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ANEUPLOIDY AND THE ORIGIN OF OFF-TYPES IN SEMIDWARF WHEAT CULTIVARS

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ABSTRACT

The frequency of off-type plants observed among 111111; 136363 and 120000 plants in breeder seed plots of cvs Sonalika, IWP 722 and PBW 154 varied from 0.010 to 0.018%. Cytological analysis of 12 off-type progenies of each cultivar revealed that 50.0, 58.3 and 83.3% of progenies, respectively for cvs Sonalika, IWP 72 and PBW 154 were aneuploids. Thus aneuploidy contributed to 0.009, 0.006 and 0.008% of off-type plants.

Key words: Semidwarf wheats, off-types, aneuploidy.

Genetic purity is the first consideration in seed certification programmes and only a very low frequency of off-type plants is permissible in seed multiplication plots. However, despite the best efforts made by the growers of certified seed new varieties soon get contaminated with off-types beyond the acceptable limits. The occurrence of such off-type plants has been attributed to mechanical mixtures, outcrossing, mutation(s), development variations, and volunteer plants, etc. [1]. However, sometimes these traditional factors fail to explain all the observed phenotypic variations. Obviously, some factor(s) other than those mentioned above appear to account for the occurrence of off-type plants.

Reduced plant height in commercial wheats is primarily due to two genes, Rht_1 and Rht_2 from Norin 10. Apart from acting as strong height suppressor, these genes are known to promote chromosomal instability [2, 3] resulting in a high frequency of tall off- types [4].

In the present communication the role of aneuploidy in the origin of phenotypic variation in three semidwarf wheat cultivars, viz., Sonalika, IWP 72, and PBW 154 is discussed.

MATERIALS AND METHODS

Breeder seed plots of three semidwarf wheat cultivars, viz., Sonalika, IWP 72 and PBW 154 were monitored throughout the growing season during rabi 1989-90, and off-type plants

Table 1. Number of families with aneuploidy and aneuploid types corresponding to off-type plants in breeder seed plots of semidwarf wheat varieties

Variety	Total plants	Off-type plants total (%)	No. of families analysed			No. of families with off-type and aneuploids		Frequency of aneuploids (%)		
			total	with aneuploids	without aneuploids	primary	secondary	primary	secondary	total
Sonalika	1,11,111	20 (0.018)	12	6	6	5	1	41.6	8.3	50.0
IWP 72	1,36,363	15 (0.011)	12	7	5	5	2	41.6	16.6	58.3
PBW 154	1,20,000	12 (0.010)	12	10	2	5	5	41.6	41.6	83.3

deviating from the parent variety in plant height, flowering range, ear and grain characteristics, etc. of each cultivar were tagged and harvested individually at maturity. In the following season progeny rows of the 12 selected off-type plants were grown in the field and at flowering stage, immature spikes of 5 randomly selected plants/progeny row were fixed in 1:3 acetic acid–ethanol and acetocarmine smears of anthers were prepared for meiotic studies.

RESULTS AND DISCUSSION

Out of the 12 families of the off-type plants analysed for each variety 6-10 families showed the presence of aneuploidy (Table 1). Though the frequencies of primary aneuploids (monosomics) among the three cultivars were comparable, the secondary aneuploids (nullisomics, monotelosomics, etc.) were more frequent in PBW 154 than those found in Sonalika (8.3%) and IWP 72 (16.6%). A distinctly higher number of progenies showing the presence of secondary aneuploids (mainly nullisomics) suggests that off-type plants isolated from PBW 154 seed plot had higher proportion of mono-iso- and monotelosomics than those sampled from Sonalika and IWP 72 seed plots [5]. The observed variation in frequency of aneuploidy (primary plus secondary) agrees with the findings of other workers [6, 7] and could be due to: (1) chance errors in selecting off-type plants, (2) small sample sizes, and (3) varietal differences.

Since all the three test cultivars are derived from Norin-10 which is known for its cytological instability, occurrence of off-type plants in them can be explained due to aneuploidy. An association between semidwarfism and aneuploidy has also been reported by Suarez and Favret [4].

According to Worland and Law [8] reciprocal translocations induce instability at meiosis which ultimately leads to the production of monosomics and nullisomics. The findings of the present investigation suggest that aneuploidy in conjunction with traditional factors can explain the origin of phenotypic variation in commercial wheats.

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