

Short Communication

Department of Plant Breeding (IvP), Agricultural University, Wageningen (The Netherlands),
Laboratory of Plant Biochemistry; Institute of Plant Science, Katholieke Universiteit, Leuven
(Belgium)

Variation in Relative Amounts of Isolectins in Bread Wheat (*Triticum aestivum*) Landraces from Northern Nigeria and Chad

A. C. ZEVEN and W. J. PEUMANS

With one table

Received April 14, 1986 / Accepted October 17, 1986

Abstract

Wheat germ agglutinin (WGA) present in the embryo of a bread wheat grain is a mixture of three isolectins, viz CL_A, CL_B and CL_D which are coded by genes located on the chromosomes 1A, 1B and 1D. Their respective absolute amounts were determined in 62 Nigerian and five Chad landraces. Added was the Madagascar variety 'Kanem' which is stated to be selected from Chad material. Some of the Nigerian landraces were formerly identified as derived from Indian/Pakistani wheat varieties/landraces introduced into Northern Nigeria before 1940. These had relatively high CL_D/CL_A and CL_B/CL_A ratios. Other Nigerian landraces with such high ratios were postulated to come from India/Pakistan, too.

The Chad wheats, except 'Kanem', have WGA amounts and ratios similar to those native to Northern Nigeria. This may point to a common history. 'Kanem' is said to be bred in Madagascar from Chad wheats. Apparently it has a different origin.

So the determination of the WGA amount and its isolectin composition is a helpful means to identify the history of a landrace or of an improved variety.

Key words: *Triticum aestivum* — wheat landraces — evolution — cereal lectin — isolectin

Cereal lectins are a class of closely related proteins occurring in embryos of all species belonging to the Triticeae tribe of the Gramineae (STINISSEN et al. 1983 a).

Studies with allopolyploid cereals such as tetraploid and hexaploid wheats and hexaploid

triticale demonstrated that in the embryo cells of these species each individual genome directs the synthesis of its own specific lectin. As a result, these polyploids usually contain two or three molecular forms of cereal lectins (CL) which are designated as 'isolectins' (PEUMANS et al. 1982 a). In the case of hexaploid wheat, it is well established now that genes for CL_A, CL_B and CL_D are located on the homoeologous chromosomes 1A, 1B and 1D respectively (STINISSEN et al. 1983 b). With respect to the relative amounts of the three isolectins, however, bread wheat varieties exhibit pronounced inter-variety differences (PEUMANS et al. 1982 a). Since wheat isolectins have been conserved fairly well during the evolution of the genus *Triticum* (and related genera), and can easily be separated and quantified, isolectin pattern analyses are of great potential use for comparative genetic studies of collections of bread wheat varieties. In this report we describe the variation of the relative amounts of the three cereal lectins in embryos of bread wheat landraces from Northern Nigeria and Chad.

In 1968 the senior author received from the Zaria Agricultural Research Station, Samaru, a collection of seeds of 62 landraces of bread wheat from various parts of Northern Nigeria (Table 1). A description of this material is presented by ZEVEN (1974). The collection was multiplied at Wageningen when necessary.

We also received eight seed samples of bread wheat landraces from Chad to compare the results with those from Northern Nigeria. Except for 'Kanem', which came from IRAT, Tananarive, Madagascar, the Chad landraces were collected in Chad by A. Dobos, Station de Matafo near Bol. 'Kanem' was selected from 9 lines sent from Chad to Madagascar (FRITZ 1953).

Our investigation does not deal with the within-variation of a landrace, but with the variation between landraces. It should be remembered that most existing landraces are of more than one genotype, as was observed for the hairy/hairless chaff character (ZEVEN 1974). Lectin was isolated from 50 wheat embryos by affinity chromatography on immobilized N-acetylglucosamine (Selectin 1 from Pierce Chemical Company, Rockford, Ill. USA) as described previously (PEUMANS et al. 1982b), except that the lectin was desorbed with 1 ml of formiate buffer (50 mM formiate-NaOH pH 4.0) containing 0.1 M N-acetylglucosamine.

Separation of the cereal lectins was achieved by ion-exchange chromatography on a Pharmacia Fast Protein Liquid Chromatography (FPLC) system (Type GP-250) equipped with a Mono S (Type HR 5/5) cation-exchanger column. Lectin samples were loaded on the column equilibrated with formiate buffer. After washing the column with 4 ml of formiate buffer, lectins were eluted with a linear gradient (20 ml) of increasing NaCl concentration (0—0.4 M) at a flow rate of 2 ml/min. The position of the lectins was followed by monitoring the A_{280} of the eluate. To quantify the absolute amounts of each of the three isolectins, the UV monitor of the FPLC system was connected to a Hewlett-Packard Integrator (Model 3385A). The apparatus was standardized with known amounts of WGA.

ZEVEN (1974) postulated that the white-grained varieties like 'Daura Wit 14', 'Katsina Wit 07' and 'Wurno Wit 19' originated from wheat introduction from India/Pakistan in the years before 1940.

These Indian/Pakistani samples may have been improved varieties; if so, their level of improvement must have been quite low at that time. Hence, they may have resembled a landrace, or, after introduction into Northern Nigeria, they may have developed into a landrace-like variety. When studying the amounts of cereal lectins for these three varieties, we observed that they scored relatively high for both CL_B and CL_D . This may indicate that Indian bread wheat varieties contain higher amounts of CL_B and CL_D in relation to CL_A (or lower of CL_A in regard to CL_B and CL_D) than the Nigerian varieties. When studying

Table 1. The absolute amounts of CL_A , CL_B and CL_D (ng/embryo) of Nigerian and Chad wheat landraces

Landrace	Abs. amount		
	CL_A	CL_D	CL_B
Nigeria			
Daura 1	103.7	219.6	100.4
Daura Wit 14	12.4	60.6	23.1
Dikwa 01	94.0	145.6	103.4
Dikwa 02	106.3	156.0	88.2
Dikwa 03	98.0	89.5	48.6
Dikwa 04	42.2	111.4	69.7
Dikwa 05	187.4	25.8	146.2
Dikwa 06	63.9	105.0	57.8
Dikwa 07	78.9	132.8	66.1
Dikwa 08	82.1	142.2	81.1
Dikwa 09	44.4	82.0	36.8
Dikwa 10	110.6	181.7	89.3
Dikwa 11	87.5	127.6	102.3
Dikwa 12	132.1	168.9	87.9
Dikwa 13	123.5	180.6	96.8
Dikwa 14	79.4	137.9	57.4
Dikwa 15	244.4	263.4	137.7
Dikwa 16	63.2	215.3	109.6
Dikwa 17	55.3	90.6	41.9
Dikwa 18	156.3	166.5	84.2
Dikwa 19	92.5	102.1	57.0
Dikwa 20	88.9	153.0	95.1
Dikwa 21	114.2	154.6	64.4
Dikwa 22	184.9	27.9	142.7
Dikwa 23	133.5	191.6	93.2
Dikwa 25	71.0	105.7	51.1
Dikwa 26	51.5	57.3	34.6
Dikwa 27	99.1	160.8	75.9
Dikwa 31	103.8	139.7	64.1
Dikwa 32	94.7	139.3	82.4
Dikwa 33	50.5	82.4	36.1
Dikwa 34	47.2	133.9	89.0
Dikwa 35	42.8	90.7	49.5
Dikwa 36	118.1	192.0	94.9
Dikwa 37	49.6	103.2	51.8
Dikwa 38	36.0	70.8	36.4
Dikwa 39	61.4	112.9	57.4
Dikwa 40	67.2	117.5	56.0
Dikwa 41	75.5	88.8	43.6
Dikwa 42	230.7	323.8	175.8

Table 1. Continued

Landrace	Abs. amount		
	CL _A	CL _D	CL _B
Dikwa 43	53.7	81.8	39.0
Dikwa 44	72.8	117.0	64.9
Dikwa 45	54.0	116.3	60.6
Dikwa 46	53.0	94.1	46.5
Hadejia 04	132.9	245.6	120.7
Katsina 02	129.8	233.8	97.6
Katsina 09	66.0	172.5	69.1
Katsina 13	209.4	347.6	206.7
Katsina Wit 07	102.8	303.8	157.7
Nigeria 01	203.4	368.2	147.4
Nigeria 02	214.2	310.0	142.8
Wurno 05	234.9	342.2	175.0
Wurno 07	185.6	308.7	142.8
Wurno 11	173.4	278.5	140.9
Wurno 14	29.1	107.9	49.1
Wurno 18	85.7	153.3	62.2
Wurno 21	46.4	112.4	59.0
Wurno 22	135.1	202.2	91.9
Wurno 23	83.6	172.7	69.0
Wurno Wit 19	153.8	371.3	156.2
Zaria 01	196.9	257.8	131.9
Zaria 02	190.0	288.0	173.1
Chad			
Bol 11	171.0	259.3	124.9
Bol 12	106.6	182.4	76.5
Bol 13	227.3	305.1	163.2
Bol 14	191.1	246.9	118.2
Bol 19	120.5	180.6	97.0
Kanem	81.4	235.8	100.7

Table 1 for other accessions with relative high amount of CL_B and CL_D we observed the accessions 'Dikwa 04', 'Dikwa 34', 'Katsina 09', 'Wurno 14' and 'Wurno 21'. 'Wurno 14' carried the gene Ne1w for hybrid necrosis, which also is not native to Nigeria; it occurs frequently in bread wheat landraces from India (ZEVEN 1980). Hence, we may conclude that 'Wurno 14' also has an Indian origin. Furthermore, we may extrapolate that 'Dikwa 04', 'Dikwa 34', 'Katsina 07' and 'Wurno 21' also have an Indian/Pakistani origin.

The results of the Chad wheats (Table 1), with one exception, fall within the range found

for the Nigerian wheats. This was expected as the Chad wheats and the Nigerian wheats have a common origin (ZEVEN 1980). The exception is 'Kanem'. The other Chad wheat accession reached us directly from Chad, but 'Kanem' was sent from Madagascar, where it had been introduced in 1949 (FRITZ 1953). This "detour" may have led to errors and the 'Kanem' accession which came from Madagascar may have differed from the 'Kanem' accession previously sent to that country. This assumption is supported by 'Kanem's' data for relative amounts of cereal lectins.

The relative amounts of cereal lectin in the Nigerian and Chad wheats fall within a range covered by a normal distribution, while those with a high relative amount of CL_B and CL_D (or a low relative amount of CL_A) probably came from India/Pakistan.

Zusammenfassung

Variation der relativen Gehalte an Isolectinen in Landsorten von Brotweizen (*Triticum aestivum*) aus Nordnigeria und aus dem Tschad

Die relativen Gehalte an Getreide-Lectinen in Weizen-Landsorten aus Nigeria und aus dem Tschad liegen innerhalb des Bereichs einer normalen Verteilung. Diejenigen der untersuchten Landsorten, die einen hohen relativen Gehalt an CL_B und CL_D (oder einen niedrigen relativen Gehalt an CL_A) aufwiesen, stammen ursprünglich wahrscheinlich aus Indien bzw. Pakistan.

This work is supported in part by grants of the National Fund for Scientific Research (Belgium). W.P. is Research Associate of this fund.

References

- FRITZ, J., 1953: Amélioration des plantes. G. Le blé. C. R. Rech. agron. de Madagascar no. 2, 114—116.
- PEUMANS, W. J., H. M. STINISSEN, and A. R. CARLIER, 1982a: A genetic base for the origin of six different isolectins in hexaploid wheat. *Planta* 154, 562—567.
- , —, and —, 1982b: Lectin synthesis in developing and germinating wheat and rye embryos. *Planta* 156, 41—44.

- STINISSEN, H. M., W. J. PEUMANS, and A. R. CARLIER, 1983 a: Occurrence and immunological relationships of lectins in gramineous species. *Planta* **159**, 105—111.
- , —, C. N. LAW, and P. I. PAYNE, 1983 b: Control of lectins in *Triticum aestivum* and *Aegilops umbellulata* by homeologous group 1 chromosomes. *Theor. Appl. Genet.* **67**, 53—58.
- ZEVEN, A. C., 1974: Indigenous bread wheat varieties from Northern Nigeria. *Acta Bot. Neerl.* **23**, 137—144.
- , 1980: The spread of bread wheat over the old world since the Neolithicum as indicated by its genotype for hybrid necrosis. *JATBA* **27**, 19—53.

Authors' addresses: Dr. A. C. ZEVEN, Department of Plant Breeding (IvP), Agricultural University, P.O. Box 386, 6700 AJ Wageningen (The Netherlands); Dr. W. J. PEUMANS, Laboratory of Plant Biochemistry, Institute of Plant Science, Katholieke Universiteit, Kardinaal Mercierlaan 92, B-3030 Leuven (Belgium).