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CHROMOSOME TRANSLOCATIONS IN WHEAT (*TRITICUM AESTIVUM* L.) OF THE CV. GRANA[1]

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Summary. The paper concerns identification of reciprocal translocations in several wheat varieties as compared to cv. Grana. The cv. Grana differs from the cv. Chinese Spring and Sava by a single translocation. The cv. Bezostaja 1 and Grana, as well as Sava and Cappelle-Desprez are heterozygous with regard to two translocations. The cv. Grana differs from Cappelle-Desprez by three translocations.

The common wheat, *Triticum aestivum* L., is an allohexaploid, however, cytologically it behaves like a diploid species and forms 21 bivalents at meiosis. Riley (1958, 1960) found that bivalent conjugation is controlled by a gene localized on the chromosome 5*B*. The presence of multivalents at meiosis in wheat is related either to a damage of the mechanism controlling homologous conjugation or to the presence of reciprocal translocations.

Wheat cultivars differ from one to another by reciprocal translocations. Intervarietal hybrids may be heterozygous with regard to translocations and form multivalents in meiosis (Sears 1953, Baker and Mc Intosh 1966, Riley 1967, Law 1971, Petrovic 1972, Zeller 1973, Otłowska-Miazga 1974, Vega and Lacadena 1982, 1983).

The purpose of the present paper was to identify reciprocal translocations in several wheat varieties in comparison with Grana.

MATERIAL AND METHODS

For cytological studies five wheat varieties, Bezostaja 1, Cappelle-Desprez, Chinese Spring, Grana and Sava, were used. Monosomity was introduced into these varieties, except Chinese Spring, under the European Program of Aneuploids EWAC (Law 1971).

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For a comparison of the genetic structure the varieties were intercrossed. Prior to heading, the spikes from five varieties and their hybrids were taken for the studies of meioses. The spikes were fixed in Carnoy's solution and smear preparations were done. Reciprocal translocations in intervarietal hybrids were determined on the basis of the number of multivalents at metaphase I of meiosis.

RESULTS

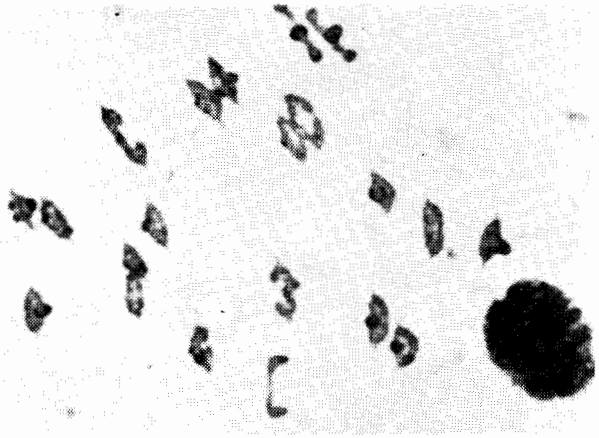
The cv. Bezostaja 1 had 0.28 univalents and 20.86 bivalents per cell. A single cell had on the average 42.6 chiazmata. In the cv. Cappelle-Desprez the number of univalents was smaller, 0.06. There were on average 44.3 chiazmata per pollen mother cell (Table 1). Cytological analyses showed that the cv. Chinese Spring had on the average 0.12 univalents and 20.94 bivalents per PMC. No univalents were observed in 40 analysed cells of the cv. Grana. A single cell contained on average 44.4 chiazmata. A similar chiazma frequency was calculated in the cv. Sava (Table 1).

Table 1. Chromosome associations per cell at metaphase I in wheat cultivars and hybrid forms

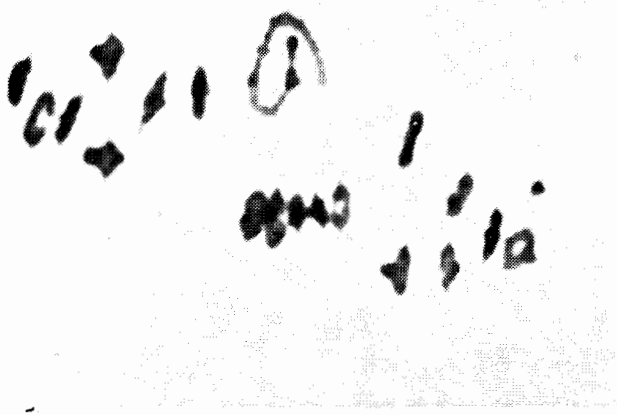
Cultivars and hybrid forms	PMC No.	Univalents	Bivalents			Trivalents	Quadrivalents	Other configurations	Chiazmata	Translocations (maximum)
			ring	rod	totally					
Bezostaja 1	27	0.28	1.57	19.29	20.86				42.6	
Cappelle-Desprez	30	0.06	0.87	20.10	20.97				44.3	
Chinese Spring	30	0.12	2.17	18.77	20.94				42.6	
Grana	40	0.00	0.70	20.30	21.00				44.4	
Sava	30	0.10	1.80	19.15	20.95				44.8	
Chinese Sp. × Grana	20	0.30	1.95	17.40	19.35	–	0.75		42.2	1
Bezostaja × Grana	68	0.19	2.09	17.12	19.21	0.06	0.84		41.7	2
Sava × Cappelle-Desprez	66	0.53	1.47	17.67	19.14	0.07	0.74		42.2	2
Cappelle-Desprez × Grana	75	0.15	2.32	16.39	18.71	0.08	0.37	0.01^{V} 0.44^{VI}	41.2	3
Sava × Grana	52	0.17	2.19	16.83	19.02	0.00	0.80	–	41.9	1

Hybrids of Chinese Spring × Grana at metaphase I of meiosis were observed to have univalents, bivalents and a single quadrivalent (Phot. 1). A single quadrivalent was also identified in the combination Grana × Sava. This indicates that the cv. Grana differs from Chinese Spring and Sava by one translocation with a similar frequency. The average number of quadrivalents per cell was similar in the both combinations (Table 1). In the combination Bezostaja 1 × Grana, beside univalents and bivalents at metaphase I, two multivalents were observed (Phot. 2). There were, on average 41.7 chiazmata per cell. The presence of two multivalents proves that Grana and Bezostaja differ by two translocations (Fig. 1). The frequency of one translocation is large (0.84 quadrivalents), whereas that of the second one is small (0.06 trivalents). Two multivalents were also observed in the hybrids of Sava × Cappelle-Desprez. There were on average 0.07 trivalents

Phot. 1. A hybrid of Chinese Spring × Grana, 19 bivalents and 1 quadrivalent



Phot. 2. A hybrid of Bezostaja 1 × Grana, 17 bivalents and 2 quadrivalents



Phot. 3. A hybrid of Cappelle-Desprez × Grana, 18 bivalents and 1 hexavalent

and 0.74 quadrivalents per cell (Table 1). The frequency of two translocations was similar to that in the combination Bezostaja × Grana. The average number of chiazmata per cell in these combinations was similar.

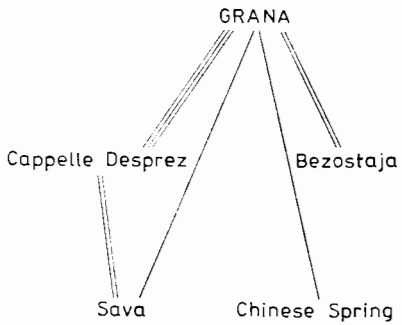


Fig. 1. The number of translocations differing Grana from other cultivars

In the combination Cappelle-Desprez × Grana a single cell had on average 0.15 univalents, 18.71 bivalents, 0.08 trivalents, 0.37 quadrivalents, 0.01 pentavalents and 0.44 hexavalents. A single cell had on average 41.2 chiazmata. The presence of hexavalent indicates that the cv. Cappelle-Desprez and Grana differ by three translocations (Fig. 1 and Phot. 3).

DISCUSSION

Results of the studies show that Grana differ from the varieties analysed in this paper by a single, two and even three translocations.

Riley et al. (1967) reported that the cv. Chinese Spring has a primitive genetic structure and for that reason is treated as a control in translocation identification. The cv. Grana differs from Chinese Spring by a single translocation. A hexavalent identified in the combination Grana × Cappelle-Desprez indicates that these varieties are heterozygous in respect of three translocations. From the studies by Riley and Chapman (1977), supported by Petrovic (1972), it follows that the cv. Cappelle-Desprez differ from Chinese Spring by two translocations covering the chromosomes *5B-7B*, *3B-3D*. The cv. Cappelle-Desprez is a progeny of the cross Vilmorin 27 × Hybride du Jonquois. Law (1971) reports that the same chromosomes are involved in translocations in Cappelle-Desprez and its parents.

From the performed studies it follows that Grana differs from cv. Bezostaja by two translocations. According to Petrovic (1972) the cv. Chinese Spring and Bezostaja are heterozygous with regard to a single translocation.

While introducing monosomity into a definite variety translocations constitute a large difficulty (Law 1971). If varieties, being a donor and recipient of monosomity,

do not differ by translocations, the hybrid is not observed to have multivalents. By crossing aneuploid lines of Chinese Spring with a given variety it may be determined, which chromosomes are covered by reciprocal translocations. From the latest reports it follows that chromosomes from the B genome are translocated most frequently (Vega 1983). In view of the fact that chromosomes of the *B* genome are relatively frequently covered by translocations, their initial structure was changed. Probably for that reason, despite many attempts, the donor of the *B* genome could not be identified (Kimber 1983). The *A* genome in hexaploid wheat is recombined to a smaller degree. In the *A* genome, chromosome 4 does not conjugate with any of the chromosomes of the diploid wheat *T. boeoticum* (Miller et al. 1981). According to Vega and Lacadena (1983) mostly chromosome 4 is translocated from the genome *A*.

Translocations take place mostly between nonhomologous chromosomes. Only one out of the so-far identified translocations involves homologous chromosomes (Vega and Lacadena 1983), which indicates that crossing-over within homologous chromosomes had no significant influence on the presence of translocation.

CONCLUSIONS

1. The cv. Grana differs from Chinese Spring and Sava by a single translocation.
2. The cultivars Bezostaja 1 and Grana, as well as Sava and Cappelle-Desprez are heterozygous with respect to two translocations.
3. The cv. Grana differs from Cappelle-Desprez by three translocations.

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CHROMOSOMOWE TRANSLOKACJE U PSZENICY (*TRITICUM AESTIVUM* L.) ODMIANY GRANA

Streszczenie

Praca dotyczy identyfikacji wzajemnych translokacji u kilku odmian pszenicy w porównaniu z odmianą Grana. Odmiana Grana różni się od Chinese Spring i Savy jedną translokacją. Odmiany Bezostaja 1 i Grana oraz Sava i Cappelle-Desprez są heterozygotyczne pod względem dwóch translokacji. Odmiana Grana różni się od Cappelle-Desprez trzema translokacjami.

ХРОМОСОМНЫЕ ПЕРЕМЕЩЕНИЯ У ПШЕНИЦЫ (*TRITICUM AESTIVUM* L.) СОРТА ГРАНА

Резюме

Работа касается идентификации взаимных перемещений у нескольких сортов пшеницы в сопоставлении с Граной. Сорт Грана отличается от Чайниз Спринг и Савы одним перемещением. Сорта Безостая I и Грана, а также Сава и Капель Депре гетерозиготные в отношении двух перемещений. Сорт Грана отличается от Капель Депре тремя перемещениями.