00 | 0.00 |
| A1322 | M/W | 467 | 5 | 307 | 65.74 | 1 | 0.33 | 0.21 |
| Total | | 1428 | 8 | 736 | 51.54 | 1 | 0.14 | 0.07 |
| Total all tetraploids | | 2664 | 16 | 1209 | 45.38 | 5 | 0.41 | 0.19 |
| Selfed 4x control | | — | 140 | 140 | — | 140 | 100.00 | — |
| Hexaploid wheats × rye | | | | | | | | |
| (a) Tetra-Canthatch - *Ae. squarrosa* allohexaploids × rye | | | | | | | | |
| A1304 | M/W | 428 | 70 | 77 | 17.99 | 38 | 49.35 | 8.88 |
| A1305 | M/W | 564 | 41 | 52 | 9.22 | 9 | 17.31 | 1.60 |
| A1306 | M/W | 414 | 21 | 31 | 7.49 | 12 | 38.71 | 2.90 |
| A1307 | M/W | 380 | 68 | 93 | 24.47 | 11 | 11.83 | 2.89 |
| A1308 | M/W | 508 | 100 | 132 | 25.98 | 34 | 25.76 | 6.69 |
| A1309 | W | 242 | 5 | 31 | 12.81 | 3 | 9.68 | 1.24 |
| A1310 | M/W | 405 | 58 | 69 | 17.04 | 19 | 27.54 | 4.69 |
| Total | | 2941 | 363 | 485 | 16.49 | 126 | 25.98 | 4.28 |
| (b) *T. dicoccum* - *Ae. squarrosa* allohexaploids × rye | | | | | | | | |
| A1312 | M/W | 270 | 28 | 94 | 34.81 | 6 | 6.38 | 2.22 |
| (c) *T. durum* - *Ae. squarrosa* allohexaploids × rye | | | | | | | | |
| A1313 | M/W | 97 | 40 | 41 | 42.27 | 24 | 58.54 | 24.74 |
| A1314 | M/W | 551 | 101 | 124 | 22.56 | 68 | 54.84 | 12.34 |
| Total | | 648 | 141 | 165 | 25.46 | 92 | 55.76 | 14.20 |
| (d) *T. carthlicum* - *Ae. squarrosa* allohexaploids × rye | | | | | | | | |
| A1316 | M/W | 243 | 44 | 108 | 44.44 | 29 | 26.85 | 11.93 |
| A1318 | M/W | 384 | 10 | 50 | 13.02 | 15 | 30.00 | 3.91 |
| A1319 | M/W | 441 | 17 | 27 | 6.12 | 5 | 18.52 | 1.13 |
| A1321 | M/W | 498 | 122 | 142 | 28.51 | 104 | 73.24 | 20.88 |
| A1323 | M/W | 332 | 94 | 166 | 50.00 | 77 | 46.39 | 23.19 |
| Total | | 1898 | 287 | 493 | 25.97 | 230 | 46.65 | 12.12 |

Table 2. (Continued)

| Wheat line | Rye parent | No. of florets pollinated | Kernels set | | Kernels set as % of pollin. florets | No. of kernels germinated | % germ. of kernels set | % florets bearing viable kernels |
|---|---|---|---|---|---|---|---|---|
| | | | filled | total | | | | |
| Total all synthetic hexaploids | | 5757 | 819 | 1237 | 21.49 | 454 | 36.70 | 7.89 |
| (e) *T. vulgare* × rye | | | | | | | | |
| Canthatch | M/W | 664 | 46 | 81 | 12.20 | 11 | 13.58 | 1.66 |
| Flameks | M | 960 | 76 | 80 | 8.33 | 64 | 80.00 | 6.67 |
| Total | | 1624 | 122 | 161 | 9.91 | 75 | 46.58 | 4.62 |
| (f) *T. sphaerococcum* × rye | | | | | | | | |
| A550 | M | 500 | 298 | 356 | 71.20 | 199 | 55.90 | 39.80 |
| Total 6x bread wheats | | 2124 | 420 | 517 | 24.34 | 274 | 53.00 | 12.90 |
| Selfed 6x control | | — | 325 | 325 | — | 324 | 99.69 | — |

Whatever the underlying mechanism may be, it is evident that the above findings may be of practical value to the triticale breeder and supplement those of KROWLOW (op. cit.). In those cases where the 4x wheat×rye crosses fail to produce hybrids, even with the aid of the embryo culture techniques, the tetraploid wheats can be supplemented with A- or D-genomes to produce hexaploids that will give viable kernels when crossed with rye. However, the D-genome appears to be the more useful of the two genomes for this purpose, because 21.49% of the florets of the synthesised hexaploids which contain a pair of D-genomes were able to set hybrid kernels (Table 2), whereas only 3.96% of the florets of the auto-allohexaploids with an extra pair of A-genomes were able to do so (KROWLOW, op. cit.). The germinability of the hybrid kernels set by the former and latter types of hexaploids in crosses with rye was 36.7% (Table 2) and 60.99% (KROWLOW, op. cit.) respectively; consequently 7.89% of the florets of the former hexaploids (AABBDD) produced germinable hybrid kernels (Table 2) compared to only 2.41% of the florets of the AAAABB autoallohexaploids.

In the various hexaploids synthesised from different tetraploid wheats and *Ae. squarrosa* varieties, the percentage florets which yielded viable kernels when crossed with diploid rye ranged from 1.24% to 24.74% (Table 2). Similarly the precentage florets of the natural hexaploids (bread wheats) which produced viable hybrid kernels ranged from 1.66% to 39.80% (Table 2). This wide range in both the synthesised hexaploids and bread wheats is due to genetic variability that affects crossability and the viability of the hybrid kernels. Kernel set ranged from 6.12% to 50.0% in the synthesised hexaploids, and from 8.33% to 71.2% in the bread wheats, whereas the viability of the hybrid kernels ranged from 6.38% to 73.24% in the synthesised hexaploids, and from 13.58% to 80.0% in the bread wheats (Table 2).

The D-genome not only affects the germinability of the wheat × rye hybrid kernels, but also appears to have an effect on the crossability of wheat with rye. The tetraploids, *T. durum*, *T. dicoccum* and *T. carthlicum*, produced a significantly (at 1% level) larger number

of hybrid kernels than their synthesised hexaploid counterparts (Table 2). This may be due to the operation of a weak *Kr*-system in the D-genome as suggested by KROWLOW (op. cit.).

The crossability with rye of various wheat species and cultivars, with special reference to the *Kr*-system, is discussed in a separate paper (MARAIS and PIENAAR, 1976).

The cytoplasm of 6x breads wheats appears to have no effect on the development of wheat × rye hybrid kernels. In Table 2 it can be seen that the $F_1$ kernels resulting from the Tetra-Canthatch (with 6x cytoplasm) × rye crosses are as inviable as those produced by the crosses involving the normal tetraploid wheats – none of the 25 Tetra - Canthatch × rye hybrid kernels that were obtained, germinated.


## Acknowledgments

We wish to thank Dr. E.R. KERBER, Canada Department of Agiculture, Winnipeg, Manitoba, Canada, for most of the material listed in Table 1.


## Literature Cited


KATTERMANN, G. 1941. Ueber heterogenomatische amphidiploides Weizenroggenbastard. Z. Pflanzenzüchtung. **23**: 179–209.

KERBER, E.R. and G.G. ROWLAND 1974. Origin of the free threshing character in hexaploid wheat. Can. J. Genet. Cytol. **16**: 145–154.

KROWLOW, K.D. 1964. Kreuzungen zwischen tetraploiden Weizen der Emmerreihe und 4*n*-bzw. 2*n*-Roggen in Verbindung mit Embryotransplantationen. Z. Pflanzenzüchtg. **51**: 21–46.

————. 1970. Untersuchungen über die Kreuzbarkeit zwischen Weizen und Roggen. Z. Pflanzenzüchtung. **64**: 44–72.

———— 1973. 4x-triticale, production and use in triticale breeding. Proc. 4th Int. Wheat Genet. Symp., Columbia, Mo. 237–243.

KRUSE, A. 1974. An in vivo/vitro embryo culture technique. Hereditas **77**: 219–224.

LEIGHTY, C.E. and W.J. SANDO 1928. Natural and artificial hybrids of a chinese wheat and rye. J. Heredity **19**: 23–27.

MARAIS, G.F. and R. DE V. PIENAAR 1976. Hybridisation between wheat and rye. I. Variations in the frequency of kernels set. Agroplantae. (In press).

MELNYK, J. and J. UNRAU 1959. Pairing between chromosomes of *Aegilops squarrosa* L. var. *typica* and *Secale cereale* L. var. *prolific*. Canad. J. Genet. Cytol. **1**: 21–25.

OEHLER, E. 1931. Untersuchungen über Ansatzverhältnisse, Morphologie und Fertilität bei Weizen-Roggen bastarden. Z. Pflanzenzüchtung. **16**: 357–393.

PIENAAR, R. DE V. 1973. Methods to improve the gene flow from rye and wheat to triticale. Proc. 4th Int. Wheat Genet. Symp., Columbia, Mo. 253–258.

ROMMEL, M. 1958. Eine vereinfachte Methode der Embryokultur bei Getreide. Züchter **28**: 149–151.

———— 1960. The effect of embryo transplantation on seed set in some wheat-rye crosses. Can. J. Plant Sci. **40**: 388–395.

# Doubling chromosome numbers of wheat-rye amphiploids with colchicine, DMSO, and cold treatment

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The introduction of diversity into triticale (× *Triticosecale* WITTMACK) from the extensive genetic variability found among wheat and rye cultivars has been limited by difficulties in synthesizing new primary hybrids. For a fertile hexaploid triticale hybrid to be obtained, successful pollinations should be followed by 1) culture of embryos on synthetic media and 2) subsequent doubling of the chromosome number of the sterile amphiploid plants. Conventional methods of colchicine treatment yield approximately 3 to 15% fertile plants (LARTER, TSUCHIYA and EVANS 1968). Some specific parental combinations produce seed only after persistent repetition of the various steps from pollination to seed production.

BELL (1950) and SIDDIQUI (1971) have reviewed methods of colchicine chromosome number doubling among interspecific and intergeneric cereal hybrids. Bell's capping method of application has been generally the most effective method for cereals, allowing repeated treatments and resulting in lowered mortality rates. Capping introduces colchicine into the meristem of the crown through a cut tiller; subsequent development and differentiation of polyploid tissue is influenced by temperature, turgidity, vigor and the genetic constitution of the individual plant. Since low temperatures and short days during early developmental stages frequently increase the number of tillers per plant among cereals, it seemed possible that a combination of chemical and cold treatment could increase the production of fertile alloploid spikes. This report describes observations on triticale development that resulted in a higher frequency of amphidiploid production following colchicine treatment than has been noted in previous work.

## Materials and Methods

Cultures of embryos germinated on synthetic media (NORSTOG 1973) yielded 111 amphiploid seedlings of *Triticum turgidum* L. (*durum* group) × *Secale cereale* L. and 124 seedlings of *T. aestivum* L. em. THELL. (*vulgare* group) × *S. cereale*. These 235 hybrids originated from 10 tetraploid and 5 hexaploid wheats pollinated by various diploid rye lines. Amphiploid plants were removed from agar medium in test tubes and placed in small peat pots containing a 1:1:1 mixture of peat moss, vermiculite and soil. The plants were placed in a cool (20 to 22°C) greenhouse, suitable fertilizer was added and time was allowed for the development of three or more vigorous tillers about 10 cm tall. Plant numbers can be

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increased by separating tillers at the crown but time to resume vigorous growth should be allowed before further treatment.

The main tiller was cut 2 cm from the crown and a vial containing 0.1% colchicine in an aqueous 2.0% dimethyl sulfonate (DMSO) solution was inverted over the cut stem. Vials were prepared by cutting 5 mm glass tubing into 5 cm lengths, sealing one end with floral clay and attaching the glass tube vial to wooden pot labels with floral caly. Absorption of colchicine seemed to be increased if the pots were kept slightly dry during treatment. If leakage occurred from the inverted vial the plants were watered thoroughly to wash the colchicine from the root system and the vial was not refilled for a few days. Care was taken to avoid skin contact during handling of the DMSO and colchicine.

The vials were refilled one or more times on alternate days. Swelling at the base of the treated tiller, leaf tip-burn and/or intensification of color in the leaves indicated that colchicine was absorbed into the tissues. One to three days of thorough watering allowed recovery after the colchicine applicator was removed from the plant. Following colchicine application the plants were placed for 2 to 5 weeks in a vernalization chamber or growth cabinet at 5°C with 12 hr light (both fluorescent and incandenscent). Two weeks were sufficient for hybrids from spring habit parents; five or more weeks were required for simultaneous treatment and vernalization of hybrids from winter habit parents. The plants were returned to a greenhouse and lighted for 12 hr per day until strong vegetative growth was initiated. After a vigorous vegetative plant had been produced the light period was extended to 16 hr to stimulate rapid flowering.

## Results and Discussion

Combining the colchicine, DMSO and cold treatments resulted in the production of 59.8% fertile alloploid triticales from surviving plants among hexaploids and 12.3% among octoploids (Table 1). Twenty five percent of another group of hybrids between hexaploid wheat and diploid rye, not recorded in Table 1, produced selfed amphiploid seed when treated with this technique. The mortality rate undoubtedly could have been reduced by additional care to prevent leakage of colchicine from the vials and elimination of

Table 1. Fertility in *Triticum-Secale* hybrids after colchicine, DMSO and cold treatment

| Triticale type | Hexaploid | Octoploid |
|---|---|---|
| No. plants treated | 111 | 124 |
| No. plants surviving | 82 | 106 |
| Surviving plants with seeds No. | 49 | 13 |
| Surviving plants with seeds % | 59.8 | 12.3 |
| Total No. seeds | 769 | 75 |
| Mean No. spikes/fertile plant | 8.1 | 4.2 |
| Mean No. fertile spikes/fertile plant | 2.3 | 1.2 |
| Mean No. seeds/fertile spike | 6.8 | 5.0 |
| Mean No. seeds/fertile plant | 15.7 | 5.8 |

weak plants from the experiment. No explanation is known for the lower percentage of fertile plants among octoploid hybrids but it is possible that plants with higher chromosome numbers require additional or more concentrated applciations of the alkaloid. The lower success rate may reflect the unfavorable balance of three wheat genomes (A, B, D) to one rye genome (R).

Both colchicine and low temperature are known to allow chromosome multiplication while inibiting cell division (TILNEY 1971; INOUE 1952). Our results suggest that low treatment and shortened days may stimulate the development of new tillers from polyploid cells.

Additional experiments are in progress to devise a means of treating crown meristems while the seedlings are still in culture tubes and the roots are protected by submersion in agar medium. Such a procedure has been used successfully to double chromosome numbers of barely haploids (K. KASHA, personal communication). Results were inconclusive in various attempts to combine colchicine with growth regulators such as kinetin and gibberellin.

## Acknowledgment

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## Literature Cited

BELL, G.D.H. 1950. Investigations in the Triticinae. I. Colchicine techniques for chromosome doubling in interspecific and intergeneric hybridization. J. Agric. Sci. **40**: 9–18.

INOUE, S. 1952. Effect of temperature on the birefringence of the mitotic spindle. Biol. Bull. **103**: 316.

JENSON, C.J. 1974. Chromosome doubling techniques in haploids. Proc. First Int. Symp. Haploids in Higher Plants. Univ. of Guelph. Ontario, Canada. pp. 153–190.

LARTER, E.N., T. TSUCHIYA and L.E. EVANS 1968. Breeding and cytology of triticale. Proc. 3rd Int. Wheat Gent. Symp., Austral. Acad. Sci., Canberra, pp. 213–221.

NORSTOG, K. 1973. New synthetic medium for the culture of premature barley embryos. In Vitro **8**: 307–308.

SIDDIQUI, K.A. 1971. Induction of polyploidy in multigeneric hybrids in the group Triticeae. Hereditas **67**: 191–203.

TILNEY, T.G. 1971. Origin and continuity of cell organelles. **2**: 222–231.

# Yielding ability of the mutants induced from wheat var. K68 against released varieties at different levels of nitrogen

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## Introduction

Gamma-rays in addition to other physical and chemical mutagens have been exploited in inducing economically useful mutants. Mutants *viz.*, 'Remei' from Fujiminori (FUTSUHARA *et al.* 1967), 'Sarbati Sonora' from Sonora 64 (SWAMINATHAN *et al.* 1968), and 'Rajeni' from Mexi Pak 65 (KHAN 1973), are worth mentioning in this regard. According to the last tally made by FAO/IAEA, Joint division of atomic energy in 1973, through out the world, there were 116 commercially accepted varieties, developed by mutation breeding. Out of these 22, were developed through gamma-rays. In all 48 varieties had been induced in cereals. Thus, gamma-rays may some times be equally effective in generating useful variability as that from conventional breeding procedures.

Present investigation deals with the conduction of a yield trial of 4 mutants against 4 released varieties at three levels of nitrogen in $M_5$ generation (1973–74).

## Material and Methods

Certain agronomically improved mutants were induced in a tall growing wheat var. K68, through the exposure of different doses (5, 10, 15 and 20 kr) of $Co^{60}$ gamma-rays at two seed moisture (14.0 and 4.0%) levels. These mutants were stabilized in $M_3$ generation and were assessed for yielding ability against control in $M_4$ generation. Four mutants on the basis of their performance in $M_4$ generation were selected for the final yield trial against released varieties in $M_5$ generation (1973–74). Mutants chosen were, HUW-Df 8, HUW-SDf 1, HUW-Df-Hp 1 and 3. Varieties used were, Kalyan Sona, HD 1982, HD 2028 and K 852. Latter three were released for commercial sowing in 1972–73. Three levels i.e. 80, 120 and 160 of kg/ha of nitrogen and one level i.e. 60 kg/ha of phosphorus and potash, each were used for this purpose. Split-plot-design with three replications was used. Standard plot size used was 10 $m^2$.

## Results and Discussion

The data on mean yield (Q/ha) of mutants and released varieties at three levels of nitrogen are presented in Table 1. It is evident from the results that with 80 kg N/ha, Kalyan Sona out yielded all the mutants and varieties. While mutant HUW-Df-Hp 1 and the variety K 852 yielded the lowest. Whereas, with 120 kg N/ha, Kalyan Sona yielded the same as with 80 kg N/ha, thus showing no response of increased level of nitrogen. Variety HD 1982 yielded the highest followed by mutant HUW-SDf 1 at 120 kg N/ha.

Though mutant HUW-SDf1 and the variety HD 1982 exhibited differential yielding ability, yet their response towards increased nitrogen (upto 120 kg/ha) was similar. For instance almost 19.8 and 18.4% increased yield was achieved at 120 kg N/ha level as compared to 80 kg N/ha for HD 1982 and the mutant HUW-SDf1 respectively. High protein mutants (HUW-Df-Hpl and 3) yielded the lowest expressing negative correlation between yield and total protein. Results are in agreement with those of BAKER *et al.* (1968) and MEHDI (1970).

Variety HD 1982 which yielded the highest at 120 kg N/ha level exhibited nearly 7.5% decreased yield return at 160 kg N/ha level. Similarly the mutants HUW-Df8 and HUW-Df-Hp 3 exhibited nearly 3.5 and 6.4% decreased yield at this level as compared to 120 kg

Table 1. Mean yield (Q/ha) of induced mutants ($V_1$-$V_4$) and released varieties ($V_5$-$V_8$) at three levels ($N_1$-$N_3$) of nitrogen in $M_5$ generation

| Mutants and released varieties | Levels of nitrogen | | | Total |
|---|---|---|---|---|
| | $N_1$ 80 kg/ha | $N_2$ 120 kg/ha | $N_3$ 160 kg/ha | |
| HUW-Df8 ($V_1$) | 42.66 | 50.00 | 47.00 | 139.66 |
| HUW-SDf1 ($V_2$) | 45.33 | 54.33 | 56.00 | 155.66 |
| HUW-Df-Hpl ($V_3$) | 40.33 | 46.00 | 49.33 | 135.66 |
| HUW-Df-Hp3 ($V_4$) | 41.66 | 44.33 | 42.83 | 128.82 |
| Kalyan Sona ($V_5$) | 48.00 | 48.00 | 53.00 | 149.00 |
| HD 1982 ($V_6$) | 45.66 | 57.00 | 53.00 | 155.66 |
| HD 2028 ($V_7$) | 46.66 | 50.00 | 56.66 | 153.32 |
| K 852 ($V_8$) | 40.30 | 46.33 | 55.66 | 142.32 |
| Total | 350.63 | 395.99 | 413.48 | 1160.16 |

N/ha. Reduction was probablly due to deleterious effects of higher does of nitrogen leading to the lodging of crop. It is evident from the results that for the mutants HUW-Df8, HUW-Sdf1 and HUW-Df-Hp3 and the variety HD 1982, 120 kg N/ha seems to be the optimum economic fertilizer requirement. These findings are in agreement with those of SINGH *et al.* (1971) who have reported the optimum requirement for 'chotti lerma' as 120 kg N/ha.

Kalyan Sona yielded quite high at 160 kg N/ha level and exhibited nearly 9.4% increased yield as compared to 80 and 120 kg N/ha levels respectively. Similarly, variety K 852 exhibited 13.7% increased yield at 120 kg N/ha as compared to 80 kg N/ha and 16.7% at 160 kg N/ha as compared to 120 kg N/ha level. Yield behaviour of HD 2028 with increased level of nitrogen was also the same as that of K 852. Thus, the yield of Kalyan Sona, HD 2028 and K 852 might be increased by applying nitrogen levels upto 160 kg/ha and this level seems to be the optimum dose for these varieties. High tillering ability (though not presented here) of these varieties may be responsbile for this type of nitrogen response.

Table 2. Analysis of variance for yield based on the data presented in Table 1

| Source of variation | Degree of freedom | Sum of squares | Mean sum of squares |
|---|---|---|---|
| Replication | 2 | 0.05 | — |
| Nitrogen | 2 | 7.98 | 3.990** |
| Error (a) | 4 | 0.20 | |
| Varieties & Mutants | 7 | 6.92 | 0.988 |
| Nitrogen × Varieties and Mutants | 14 | 3.87 | 0.276 |
| Error (b) | 42 | 5.22 | 0.124 |

** Significant at 1% level of significance.

Study on polled data for all the mutants and varieties at different levels of nitrogen showed increased yield return with increasing nitrogen level. There was 11.4 and 4.7% increased yield return from 80 to 120 to 160 kgN/ha level respectively. Which indicated that 160 kg N/ha level gave the optimum but uneconomic yield return.

Statistical analysis (Table 2) of data indicates a significant effect of nitrogen on varieties and interaction between nitrogen levels and the varieties. Thus, it is concluded from the results (Table 2) that induced mutants, tested, were as good as the released varieties through conventional breeding procedures with regard to their yielding ability.

High yielding ability of the mutant(s) is attached to their improved plant type, i.e. short and stiff straw; erect and synchronized growth habit and high fertility. Gamma-ray treatment has thus been quite effective in improving tall growing wheat var. K68 by induction of macromutants better in above yield components (for yield components of these mutants, KUMAR and SINGH 1974).

## Literature Cited


BAKER, R.I., V.M. BENDELOW and M.L. KAUFMAN 1968. Inheritance and inter-relationships among yield and several quality traits in common wheat. Crop Sci. **8**: 725–728.

FUTSUHARA, Y., K. TORIYAMA and K. TSUNODA 1967. Breeding of a new rice variety 'Remei' by gamma-ray irradiation. Jap. J. Breed. 176–190.

KHAN, A.H. 1973. Improvement of quality and yield of wheat by mutation breeding. Wheat Inform. Serv. **36**: 7–9.

KUMAR, D. and R.M. SINGH 1974. Role of low seed moisture in increasing the effectiveness of gamma-rays for plant type and grain quality mutations in wheat *Triticum aestivum* var. K 68. Proc. Symp. on "Use of Radiations and Radioisotopes in Studies of Plant Productivity". Pantnagar, April **12–14**: 77–83.

MEHDI, V. 1970. Studies on the caryopsis of some of the recently evolved varieties of *T aestivum* with special reference to nutritional constituents. Ph. D. Thesis, Dept. of Botany. A.M.U., India.

SINGH, A., R.B.L. BHARDWAJ, R.G., GAUTAM and M. SINGH 1971. Optimum seed rate and nitrogen requirement of dwarf wheat varieties under different sowings. Ind. J. Agron. **16**: 23–27.

# Microsporogenesis of two wheat cultivars with *Aegilops caudata*, *Aegilops ventricosa* and *Triticum timopheevi* cytoplasms

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KIHARA (1951) and FUKASAWA (1953) obtained the first alloplasmic wheats with the cytoplasms of alien species of the genera *Triticum* and *Aegilops*, and made preliminary observations on the male-sterility effects that are produced in some nucleo-cytoplasmic combinations. A great deal of information on cytological, morphological, physiological and biochemical effects of foreign cytoplasms has been subsequently accumulated. MAAN (1975)

Table 1. Chromosome pairing at metaphase I in alloplasmic and normal forms.

| Material | Number of PMC | Mean number univ. per PMC | Mean bivalents per PMC | | Mean trivalents per PMC | Mean chiasmata per PMC | % normal PMC | $p^1$ | $p^2$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Closed | | | | | |
| (c) Aragón 03 | 30 | 1.7(0-6) | 20.1(18-21) | 14.2(3-16) | | 40.4(30-48) | 40 | ### | – |
| (c) Toroma | 30 | 2.1(0-6) | 19.9(18-21) | 14.4(7-19) | 0.03(0-1) | 42.3(30-52) | 14 | ### | |
| (t) Aragón 03 | 30 | 1.4(0-4) | 20.3(19-21) | 12.0(7-19) | | 37.7(29-54) | 46.1 | ### | – |
| (t) Toroma | 30 | 2.1(0-6) | 19.9(18-21) | 14.1(9-20) | | 40.4(31-50) | 32 | ### | |
| (v) Aragón 03 | 30 | 1.6(0-6) | 20.2(18-21) | 15.8(13-21) | | 42.9(36-54) | 46.6 | ### | – |
| (v) Toroma | 30 | 2.1(0-6) | 19.9(18-21) | 14.5(12-19) | | 43.5(37-51) | 33.7 | ### | |
| Aragón 03 | 30 | 0.1(0-2) | 20.9(20-21) | 18.8(16-21) | | 42.1(38-45) | 96.6 | | – |
| Toroma | 30 | 0.1(0-2) | 20.9(20-21) | 18.2(15-21) | | 42.2(36-52) | 93.3 | | |

(c)=EC1 cytoplasm of *Ae. caudata*; (t) =ET8 cytoplasm of *T. timopheevi*; (v)=EV1 cytoplasm of *Ae. ventricosa*; $p^1$=P for $\chi^2$ test comparing alloplasmic and normal lines with the same nuclear genotype; $p^2$=P for $\chi^2$ test between lines with different nuclear genotype and the same cytoplasm; –=P>0.05; ###=P<0.001.

Table 2. Meiotic irregularities at anaphase I and tetrads in

| Material | Number of PMC | Mean laggards per PMC | Mean misdivision per PMC | Mean bridges per PMC | Mean fragments per PMC |
|---|---|---|---|---|---|
| (c) Aragón 03 | 42 | 0.6(0-2) | 0.05(0-1) | 0.01(0-2) | 0.2 (0-3) |
| (c) Toroma | 42 | 0.8(0-2) | 0.1 (0-2) | 0.08(0-1) | 0.08(0-1) |
| (t) Aragón 03 | 32 | 0.4(0-2) | | 0.03(0-1) | 0.03(0-1) |
| (t) Toroma | 32 | 0.6(0-2) | | | |
| (v) Aragón 03 | 30 | 0.4(0-2) | | 0.1 (0-1) | 0.1 (0-2) |
| (v) Toroma | 30 | 0.5(0-2) | | | |
| Aragón 03 | 30 | | | | |
| Toroma | 30 | 0.1(0-1) | | | |

assumed the existence of 16 distinct cytoplasms among 18 species of the genera *Triticum*, *Aegilops* and *Secale*, on the basis of reduced male fertility and reduced plant vigor effects of alloplasmic forms of *T. turgidum* and *T. aestivum*.

The present paper reports a comparative study on meiotic behavior, development of anthers and male fertility of two Spanish common wheat cultivars: "Aragón 03" and "Toroma" and its alloplasmic forms with the cytoplasms of *Aegilops caudata*, *Ae. ventricosa* and *T. timopheevi* obtained by substitution backcrosses.

Meiotic behavior data are presented in Tables 1 and 2. The cytoplasms of *Ae. caudata* and *T. timopheevi* seem to induce more meiotic irregularities than the *ventricosa* cytoplasm. The forms of common wheat with this cytoplasm show higher number of PMC with 21 bivalents, and higher average number of chiasmata and of ring bivalents per PMC than with the other two cytoplasms. However, the average number of bivalents per PMC in all alloplasmic forms shows the same difference of one unit with respect to their analogues possessing their own cytoplasm. The statistical test comparing the distribution of univalents between alloplasmic and normal forms with the same nuclear genotype (intercytoplasmic comparation) shows significant differences at the 0.1% level in all cases ($p^1$). The same test comparing forms with different nuclear genotype and the same cytoplasm (internuclear comparation) shows not significant differences at the 5% level ($p^2$).

The number of meiotic irregularities at anaphase I and tetrads shows a greater influence of the *caudata* and *timopheevi* cytoplasms, independently of the nuclear genotype.

Other observations have been made on anthers development and male fertility with the following results:

— pseudopistilloid anthers, in all plants possessing *caudata* cytoplasm, and occasionally in several flowers of the alloplasmic form of the variety "Toroma" with *timopheevi* cytoplasm,

— abortion of several anthers, in all forms possessing *caudata* and *timopheevi* cytoplasm. This has not been observed in forms with *ventricosa* cytoplasm,

— reduced number of PMC per anther, in all alloplasmic forms, the reduction being more intense in forms possessing *caudata* cytoplasm,

— asynchrony in the cellular cycle of the PMCs of the same anther, only observed in

Tab. 2 (*Continued*) alloplasmic and normal forms. $\lambda_i + = 0.01 > P > 0.05$.

| % normal PMC | $p^1$ | $p^2$ | Number of tetrads | Mean micro nuclei per tetrad | % normal PMC | $p^1$ | $p^2$ |
|---|---|---|---|---|---|---|---|
| 45.2 | ## | } − | 50 | 0.9(0-5) | 55.2 | ## | } − |
| 30 | ## | | 50 | 1.5(0-6) | 36 | ## | |
| 56.2 | ## | } − | 41 | 0.9(0-4) | 59.9 | # | } # |
| 48 | ## | | 50 | 0.6(0-3) | 62 | # | |
| 60 | # | } − | 30 | 0.7(0-4) | 60 | # | } + |
| 60 | − | | 50 | 0.6(0-3) | 72 | + | |
| 100 | | } − | 30 | | 100 | | } − |
| 90 | | | 50 | 0.1(0-2) | 92 | | |

alloplasmic forms with *caudata* and *timopheevi* cytoplasms.

— male-sterility, in forms possessing *caudata* and *timopheevi* cytoplasms, and male-fertility in the alloplasmic forms with *ventricosa* cytoplasm.

The results presented here show a differential nucleo-cytoplasmic interactions that affect the meiotic behavior, development of anthers and male fertility in the material studied.

Different effects of the cytoplasm on microsporogenesis have been observed in previous studies (LACADENA 1969; SANCHEZ-MONGE and SOLER 1973; LACADENA and PEREZ 1973; LARTER and HSAM 1973; SOLER 1975).

The cytoplasmic differences among the species used in this study have been reported by several authors in previous studies. Recently, CHEN *et al.* (1975) by means of electrophoretic analysis of the large subunit of the fraction 1 proteins of common wheats (with genetic information in chloroplasts DNA), have separated two distinct groups of species within the *Triticinae* with respect to their cytoplasmic constitution: (1) *Ae. speltoides*, *T. dicoccum*, *T. aestivum* and *T. dicoccoides*; and (2) *Ae. squarrosa*, *T. boeoticum*, *T. urartu* and probably *T. monoccum*. Assuming cytoplasmic identity among *Ae. squarrosa* and *Ae. ventricosa*, and cytoplasmic differences of both species with respect to *T. aestivum*, cytoplasmically derived from *Ae. speltoides*, the effects of that cytoplasm on meiotic stability of common wheat corroborate cytoplasmic differences. However, on the basis of cytogenetic, morphological and fertility effects it can be assumed that the *ventricosa* cytoplasm is more similar to the cytoplasm of common wheats than the cytoplasms of *T. timopheevi* and *Ae. caudata*. It can be said that the *timopheevi* cytoplasm, that induces higher meiotic instability and male sterility than the *ventricosa* cytoplasm, is genetically different from the cytoplasms of the tetraploids and hexaploid wheats of today. CHEN *et al.* (1975) suggest that in the origin of tetraploid wheats, the B-genome donor was also the source of the cytoplasm. Similary, the B'-genome donor of *T. timopheevi* must have been the maternal parent in the cross with *T. monococcum*. The contributing species of the B and B' genomes must consequently differ both genetically and cytoplasmically.

There is no difference between the effects of the nuclear genes of the two Spanish cultivars used in this work with respect to the meiotic stability and male-fertility-restoring genes.

The data presented here show that *ventricosa* cytoplasm seems to have less intense effects on meiotic stability, development of anthers and male-fertility. The *caudata* cytoplasm induces meiotic instability and produces pistilloid stamens, malformation of anthers and male-sterility. The *timopheevi* cytoplasm induces male-sterility and a lesser level of meiotic instability, being for this reason more useful in programs of utilization of male-sterility in the improvement of wheat.

## Literature Cited

CHEN, K., J.C. GRAY and S.G. WILDMAN 1975. Fraction 1 protein and the origin of polyploid wheats. Science, **190**: 1304–1306.

FUKASAWA, H. 1953. Studies on restoration and substitution of nucleus in *Aegilotricum*. I. Appearance of male-sterile *durum* in substitution crosses. Cytologia **18**: 167–175.
KIHARA, H. 1951. Substitution of nucleus and its effects on genome manifestations. Cytologia **16**: 177–193.
LACADENA, J.R. 1969. Microsporogenesis in alloplasmic rye. Wheat Inf. Serv. **29**: 21–22.
———— and M. PEREZ 1973. Cytogenetical analysis of the interaction between *Triticum durum* cytoplasm and *Secale cereale* nucleus at the diploid and tetraploid nuclear levels. Proc. 4th. Int. Wheat Genet. Symp.: 355–360.
LARTER, E.N. and S.L.K. HSAM 1973. Performance of hexaploid *Triticale* as influenced by source of wheat cytoplasm. Proc. 4th. Int. Wheat Genet. Symp.: 245–251.
MAAN, S.S. 1975. Cytoplasmic variability in *Triticinae*. Wheat Inf. Serv., **40**: 1–6.
SANCHEZ-MONGE, E. and M.C. SOLER 1973. Wheat and *Triticale* with rye cytoplasm. Proc. 4th Int. Wheat Genet. Symp.: 387–390.
SOLER, C. 1975. Estudio comparativo de un alohexaploide artificial, *Triticum* × *Secale* (*Triticale*) sobre los citoplasmas de las especies parentales. An. I.N.I.A. Ser. Prod. Veg. **5**: 9–82.

## Gamma irradiated morphogenesis in bread wheat (*Triticum aestivum* L.)

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Morphogenetic variations in crop plants are not uncommon after exposure to ionizing radiation. The normal expressions of leaves, roots, stems, spikes and flowers are often altered by radiation. During the course of investigations to produce beneficial mutants in $M_2$, interesting morphological changes were noticed, a preliminary report of which is given here.

Seeds of four varieties of *Triticum aestivum* L. em. THELL namely, Wisconsin Supermo, No. 43, Kenya Plume and Keyna Hunter were exposed to acute gamma radiation with dose ranges from 25 to 45 kR from $Co^{60}$ source.

Flag leaves were deformed in few populations especially in case of 35 kR, and 45 kR. During blade formation the flag leaves were very redumentary in some plants of No. 43 and Kenya Hunter population. Curling of primary leaves in 35 kR and 45 kR populations were observed. The coleoptile in these cases failed to open in time, resulting into forced emergence of primary leaves from midway of coleoptile forming loops.

Chimerical transformations were observed in the region of head. This observation is quite interesting and specific examples like one twin ear chimera in dosage 25 kR of No. 43. Kenya Hunter had greater variation with respect to ear types showing from lax to compact types and from large to short ones. Wisconsin Supremo was least susceptible to chimera though it possessed a few such plants. Three plants in 35 kR and two in 45 kR of No. 43

had axillary spikes on nodes (branches) other than those found at usual terminal position. The spikes were completely sterile, for they bore no seeds. Twisted spike internodes and spike arising from sheathless flag leaves were observed in Kenya Hunter, a few in No. 43 in all the three treatments especially in 35 and 45 kR. Two plants (with three and two tillers) in 35 kR and one (two tiller) in 45 kR of No. 43 had solid upper-culm internode chimera.

Supernumerary spikelets were of frequent occurrence in Kenya Plume, many in Kenya Hunter and few in Wisconsin Supremo and No. 43. One plant in Keyna Hunter was recorded with only three fully awned tillers while the rest were awnless as per varietal characteristics. No awnless mutant could be observed in awned variety.

Occurrence of chimeras in nearly all the populations corroborate the established and known facts that various chimeric forms are quite frequently met with during second mutation generation raised from seeds treated with ionizing radiations. Different mechanisms are involved for their production and mode of inheritance. Most of the head pecularities recorded were chimerical arising most probably from a disturbed sub-dermatogen sectors of the head primordia. These views have been expressed by notable workers like SEARS (1956), MAC KEY (1960), TAVCAR (1962), GAUL (1963), GUSTAFSSON (1963) and SWAMINATHAN (1964).

The head chimeras obtained by the author might be useful in unravelling the problem of zygote differentiation. There exists a strong indication of existence of more than one bud in the seed embryo which are most probably in different stages of cell differentiation. The size of the sectors may reveal the size of the radiation flux which inflicted the damage, if the number of cells is known. This can be estimated from the number of heads bearing the heteromorphic characters. DAMATO *et al* (1962) and GAUL (1965) have concluded that the size of the spike sector depends on the irradiations dose. GAUL explained that with no irradiation or with low doses a single spike (generative tissue) is presumably formed by about four, and possibly by exactly four embryo cells. With increasing dose the number of embryo cells per spike primordia decreases. This results in an increased size of mutated spike sectors. The increasing sector size with increasing dose appears to be a results of the increased killing among the initial cells of the spike primordia.

The emergence of the ear from such leaves that consisted of only blade without sheaths was not regular. Internodes of the spikes were found to be convoluted or spiral. This type of anomaly resulting into irregular shooting can be ascribed to the mechanical push of the ear that got arrested by the auricles. Such type of irregular emergence has also been reported by MATSUMURA (1955). Twin ear type chimera has been reviewed by several workers. MAC KEY (1954) and KARAPETJAN (1960) believe that it is a recessive mutant whereas SWAMINATHAN *et al* (1966) selected progenies of branched ear variants from $S^{35}$ culture and MASUBUCHI (1964) obtained branched ears from a cross between Mantimus Amber × Red Genealogical. He classified them according to the form and size of branching. He further remarked that the aberrant characters were found to be

cummulative and heritable.

The appearance of solid internodes, on the upper region of the culm, signifies the potentialities of radiation in unravelling certain fundamental principles of evolution and cell lineages or organogenesis in wheat through mutagenesis. Other workers who have reported solid culms in their experiments are MAC KEY (1954), SCARASCIA *et al.* (1961) and AVANZI (1961). As per LARSON (1952) and SEARS (1956) at least some of the eleven chromosomes bearing genes for solidness might have been disturbed through irradiation. The character being monofactorial and dominant, it may be deduced that epistatic genes have been deleted from their loci (PLATT 1961).

Supernumerary spikelets have also been reported oftentimes, as observed during the present studies (MAC KEY, 1954; SEARS, 1946; KARAPETJAN, 1960; BHATIA and SWAMINATHAN, 1963). MAC KEY believes that they are non heritable recessive. The degree of expression depends, to a large extent on the environment. Chimerical awning, which is of rare occurrence has been recorded by the author in Kenya Hunter – an awnless variety. Awndness has been established, through genetic studies to be a dominant character. These studies would tend to put forth that Kenya Hunter is an awned variety, the expression being inhibited by suppressor genes whose loci were deleted, while the expression of the various lengths viz. short typed (29.30%), long typed (13.37%) half awned (3.23%) and all other similar expressions, may be ascribed to the reduction or enhancement of dosage level of promotor genes.

## Literature Cited


AVANZI, S. 1961. Atti Assoc. Genet., Italy **6**: 353–64.

BHATIA, C.R. and M.S. SWAMINATHAN 1963. Genetica **34**: 58–65.

D'AMATO, F., G.T. SCARASCIA, L.M. and A. BOZZINI 1962. Radiation Botany **2**: 217–239.

GAUL, H. 1963. Proc. XI Int. Cong. Genet. The Hague, Netherlands: 609–709.

———— 1965. Induction of mutation and the mutation process, Germany: 1–11.

GUSTAFSSON, A., 1963. Recent Plant Br. Res. 89–104.

KARAPETJAN, V.K., 1960. Agrobiology, **1**: 82–85.

MAC KEY, J. 1954. Hereditas, **40**: 65–180

————, J. 1960. Genetica Agraria 12 (3–4): 201–230.

MATSUMURA, S. 1955. Seikenziho, Kihara Inst. Biol. Res. **7**: 45–50.

PLATT, A.W. 1961. IAEA Vienna 103–116.

SCARASUA, G.T., F., D'AMATO, F. and A. BOZZINI 1961. Atti. Assoc. Genet. *et al*, **6**: 371–80.

SEARS E.R. 1956. Sonderdruck aus Handbuch der Pflanzenzüchtung. II. Band, **2**. Aufl: 165–187.

SWAMINATHAN M.S. 1964. Rep. FAO/IAEA Tech. Meet: 620–641.

————, V.L. CHOPRA and G.R.K. SASTRY. 1966. Ind. Agr. Res. Inst. New Delhi.

TAVCAR, A., 1962. Arh. Poljopr. Nank. **15**: 20–23.

## II. Report

# Report of the International Board for Plant Genetic Resources Advisory Committee on Wheat Genetic Resources

First Meeting

Rome, Italy, 20–22 September 1976

IBPGR Secretariat
FAO, Rome, Italy

### Introduction

1. The first meeting of the IBPGR Advisory Committee on Wheat Genetic Resources was held at FAO Headquarters in Rome on 20–22 September 1976. Professor W. Hondelmann chaired the meeting which was attended by all members of the Committee except Dr. M.A. Fedin acted for Dr. V.F. Dorofeev and Dr. R.G. Anderson who was unable to be present. Professor G. Fischbeck attended as a member of IBPGR. Participants are listed in Appendix I. Dr. J.T. Williams acted as Rapporteur. (F: Appendix I~III)[1)]

2. The Secretary of the Board, Mr. Pichel, welcomed the members of the Committee on behalf of FAO.

3. Dr. Fischbeck outlined the aims and policies of the Board in relation to the terms of reference of the Committee.

4. The provisional agenda was adopted (Appendix II).

5. Prof. Yamashita kindly showed his film entitled "A documentary of the botanical expedition to the heart of the *Aegilops* distribution".

### Terms of Reference

6. The terms of reference of the Committee (AGPE:IBPGR/75/41) were approved.

### Review of data available on existing collections

7. Recognizing from the data on major collections assembled for the Committee by the Secretariat: (a) that there exist serious gaps for regions and species; and (b) that duplciation is extensive and may not ordinarily be recognized until genetic evaluation has been made; it was agreed that an attempt must be made to ascertain more fully what is present in existing collections. It is recommended that the Board requests that the GR/

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CIDS team in Boulder, Colorado will use the data made available to the Secretariat, obtain data not yet available from the major wheat collections and computerise these on the basis only of the passport record descriptors agreed at the Leningrad Symposium 1975 (Appendix III). If possible this work should be part of the GR/CIDS regular programme and should be completed for the next meeting of the Wheat Advisory Committee.

**Exchange of material for completing existing collections**

8. In order to implement plans for the exchange of material to complete the existing collections and the dupilcation of base material, the Committee recognized that a limited number of centres should be asked to accept responsibility for holding the major collections of wheat germplasm. The Committee unanimously recommended that the Board should request the following centres to undertake such responsibilities:

(1) the N.I. Vavilov All-Union Institute of Plant Industry, USSR
(2) the USDA Agricultural Research Center, Beltsville and Fort Collins
(3) the Germplasm Laboratory of the C.N.R., Bari, Italy
(4) the Kyoto University Plant Germ-plasm Institute, Japan.

Of these, the Kyoto centre will assume major responsibility for the wild species collections.

9. It was further recognized that: (a) where the institution named above has regional responsibilities, any sub-collections will be the responsibility of the major collection, and (b) there are many other institutions holding wheat germplasm which are or will be active in the world network of genetic resources centres, and these may be asked to accomodate duplications once these are identified.

10. The recognition of the four centres in para 8 has been based on the possession of competent and trained personnel, the active evaluation of material and space which can be made available for international storage.

11. The four centres will be asked to guarantee the availability of material and information. Each major centre will be asked to advise the Board on the feasibility of maintaining the samples at –10°C. In addition the centres in USSR, USA and Italy would be expected to accept initially up to 30,000 samples and to accomodate between 3,000 and 4,000 additional samples over the next 10 years. The centre in Japan would be asked to accomodate up to 3,000 additional samples.

12. The Board should state to each designated centre whether or not it is willing to provide any financial assistance and the Board should note that inherent in the centre accepting this role there will be limited additional manpower requirements.

13. The Committee agreed that technical discussions will be necessary and probably at its next meeting (when the computerised information will be available) on: (a) the duplications within collections; and (b) the details of the duplications of base collections. Other technical matters relating to methodology will be included in the discussions.

## Priorities for regions and species

14. The Committee considered the priority ratings of geographical regions for wheat collecting which were drawn up at the Leningrad Symposium and reaffirmed these with some modifications:

Priority 1:
1. The Near East area (from Afghanistan to the Mediterranean) and the Caucasus
2. Greece
3. Ethiopia
4. Peoples Republic of China

Priority 2:
5. Tunisia, Algeria, Morocco, Spain and Portugal
6. Yugoslavia and Albania
7. South Asian sub-contient (India and Pakistan)

Priority 3:
8. France and Italy
9. Northern Europe
10. Latin America.

15. The Committee agreed that priorities should be given to species as follows: firstly, tetraploid species; secondly, hexaploid species; and thirdly, diploid species including *Aegilops*. However, expeditions and collecting teams should not be mission-orientated but must try to collect the whole range of variability.

16. It was agreed that no existing collections satisfied the Committee for their comprehensiveness of wild species. In addition it is not possible to rank the wild species into any order of priority for collection. Notwithstanding this, it was recommended that: (a) a monitoring system should be built up through the regional networks so that where there are areas rich in wild species which come under threat, the Committee can be alerted via the Secretariat who should be empowered to put teams into the field at short notice; and (b) in view of the gaps existing in the collections of wild material, and the emphasis previously laid on collecting primitive cultivars, the Board should organise a seminar (preferably in Turkey) on wild species of *Triticum* and *Aegilops*, to be led by Professor Yamashita in June 1977. The participants should include those persons active in the national programmes in S.W. Asia, as well as selected people from the European and Mediterranean programmes, and the S. Asian sub-continent.

17. The Secretariat should be asked to undertake the arrangements for the seminar. It is estimated that a four-day smeinar for about 20 participants (from S.W. Asia, E. Europe and USSR, Mediterranean and S. Asian sub-continent) would cost approximately $ 18,500. The Board may wish to consider this under its training item or to divide it among its regional activities. In addition, a few participants from genetic resources centres in developed countries should be allowed to attend at their own cost.

## Exploration plans

18. The Committee stressed the need for greater international collaboration and

coordination of effort. It is recommended that all future plans for the collection of wheat germplasm be informed well in advance to the Wheat Adivsory Committee. In this context the Committee strongly endorsed two actions suggested by the Leningrad Symposium, i.e.:

(a) The curators should send to the Secretariat information on forthcoming collecting expeditions as soon as the plans for these become reasonably definite. Also they should send up-to-date information on seed exchanges and requests for material that have gone unanswered; and

(b) The feasbility of joint explorations should be explored; not, however, to the exclusion of bilateral projects, and always attempting to include a local specialist in the team.

It was recommended that the Crop Ecology and Genetic Resources Unit of FAO make contact with the indicated host countries as the initial step to organise expeditions in priority regions.

19. It was agreed that exploration plans for this meeting should be limited to Priorities 1 and 2 in para 14 above.

## Exploration plans for 1977

20. Following a discussion of past collection activities in the priority regions (para 14), the following programmes are endorsed:

**Priority 1**:

S.W. Asia. The plans of the 6 national programmes should be known by January 1977. So far for wheat, these have only considered primitive cultivars. The Committee aggreed that; (i) they should be asked to take into account wild species and be informed of the seminar to be held in 1977, (ii) they should be asked to deposit duplicates in one of the 4 designated centres in para 8 above, and (iii) collaborative efforts should be organised wherever possible.

The proposed GRSU will play a major role in coordinating such tasks and in keeping the Wheat Advisory Committee informed in advance.

It was noted that the DDR is planning an expedition in 1977 in Afghanistan and that the Vavilov Institute may well collaborate in this.

Greece (see also Priority 2). Negotiations are in the preparatory stage as part of the IBPGR Mediterranean programme. In 1977 two of the 4 priority areas of Creece will be explored by 2 teams from Italy with the participation of a Greek colleague. These areas are Epirus and Evvoia.

Ethiopia. The bilaterally funded genetic ressources centre is now operational and collecting should commence in 1977.

**Priority 2**:

Tunisia, Algeria, Spain and Portugal. Planning and action is under way as part of the IBPGR Mediterranean programme. Missions have been arranged as follows for 1977:

Feb.-March, southern Tunisia and Algeria, especially oases; June-July, Spain and Portugal and lowland Greece, followed later by exploration in the Greek mountainous area. Personnel will include scientists from the host countries in each mission plus the Bari personnel and FAO component or personnel recruited through the Secretariat. In addition, the Greek scientist will participate in Spain and Portugal and Dr. Fedin of VIR has been invited to participate.

A planning mission to Spain and Portugal will take place during a maize collecting expedition in October 1976.

Yugoslavia and Albania. No action is envisaged by the Board until 1978, but the Committee notes a US project centred on Skopje to collect wheat and other small grain cereals and maize in the Yugoslavian state of Macedonia in 1976–1979.

South Asian Sub-continent. The Committee notes that the expedition, supported by IBPGR in 1976, by the Institut de Haaff, Netherlands, recommends further collecting is necessary in Pakistan. It was agreed that the national programme should be asked to continue the collection of wheat in these areas in 1977.

No action is envisaged by the Board in India until 1978, but the Board might wish to request the Indian authorities for estimates of financial requirements well in advance (see para 25).

## Emergency operations

21. The Committee agreed that whilst the Board's S. W. Asia project is being negotiated it recommends to the Board that some emergency action should be initiated in 1977. This action is necessary in view of the extremely low number of wheat samples available from three critical areas – S.E. Turkey, N. Syria and N.E. and N. Iraq. It is recommended that the Board consider the support of an IBPGR/FAO emergency mission in 1977. A team of 3 people for 6 weeks would cost approximately $15,500. In addition, it is recommended that the Board requests the Afghanistan national programme to concentrate action on wheat collection in N.W. and S.E. Afghanistan and N. Badakhshan.

## Exploration plans for 1978

22. The Committee endorses the plans now being made under the IBPGR Mediterranean programme for collection activities in 1978 for wheat in Greece, Spain and Portugal, Morocco, Yugoslavia and Albania. The budget proposal to be made for this regional programme will include these missions.

23. The Committee requests information from the Genetic Resources Centre in Ethiopia on its plans for 1978.

24. The Committee notes that analysis of the IBPGR's 1976 N.W. India expedition will determine (in the light of previous missions in the Himalayan region) whether action is needed in W. Nepal in 1978.

25. It is recommended that the Board liaises with the Indian authorities to commence

action in 1978 in the following three areas of India: first priority, rainfed area of central India (Madhya Pradesh); second priority, Gujarat, chiefly for tetraploid wheat; and third priority, Rajasthan because of the importance of salinity/alkalinity tolerant germplasm.

### Conservation facilities

26. Assuming that the designated major wheat base conservation centres will all be able to upgrade to the storage standards requested by the Board, it is noted that facilities for long-term storage, both in these centres and in other centres likely to be associated with them, are adquate for wheat germplasm for the foreseeable future.

### Conservation of cytogenetic stocks

27. The Committee recognizes that it is necessary to conserve cytogenetic stocks of wheat but recommends that the actual producers and potential users should share the responsibility for maintaining them. The Committee agreed that such responsibility did not fall within the terms of reference of the IBPGR.

### Information and data management

28. The Commitee recommends that the relevant conclusions of the Leningrad Wheat Symposium be adopted, in particular the list of passport descriptors and the list of collection record descriptors (Appendix III).

29. In order to draw up the minimum descriptors for wheat (including *Aegilops*), the Committee recommends that the Board approves the convening of a small Working Group which should produce a minimum list of taxonomic, morphological, physiological, resistance and quality characteristics. In addition it should produce an inventory of descriptors for evaluation of wheat germplasm currently used in various gene centres and collate a minimum list (see also 33). The list should then be agreed by the Wheat Advistory Committee.

30. The membership of the Working Group is suggested as follows: a scientist to be nominated from the Vavilov Institute, USSR; Dr. M. Tanaka, Japan; Dr. Virgil A. Johnson, Lincoln, Nebraska, USA; Mr. L. Seidewitz, FRG; and the group should liaise with the GR/CIDS team in Boudler, Colorado.

31. The Group should meet in FAO, Rome, in March 1977 and it is estimated that the cost of a 2-day meeting will be $ 6,000.

### Evaluation of wheat germplasm

32. The Committee recognizes that breeders should have a widespread service at their disposal from gene banks and that as far as possible all new wheat germplasm should be evaluated.

33. The Committee proposes to establish a pilot scheme and recommends that material from existing collections in the three major centres designated (USSR, USA, Italy) be given

to approximately 10–15 institutes in all parts of the world for preliminary evaluation using the minimum descriptors (and standard descriptor states) to be drawn up by the Working Group, on single row observations.

34. It is suggested that 1,500 samples be evaluated in 1977–1978 (500 samples from each of the 3 centres) and that FAO should be asked to distribute the subsamples to the institutions and gather in the results which will be passed to Boulder, Colorado.

35. The designation of the institutes should be a task for the Secretariat and this will depend upon the institutions' acceptance of the role of a genetic resources centre as defined by the FAO Panel of Experts on Plant Exploration and Introduction. In this way the Wheat Committee envisages centres collaborating in the global network for the specific purpose of international evaluation. Initially, the following centres should be approached but not to the exclusion of others:
Argentina (INTA), Brazil (EMBRAPA). Bulgaria (Sofia), Czechoslovakia (Prague), Ethiopia, FRG-Netherlands (Braunschweig, Wageningen), Hungary (Tapioszele), India (IARI), Italy (Bari), Kenya, USSR (VIR and sub-stations), USA (USDA),

**Proposed next meeting**

36. It is proposed that the Committee on Wheat Germplasm Resources should hold a meeting after the computerization of data (para 34) and the report of the Working Party (para 29) are available. It was agreed that, if the Board approves, Kyoto University Germ–plasm Institute in Japan would host the meeting in the first week of September 1977. The cost of a meeting of the Committee in Japan in 1977 is estimated at $ 10,000.

**Other business**

37. The Committee recognized that its report entails an action programme and it expressed some concern about monitoring the implementation and progress of the activities proposed for wheat, and the manpower of the existing IBPGR Secretariat to do this. This question will be discussed at the Committee's next meeting. It was recognized that the speedy dissemination of information is an important role of the Secretariat in keeping the Board's Committees informed.

Professor Dr. W. Hondelmann, Chairman
23 September 1976

**Appendix I**

List of participants

Prof. Dr. W. Hondelmann (Chairman), Director-Gene Bank, Institut Pflanzenbau FAL, Bundesallee 50, 30 Braunschweig-Völkenrode, Federal Republic of Germany

Dr. J.C. Craddock, Small Grains Collection Bldg. 046, Agricultural Research Center-West USDA, Beltsville, Maryland 20705, U.S.A.

Dr. M.A. Fedin, Head, Laboratory of Heterosis, N.I. Vavilov Institute of Plant Industry, B. Kharitonievsky per. 21, 107814, Moscow, U.S.S.R.

Dr. E. Porceddu, Director – Germplasm Laboratory, Institute of Plant Breeding, Via G. Amendola 165/A, 70126 Bari, Italy

Dr. M.V. Rao, Project Coordinator, All-India Coordinated Wheat Improvement Project (ICAR), Indian Agricultural Research Institute, New Delhi 110012, India

Prof. K. Yamashita, Kihara Institute for Biological Research, Yata-Ohara, Misima, Sizuoka-ken, 411, Japan

Prof. Dr. G. Fischbeck, Technische Universität München, Lehrstuhl für Pflanzenbau und Pflanzenzüchtung, 8050 Freising-Weihenstephan, Federal Republic of Germany

Mr. R.J. Pichel (Secretary, IBPGR), Chief, Crop Ecology and Genetic Resources Unit, Plant Production and Protection Division

Dr. J.T. Williams (IBPGR Secretariat), Genetic Resources Officer, Crop Ecology and Genetic Resoruces Unit, Plant Production and Protection Division

Ms. Erna Bennett, Plant Exploration, Crop Ecology and Genetic Resoruces Unit, Plant Production and Protection Division

## Appendix II

Agenda

1. Opening by FAO representative
2. Introduction by Dr. Fischbeck explaining Boards' objectives
3. Discussion of the Committee's terms of reference
4. World wheat germplasm collections
   - 4.1 Review of data available on existing collections
   - 4.2 Overall plans for completing the collections
   - 4.3 Exploration priorites for regions and species
   - 4.4 Exploration plans for 1977
   - 4.5 Exploration plans for 1978
   - 4.6 Review of present conservation facilities including duplicate collections
   - 4.7 Future plans for conservation
5. Information and data documentation
6. Discussion on utilisation of wheat germplasm
7. Summary of recommendations for action
8. Place and date of next meeting
9. Any other business

## Appendix III.

Descriptors agreed at the Leningrad Symposium

A. Exchange or "Passport" Record Descriptors
   (1) Institution (Reporting Institution)
   (2) Accession number (Reporting Institution)
   (3) Genus
   (4) Species
   (5) Sub-species
   (6) Designation (common, local name; line, variety identifier, country of sample)
   (7) Origin (country in which sample was taken from habitat)
   (8) Donor name (institution or individual providing sample)
   (9) Donor number (donor accession or collection identifier, number)

B. Collection Record Descriptors
   (1) Expedition/collector/organization
   (2) Team/collector name
   (3) Date of collection
   (4) Country of sample origin (in which collection was made)
   (5) Family
   (6) Genus
   (7) Designation (local name)
   (8) Habitat (cultivated, weed of cultivation, uncultivated, market sample)
   (9) Sample type (seed, spikes, herbarium)
   (10) Latitude (degrees and minutes)
   (11) Longitude (degrees and minutes)
   (12) Altitude (above sea level)
   (13) Precise locality (e.g. road point reference)
   (14) Irrigated/dry
   (15) Season (winter, spring, other)* to be taken only when exact reliable information available.
   (16) Primary donation point (principal deposit)
   (17) Soil observation* – list .... texture, stoniness, depth,
   (18) Disturbance factor observation*
   (19) Land form observation* .... aspect, slope
   (20) Plant community observation**
   (21) Sample technique observation .... pure line, population (method of sample)

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* to be taken as optional observation in general.

** to be taken in the case of "wild" species and by knowledgeable observer only.

## III. News

### (1) Fifth International Wheat Genetics Symposium

Jointly sponsored by: The Indian Society of Genetics and Plant Breeding
and Indian Council of Agricultural Research, New Delhi (India)
23rd–28th February, 1978

*First Circular*

INVITATION

The organising Committee of the Fifth International Wheat Genetics Symposium takes pleasure in inviting you to attend the Fifth Wheat Genetics Symposium to be held in New Delhi; India, from 23rd to 28th February, 1978.

The six-day Symposium will cover the following topics:

1. General Genetic Analysis
2. Genetics of Quantitative Variation
3. Population Genetics
4. Genetical and Biochemical Approaches to Disease, Pest and Nematode Resistance
5. Genetics of Adaptation, Production and Stress Physiology
6. Conservation, Classification and Cataloguing of Genetic Resources
7. Evolution of Wheat — Changing Concepts
8. Natural and Induced Variability
9. Advances in Breeding Methodology
10. Next Quantum Jump in Wheat Yield
11. Alien Genetic Materials
12. Aneuploid Analysis
13. Triticale
14. Miscellaneous

It is proposed that these sessions as far as possible, will be held one after another and not concurrently. There will be both invited and contributed papers. The contributed papers will be limited, including the discussion, to 20 minutes duration.

Authors who intend to contribute papers are requested to complete the reply form and return it by 15th December, 1976 to the Local Coordinating Secretary. Replies received after the due date cannot be considered for the programme. A summary in English of the proposed paper should be sent along with the reply to enable the organisers to decide where it may be included in the programme. Papers advancing new concepts in wheat genetics and breeding will be given priority. Contributions, discussions and, proceedings of the Symposium will be in English.

Authors whose papers are accepted for the programme have to provide a final version of their contribution not later than 1st August, 1977. Contributions not received by that date may be excluded from the Programme and Proceedings. The proofs of paper will be supplied to the contributors at the Symposium for correction and return before their departure from India.

REGISTRATION

The provisional registration form (attached) should be completed and returned to the Local Coordinating Secretary before 15th December, 1976 by all who would like to participate in the Symposium. The completion and return of this form in no way requires you to attend the Symposium and does not involve any financial obligation. A second mailing, containing final registration forms, details of the programme etc., will be marked only to those who have completed and returned the provisional registration form. If any of your colleagues have not received a copy of this notice and will like to make a provisional registration, they may do so by writing directly to the Local Coordinating Secretary prior to 15th December, 1976.

The registration fee for the Symposium will be U.S. $ 50.00 for foreign delegates, Rs. 150.00 for Indian delegates and Rs. 50.00 for local students. Apart from attendance at the Symposium, this fee entitles participants to a copy of the proceedings, further symposium literature, participation

in the local events, the Symposium dinner and the local transportation.

## ACCOMMODATION

Rooms would be reserved in suitable hotels. Limited accommodation is available to the local participants on the Campus of the Indian Agricultural Research Institute. Details of the accommodation and its reservation will be indicated in the Second Notice to the delegates.

## TOURS

There will be pre- and post-symposium tours. The pre-symposium tour will be to Udaipur, Jaipur and Agra, all places of tourist interest, and post-symposium tour will be to Pantnagar, Karmaland Ludhiana, centres of agricultural research. The starting point for these tours will be New Delhi and all the participants will return to New Delhi after the tour. These tours will be undertaken mostly by road transport except the visit to Udaipur which can be reached both by air or train.

Please indicate in the provisional reply form whether you would like to participate in either or both of these tours.

## LADIES PROGRAMME

If sufficient number of ladies are coming to the Symposium, a ladies programme will be organised. This includes visits to historical places, beauty spots, shopping centres etc. Please indicate on the reply Form if you would like to have a place reserved in the ladies programme. Separate fees may be charged for this programme. Also, please indicate if you would participate in the pre- and post-symposium tours.

## SOCIAL FUNCTIONS

Social functions would be organised to facilitate informal meetings of delegates.

## WEATHER AND CLOTHING

February and beginning of March is generally pleasant in North Western India. The temperatures will be around 25°C (75°F). Light winter clothing is recommended.

## INTERNATIONAL TRANSPORTATION

AIR INDIA will be the official carrier for the Symposium.

## PASSPORTS AND VISAS

It is the responsbility of the overseas delegates to obtain their own passports, visas and necessary health documents prior to arrival in India.

## DEMONSTRATION MATERIAL

Demonstration material to be grown at New Delhi can be accepted upto 1st July 1977. In India only wheats of spring habit are grown. Winter wheats do not perform well and they come to flower in summer in May-June under New Delhi conditions. All material should be clearly labelled and mailed to reach the Local Coordinating Secretary, accompanied with the appropriate quarantine documents by the above date. Please indicate on your provisional reply form if you would like to take advantage of this facility.

*Please address all correspondence to*:

Dr. M.V. Rao,

Local Coordinating Secretary, 5th International Wheat Genetics Symposium, Cummings Laboratory, Indian Agricultural Research Institute, NewDelhi–11012, India.

## PROVISIONAL REGISTRATION FORM

To

Dr. M.V. Rao,

Local Coordinating Secretary, 5th International Wheat Genetics Symposium, Cummings Laboratory, Indian Agricultural Research Institute, New Delhi–110012, India.

☐ I would like to attend the 5th International Wheat Genetics Symposium.

☐ I shall be accompanied by.....
.....

☐ Please indicate in which function and kind of accommodation you would like space reserved:
..... Pre-Symposium tour
..... Post-Symposium tour
..... Ladies Programme
..... on campus residence
..... Hotel.

☐ I am interested in growing demonstration material at New Delhi
YES ☐ NO ☐

☐ I would like to contribute a paper with the tentative title (supply abstract on separate sheet):

☐ Please give the names of joint authors (if any) .....

☐ I would like to particularly participate in sessions dealing with the topic Nos. .....

Name ..... Date Signature

Address .....

## (2) Academy of Sciences of the USSR National Organizing Committee of the XIV International Congress of Genetics

Moscow, August 21–30, 1978

*First Announcement*

The National Organizing Committee of the XIV International Congress of Genetics, Academy of Sciences of the USSR, informs you that the Congress will be held in Moscow, USSR, August 21–30, 1978. The idea of the Congress is "Genetics and Human Welfare".

### Program of the Congress

**A. Plenary Sessions and Symposia**

The Program of the Plenary Sessions and Symposia will be announced later.

**B. Sessions**

The preliminary program of the sessions includes the following items. In order to schedule your abstract with others in the program, please, indicate the number of the session at which you intend to present your paper and/or to participate in the discussion, in the Request Card.

1. Gene Fine Structure in Prokaryots
2. Gene Fine Structure in Eukaryots
3. Genic Regulation
4. Experimental Mutagenesis
5. Immunogenetics
6. Oncogenetics
7. Behavior Genetics
8. Plant Evolutionary and Population Genetics
9. Animal Evolutionary and Population Genetics
10. Plant Genetics and Breeding
11. Animal Genetics and Breeding
12. Genetics and Selection of Microorganisms
14. Viral Genetics
14. Anthropogenetics
15. Medical Genetics
16. Biochemical Genetics and Isozymes
17. Developmental Genetics
18. Plant Cytogenetics and Karyosystematics
19. Animal Cytogenetics and Karyosystematics
20. Human Cytogenetics
21. Chromosome Structure, Function and Evolution
22. Somatic Cell Genetics
23. Extrachromosomal Inheritance
24. Cytology and Genetics of Protozoa
25. Physiological Genetics of Plants
26. Mathematical Genetics
27. Gene Engineering
28. Polyploidy
29. Endocrinological Genetics
30. Interspecific and Intergenic Hybridization
31. Space Genetics
32. Genetics of Gametes
33. Genetic Control of Replication and Repair
34. Teaching of Genetics
35. Others (specify)

The working languages of the Congress are Russian and English in which all the current information will be published. The abstracts are to be presented in either of them.

The Registration Fee will probably be about US $ 50 for regular members. This includes participation in all kinds of Sessions and receipt of all the materials and souvenirs of the Congress. The Registration Fee for associate members will probably be US $ 30, which entitles the associate members to participate in all kinds of sessions and in the Special Program. Registration Fees may not include participation in the Closing Banquet.

Hotel accommodation can be guaranteed for all the attendants. The attendants may arrange their trip through any agency trading with the Intourist in their own or any other country.

The Holiday Tours and Post-Congress Excursions will be available for the attendants.

Information on accomodation arrangements, tour bookings, remittance of Fees and abstract presentation will be given in the next Circular.

The present information is distributed among most of the scientists likely to participate in the Congress. All who plan to attend the XIV ICG and wish to receive further information, please, fill in the Request Card and mail it to the National Organizing Committee, Moscow, USSR, before November 30, 1976.

REQUEST CARD

I should like to attend the XIV ICG. Please, forward me further information and the Registration Folder.

1. Name _____
2. Address _____

_____

_____

3. Institute, Position occupied _____

_____

_____

4. Sessions of interest to me (Nos.) _____

_____

(First indicate the Session, at which you would like to present a paper).

5. Date _____
6. Signature _____

Please address all correspondence to:


D.K. BELIAEV
Secretary General
XIV ICG

N.P. BOCHKOV
Chairman, National
Organizing Committee
XIV ICG

Academy of Sciences of the U.S.S.R.
Moscow, 117312, U.S.S.R.

## IV. Editorial Remarks

### Announcement for future issues

WIS No. 44 will be planned for publication in March 1977. Manuscripts for this issue are accepted any time, not later than January 30, 1977.

WIS is open to all contributions regarding methods, materials and stocks, ideas and research results related to genetics and cytology of *Triticum, Aegilops, Secale, Haynaldia* and related genera. Manuscripts should be typewriten in English, and submitted with duplicates. One article should not exceed five printed pages, including one textfigure (smaller than $7 \times 7$ cm$^2$). Lists of stocks are exempted from this page limit. Authors receive 50 reprints of their contributions free of charge. Extra copies are printed by order at cost price. Communications regarding editorial matters should be addressed to:

Dr. Kosuke YAMASHITA
Managing Editor
Wheat Information Service
Kihara Institute for Biological Research
Misima 411, Japan

### Membership Fee

Due to the economic situations, the yearly Membership Fee has been raised up to ¥ 1,000 for foreign members and ¥ 700 for Japanese members from the fiscal year beginning April 1975. The money should be paid by the Foreign Postal Money Order, otherwise considerable loss is caused due to the bank charges. Back numbers are available.

### Acknowledgment

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*The Managing Editor*

W I S No. 43

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