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Peroxidase Diversity in Hexaploid Wheat *Triticum aestivum* (L.) Thell.

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Abstract

Seven hexaploid wheat *Triticum aestivum* (L.) Thell. varieties and six F_1-lines constituted the experimental materials for estimating the peroxidase diversity. The similarity matrix was constructed with Jaccard's coefficient and dendogram was generated with UPGMA using NTSYSPC version 2.01 software. The differential banding pattern of the F_1s from their parents may be attributed to resufling of genes. Peroxidase polymorphism among wheat varieties represented by their variation in band numbers indicated genotypic variation. Both genetic closeness and distinctness in the molecular level were evident from the results of commonness and distinctness in respect of band numbers and Rm values. Differences in band intensity and band width indicated intervarietal differences in peroxidase activity. The stress tolerant variety C-306 had higher peroxidase activity as compared to other varieties, suggesting that this isozyme synthesis might have taken place as a measure of defensive response to water stress.
Key words : Peroxidase, Banding pattern, Diversity, Wheat.

Isoenzymes provide useful evidences in the study of variation between cultivars in terms of intensity of common bands and presence or absences of other bands (1). Genetically the production of isoenzyme of multiple forms or molecular weight is accounted to the allelic variation of the organism. Therefore, isoenzymes of a particular molecular weight can be considered as a direct manifestation of the blue print of the specific gene loci (2). The utility of isoenzymes as genetic marker (3) is generally attributed to their polymorphism, codominence, simple inheritance, simple assay and obliquity in plant tissues or organ (4). Moreover, isoenzymes study may be useful to diversity analysis in plants (5). SDS-PAGE method was found to be useful for studying the peroxidase isoenzymes in wheat (6, 7).

Methods

Seven hexaploid wheat varieties like K-8027 (V-1), HD-2865 (V-2), DBW-14 (V-3), WUW-234 (V-4), C-306 (V-5), NW-2036 (V-6) and WH-775 (V-7); and six F_1s like C-2 (V-4 × V-3), C-3 (V-4 and V-2), C-5 (V-1 × V-2), C-8 (V-1 × V-4), C-10 (V-6 × V-1) and C-12 (V-5 × V-2) constituted the experimental materials.

To record the electrophoregram of peroxidase the method followed was that of Kehlar and Allard (8). Based on polyacrylamide gel, bands were scored as present (1) and absent (0) in data sheet to form a [1, 0] matrix. Then data were analyzed and similarity matrix was constructed from binary data with Jaccard's coefficient (9) and dendrogram were generated with unweighted pair group method arithmetic average (UPGMA) algorithm using NTSYSPC-version 2.01 software (10).

Results and Discussion

The Rm values ranged from 0.16 to 0.64. All bands were found to be polymorphic in nature except band 1 which was present in all varieties and F_1s but in C-12 it was less intense. Out of seven varieties band three was absent only in V-6 in which band 4 was only present. One more important observation was that the band, which was found in both the parents, was missing in respective F_1s e.g. band 2, 3 and 5 as in C-8. The differential banding pattern of the F_1s from their parents is not at all unexpected. This kind of variation might be due to the result of recombination leading to reshuffling of genes.

Clustering. All the experimental materials could be grouped into as much as five clusters based on

Table 1. Peroxidase banding profile of some wheat varieties along with some selected crosses. Figure in parenthesis indicates total number of band in respective case. +, lightly intense; ++, moderately intense; +++, highly intense band, and –, absence of the band.

Var/F_1s	Total band	Band 1 (0.16)	Band 2 (0.31)	Band 3 (0.40)	Band 4 (0.46)	Band 5 (0.50)	Band 6 (0.53)	Band 7 (0.64)
V2	4	+++	–	+++	–	–	+++	+++
V3	4	+++	–	+++	–	–	+++	+++
C3 (V4 × V2)	4	+++	–	+++	–	–	+++	+++
V4	4	+++	+	+	–	+++	–	–
C2 (V4 × V3)	4	+++	+++	+++	–	+++	–	–
V1	4	+++	+++	++	–	+++	–	–
C5 (V1 × V2)	4	+++	–	+++	–	+++	–	+++
V7	4	+++	–	+	–	++	–	+
C12 (V5 × V2)	4	+	–	+	–	++	–	+
V5	4	+++	–	++	–	+++	–	++
C10 (V6 × V1)	4	+++	–	–	+	–	–	+
V6	2	+++	–	–	+	–	++	–
C8 (V1 × V4)	3	+++	–	–	+++	–	–	+

less than 50% Jaccard's similarity coefficient. V-6 was only component of a distinct cluster. C-8 and C-10; V-4, C-2 and V-1; C-5, V-5, C-12 and V-7 and V-2, V-3 and C-3 were the four different distinct clusters (Fig. 1). It was also found that in each cluster, except the cluster having V-6 as sole member; the members were 100% similar to each other. Besides, the similarity coefficient ranged from 0.17 to 0.60 in all other combinations (Table 1). It was cleared that in respect of peroxidase banding profile, the crosses were mostly similar with one of its parent but in some cases showed similarity with other genotypes. The crosses where the effect of both the parents could not be significantly exhibited in respect of peroxidase banding profile as in C-10, C-8 and C-5 (Table 1) might be as a result of recombination leading to the formation of bands with different molecular weights.

The genotypic variation in respect of band numbers indicated differences among the genotypes. Similar type of peroxidase polymorphism among some rice varieties was observed by Khandelwal et al. (11). This finding also corroborates the previous findings of Roy et al. (12) in grass pea, Philomina and Surendran (5) in neem and Abideen and Vijayakumar (2) in *Acasia* species. Commonness in band numbers and Rm values found in the present experiment indicated their genetic closeness, whereas band number and their relative mobility values when found to be different in two genotypes, indicated their genetic distinctness in the molecular level. Difference in band intensity and band width indicated differences in peroxidase activities. Peroxidase activity is increased in plant tis-

Table 2. Jaccard's similarity coefficient for peroxidase banding profile.

Genotypes	V2	V3	C3	V4	C2	V1	C5	V7	C12	V5	C10	V6
V3	1.00											
C3	1.00	1.00										
V4	0.33	0.33	0.33									
C2	0.33	0.33	0.33	1.00								
V1	0.33	0.33	0.33	1.00	1.00							
C5	0.60	0.60	0.60	0.60	0.60	0.60						
V7	0.60	0.60	0.60	0.60	0.60	0.60	1.00					
C12	0.60	0.60	0.60	0.60	0.60	0.60	1.00	1.00				
V5	0.60	0.60	0.60	0.60	0.60	0.60	1.00	1.00	1.00			
C10	0.40	0.40	0.40	0.17	0.17	0.17	0.40	0.40	0.40	0.40		
V6	0.40	0.40	0.40	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.50	
C8	0.40	0.40	0.40	0.17	0.17	0.17	0.40	0.40	0.40	0.40	1.00	0.50

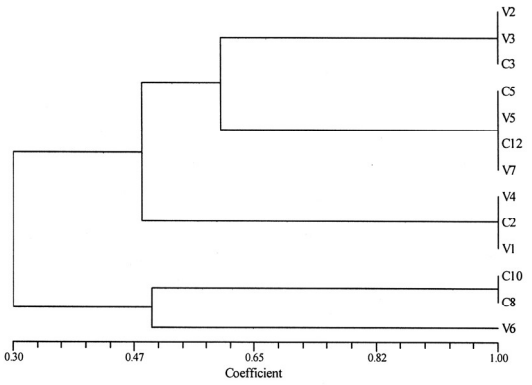

Figure 1. Dendrogram based on peroxidase banding profile.

sues as defensive response to water stress (13). As there is a significant correlation between roor characteristics and water stress condition, the information gathered from peroxidase diversity may help in breeding of wheat varieties with higher peroxidase activity. V-5 (C-306) is a wheat variety generally used as a check for rainfed wheat cultivation (14). As it is a stress tolerant variety, it is expected that peroxidase activity will increase (15). Varietal differences in peroxidase enzyme in rice seedlings grown under stress condition were observed by Pushpam and Rangaswamy (16).

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