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WHEAT SEMINAR**



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

THE INTERNATIONAL WINTER WHEAT PERFORMANCE NURSERY¹⁾

by

V.A. Johnson, J.E. Stroikey, J.W. Schmidt, and P.J. Mattern

(Presented by V.A. Johnson)

The International Winter Wheat Performance Nursery (IWWPN) was initiated as a part of a co-operative wheat protein research programme at Lincoln, Nebraska, involving the University of Nebraska, Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Agency for International Development, U.S. Department of State. We have had excellent informal co-operation from the International Maize and Wheat Improvement Centre, Mexico, D.F., and FAO, Rome. The IWWPN was patterned after an International Spring Wheat Yield Nursery established in 1960 by the Rockefeller Foundation.

Objectives of the IWWPN nursery are to:

1. Study the general adaptation characteristics of currently important winter wheat cultivars
2. Identify superior winter wheat genotypes
3. Assess the impact of production environment on phenotypic expression of genes for protein content and protein composition in winter wheat.

The first IWWPN was grown in 1969 at 22 sites in 15 countries (Table 1). Seventeen more sites were added in 1970, bringing the total to 39 sites in 25 countries, as indicated in Table 2. The nursery size was arbitrarily fixed at 30 entries and four replications. Plots were comprised of six rows for which 180 viable seeds per row were provided.

Cultivars included in the first IWWPN are listed in Table 3. The same cultivars were again grown in the second IWWPN. Many of the European entries are old cultivars that are no longer grown extensively. However, they are representative of the wheat types that have become established in Europe and, initially, will provide useful information. They eventually will be replaced in the nursery by modern European cultivars.

Co-operators provide seed of each candidate cultivar in the amount of one kilogramme. From this, a seed increase is produced under quarantine at Yuma, Arizona (Figure 1). The increase provides seed of the cultivar in the quantity needed for nursery inclusion as well as satisfying United States quarantine regulations. Yuma (33° latitude) is near the

1) Co-operative investigation of the Nebraska Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture.

Table 1

FIRST IWWPN SITES - 1969

Nebraska, U.S.A.	Ankara, Turkey
California, U.S.A.	Eskisehir, Turkey
No. Carolina, U.S.A.	Karaj, Iran
Oklahoma, U.S.A.	Kermanshah, Iran
Svalof, Sweden	Sulaimaniya, Iraq
Versailles, France	Kabul, Afghanistan
Wageningen, Netherlands	Suwon, Korea
Rieti, Italy	Sapporo, Japan
Milano, Italy	Bordenave, Argentina
Fundulea, Romania	Pergamino, Argentina
Novi Sad, Yugoslavia	Temuco, Chile

Table 2

ADDITIONAL SITES, IWWPN - 1970

Colorado, U.S.A.	Zagreb, Yugoslavia
New York, U.S.A.	Vienna, Austria
Washington, U.S.A.	Martonvasar, Hungary
Cambridge, England	Tolbukin, Bulgaria
Einbeck, Germany	Mazur-i-Shariff, Afghanistan
Weihenstephan, Germany	Jammu State, India
Jokioinen, Finland	Kashmir State, India
Zurich, Switzerland	Southern Brazil
El Harrach, Algeria	

Table 3

CULTIVARS IN THE FIRST INTERNATIONAL
WINTER WHEAT PERFORMANCE NURSERY - 1969

Felix, Netherlands	Gaines (Washington, U.S.A.)
Heine VII (Germany)	Yorkstar (New York, U.S.A.) ¹⁾
Odin (Sweden)	Triumph 64 (Oklahoma, U.S.A.)
San Pastore (Italy)	Scout 66 (Nebraska, U.S.A.)
Cappell Desprez (France)	Parker (Kansas, U.S.A.)
Bezostala (U.S.S.R.)	Gage (Nebraska, U.S.A.)
Bankuti 1201 (Hungary)	Sturdy (Texas, U.S.A.)
Fertodi 293 (Hungary)	Shawnee (Kansas, U.S.A.)
Yung Kwang (Korea)	Lancer (Nebraska, U.S.A.)
Winalta (Canada)	Atlas 66 (No. Carolina, U.S.A.) ¹⁾
Blueboy (No. Carolina, U.S.A.)	Purdue 28-2-1 (Indiana, U.S.A.) ¹⁾
Benhur (Indiana, U.S.A.)	NB67730 (Nebraska, U.S.A.) ¹⁾
Riley 67 (Indiana, U.S.A.)	Arthur (Indiana, U.S.A.)
Timwin (Wisconsin, U.S.A.)	Lerma Rojo 64 (Mexico) ²⁾
Stadler (Missouri, U.S.A.)	Inia 66 (Mexico) ²⁾

1) Cultivar known to possess genes for high grain protein

2) Spring wheat

southermost limit of winter wheat production in the northern hemisphere. Strongly photo-period sensitive cultivars from northern Europe may not produce seed at Yuma. Such cultivars cannot be included in the nursery.

New cultivars that have been increased in Arizona and which will be included in the third IWFPN in 1971 are shown in Table 4. Candidate cultivars for the fourth IWFPN (1972) scheduled for increase at Yuma in 1970/71 appear in Table 5. The number exceeds that which can be accommodated in the fourth nursery.

Table 4

WINTER WHEAT CULTIVARS TO BE INCLUDED IN THE THIRD IWFPN - 1971

Baaka (Yugoslavia)	NB66425 (Nebraska, U.S.A.)
Red Star (Yugoslavia)	NB68513 (Nebraska, U.S.A.)
Sava (Yugoslavia)	TX62A4793-7 (Texas, U.S.A.)
Strampelli (Italy)	Winter Triticale (Nebraska, U.S.A.)
Starke (Sweden)	Vakka (Finland)
Hokuie (Japan)	Jyva (Finland)
Probstdorfer Extrem (Austria)	

1) Entered in third IWFPN under designation NS611

Table 5

CANDIDATE WINTER WHEAT CULTIVARS FOR THE FOURTH IWFPN - 1972

Cultivar	Origin	Cultivar	Origin
Mura	Yugoslavia	Lilifen	Chile
Zg 5994/66	Yugoslavia	Garifen 12	Chile
Clarion	Netherlands	Likafen	Chile
Manella	Netherlands	Caliafen	Chile
Maris Nimrod	England	Zenith	Switzerland
Jubilar	Germany	Marimp 3	Italy
Diplomat	Germany	Demar 4	Italy
Caribo	Germany	Victor I	Italy
Excelsior	Romania	Victor III	Italy
Moldova	Romania	Oscar I	Italy
Favrit	Romania	Oscar VI	Italy
Dacia	Romania	Yektay 406	Turkey
Rashid	Iran	Korac 66	Turkey
Nam Kwang	Korea	Bolal	Turkey
Kyung Kwang	Korea		

1969 Data

Bezostaia (U.S.S.R.) was the most productive among 30 cultivars from 10 countries evaluated in 1969. Its yield performance is compared with 27 other cultivars at 16 sites in Table 6. The yields of 23 cultivars at 19 sites appear in Table 7. The northern European cultivars Odin, Felix, and Cappell Desprez and the American cultivar Gaines were relatively non-productive over all nursery sites. Lerma Rojo 64, one of two spring wheat cultivars included in the nursery, survived the winter sufficiently at 15 sites to make a grain crop (Table 8).

Table 6

MEAN YIELDS IN QUINTALS/HECTARE OF 28 CULTIVARS GROWN IN THE FIRST INTERNATIONAL WINTER WHEAT PERFORMANCE NURSERY AT 16 SITES IN 1969¹⁾

Cultivar	Origin	\bar{x} yield (16 sites) q/ha	Cultivar	Origin	\bar{x} yield (16 sites) q/ha
Bezostaia	U.S.S.R.	45.2	Lancer	U.S.A.	36.6
Blueboy	U.S.A.	43.5	Shawnee	U.S.A.	36.5
San Pastore	Italy	41.1	Riley 67	U.S.A.	36.3
Sturdy	U.S.A.	40.5	Yorkstar	U.S.A.	35.8
Timwin	U.S.A.	39.9	Bankuti 1201	Hungary	35.6
Parker	U.S.A.	39.7	Triumph 64	U.S.A.	35.6
Fertodi 293	Hungary	39.3	NB67730	U.S.A.	34.8
Benhur	U.S.A.	38.5	Atlas 66	U.S.A.	33.4
Scout 66	U.S.A.	38.4	Purdue 28-2-1	U.S.A.	32.9
Yung Kwang	Korea	38.1	Winalta	Canada	32.2
Arthur	U.S.A.	38.1	Cappell Desprez	France	32.0
Gage	U.S.A.	37.1	Gaines	U.S.A.	30.7
Stadler	U.S.A.	36.9	Felix	Netherlands	29.6
Heine VII	Germany	36.7	Odin	Sweden	26.7

1) All sites except Pergamino, Argentina; Bordenave, Argentina; Versailles, France; Temaco, Chile; and Sapporo, Japan.

Table 7

MEAN YIELDS IN QUINTALS/HECTARE OF 23 CULTIVARS GROWN IN THE
FIRST INTERNATIONAL WINTER WHEAT PERFORMANCE NURSERY AT 19 SITES IN 1959.

Cultivar	Origin	\bar{x} yield (19 sites) q/ha	Cultivar	Origin	\bar{x} yield (19 sites) q/ha
Bezostaia	U.S.S.R.	43.0	Yorkstar	U.S.A.	34.0
Blueboy	U.S.A.	40.5	Gage	U.S.A.	33.8
Sturdy	U.S.A.	38.8	Yung Kwang	Korea	33.8
Timwin	U.S.A.	38.2	Triumph 64	U.S.A.	33.6
San Pastore	Italy	37.2	Lancer	U.S.A.	33.5
Benhur	U.S.A.	36.9	Shawnee	U.S.A.	33.2
Parker	U.S.A.	36.4	NB67730	U.S.A.	32.1
Fertodi 293	Hungary	36.3	Bankuti 1201	Hungary	32.0
Scout 66	U.S.A.	36.1	Winalta	Canada	31.2
Arthur	U.S.A.	35.8	Purdue 28-2-1	U.S.A.	30.5
Riley 67	U.S.A.	34.5	Gaines	U.S.A.	27.6
Stadler	U.S.A.	34.4			

Table 8

COMPARATIVE YIELDS OF LERMA ROJO 64 SPRING WHEAT (SEEDED IN THE FALL)
AND 9 WINTER CULTIVARS AT 15 SITES AT WHICH LERMA ROJO SURVIVED THE WINTER IN 1969²⁾

Cultivar	Origin	\bar{x} yield (15 sites) q/ha	Cultivar	Origin	\bar{x} yield (15 sites) q/ha
Bezostaia	U.S.S.R.	44.0	Scout 66	U.S.A.	38.4
Blueboy	U.S.A.	43.2	Lerma Rojo 64	Mexico	35.3
Sturdy	U.S.A.	41.4	NB67730	U.S.A.	34.2
San Pastore	Italy	40.7	Winalta	Canada	32.1
Timwin	U.S.A.	39.0	Gaines	U.S.A.	31.2

1) All sites except Pergamino, Argentina and Versailles, France.

2) Sites at which Lerma Rojo did not survive the winter: Suwon, Korea; Sapporo, Japan; Fundulea, Romania; and Stillwater, Oklahoma.

Differential winterkill occurred at 11 sites (Table 9).

Table 9

AVERAGE WINTER SURVIVAL OF 29 CULTIVARS IN THE FIRST IWWPN AT
11 SITES WHERE DIFFERENTIAL WINTERKILLING OCCURRED IN 1969

Cultivar	Winter Survival %	Cultivar	Winter Survival %
Bankuti 1201	94	Timwin	91
Scout 66	94	Riley 67	91
NB67730	93	Parker	91
Winalta	93	Yorkstar	91
Gage	93	Sturdy	91
Gaines	93	Arthur	90
Lancer	93	Purdue 28-2-1	90
Yung Kwang	92	Shawnee	90
Blueboy	92	Bezostaia	90
Triumph 64	92	Cappell Desprez	90
Odin	92	San Pastore	90
Benhur	92	Heine VII	89
Fertodi	92	Atlas 66	85
Felix	92	Lerma Rojo 64	51
Stadler	92		

San Pastore, Benhur, and Triumph 64 in that order were earliest maturing (Table 10). Straw lodging that averaged over 40 percent at 13 sites occurred among four tall-growing American cultivars, Winalta from Canada, and Bankuti 1201 from Hungary (Table 11). Lodging

Table 10

AVERAGE MATURITY (DAYS TO FLOWERING FROM 1 JANUARY) OF 28
CULTIVARS IN THE FIRST IWWPN AT 16 SITES IN 1969

Cultivar	Days to flowering (from 1 January)	Cultivar	Days to flowering (from 1 January)
San Pastore	135	Shawnee	142
Benhur	136	Fertodi 293	142
Triumph 64	136	Bankuti 1201	143
Sturdy	138	Gage	143
Arthur	139	Blueboy	143
Parker	139	Atlas 66	144
Stadler	139	Lancer	144
Scout 66	140	Winalta	146
Riley 67	140	Yorkstar	146
Yung Kwang	140	Gaines	148
Bezostaia	140	Heine VII	149
Purdue 28-2-1	140	Cappell Desprez	151
NB67730	141	Felix	153
Timwin	142	Odin	154

was least among the short-stawed cultivars from the United States and Europe. Degree of lodging was highly associated with the plant height of cultivars shown in Table 12.

Table 11

AVERAGE LODGING OF 29 CULTIVARS IN THE FIRST IWPN AT 13 SITES
WHERE DIFFERENTIAL LODGING OCCURRED IN 1969

Cultivar	Lodging (13 sites) %	Cultivar	Lodging (13 sites) %
Sturdy	7	Shawnee	26
Felix	10	Purdue 28-2-1	27
San Pastore	12	Stadler	29
Odin	13	Fertodi 293	31
Cappell Desprez	15	Riley 67	32
Blueboy	16	Yung Kwang	33
Gaines	16	Atlas 66	33
Heine VII	18	Gage	34
Parker	20 ¹⁾	Winalta	42
Bezostaia	20	Lancer	42
Benhur	21	Triumph 64	47
Lerma Rojo	64 ¹⁾	Bankuti 1201	47
Yorkstar	22	Scout 66	48
Arthur	24	NB67730	48
Timwin	25		
1) 11 sites only			

Table 12

AVERAGE PLANT HEIGHT OF 28 CULTIVARS GROWN IN THE FIRST IWPN
AT 17 SITES IN 1969

Cultivar	Plant height cm	Cultivar	Plant height cm
Gaines	76	Riley 67	107
Sturdy	83	Odin	107
Timwin	88	Triumph 64	108
Felix	93	Gage	109
Cappell Desprez	93	Stadler	111
San Pastore	96	Lancer	111
Blueboy	97	Scout 66	113
Heine VII	98	Shawnee	113
Bezostaia	98	Winalta	114
Arthur	101	Purdue 28-2-1	117
Parker	102	Fertodi 293	118
Yorkstar	103	Atlas 66	118
Benhur	103	NB67730	120
Yung Kwang	105	Bankuti 1201	125

The high protein cultivars Atlas 66, Purdue 28-2-1, and NB67730, were among the wheats tested in the first IWWPN in 1969. The mean protein content of their grain over 16 sites was 17.4, 16.5 and 16.4 percent, respectively (Table 13), which was substantially

Table 13
AVERAGE PROTEIN CONTENT FOR 28 CULTIVARS IN THE FIRST IWWPN
AT 16 SITES IN 1969

Cultivar	Grain yield ¹⁾ q/ha	Protein content %	Cultivar	Grain yield ¹⁾ q/ha	Protein content %
Atlas 66	33	17.4	Timwin	40	14.2
Purdue 28-2-1	33	16.5	Yung Kwang	38	14.2
NB67730	35	16.4	Riley 67	36	14.1
Cappell Desprez	32	16.1	Scout 66	38	14.0
Odin	27	15.7	Arthur	38	14.0
Felix	30	15.2	Lancer	37	13.9
Bankuti 1201	36	15.0	Shawnee	37	13.7
Heine VII	37	14.8	Winalta	32	13.7
Fertodi 293	39	14.7	Blueboy	44	13.6
Triumph 64	36	14.6	San Pastore	41	13.4
Gage	37	14.4	Bezostaia	45	13.3
Parker	40	14.3	Stadler	37	13.1
Benhur	39	14.3	Gaines	31	12.8
Sturdy	41	14.2	Yorkstar	36	12.5

higher than most other cultivars in the nursery. NB67730 was somewhat higher yielding than Atlas 66 and Purdue 28-2-1. Its protein content of 16.4 percent averaged approximately 1½ to 3 percent higher than other cultivars of comparable yield.

Cultivars are ranked according to their mean yields at six sites in Romania, Turkey, Iran, and Iraq in Table 14. Their mean winter survival, plant height, and lodging at the sites are shown in Table 15. Fertodi, a tall cultivar, was the most productive followed by Bezostaia, Sturdy, and San Pastore in that order. Winter survival and lodging were not factors in productivity at these sites. Some tall-growing cultivars were as productive as short ones.

1) Grain yields reported to nearest whole quintal/hectare.

Table 14

MEAN YIELD AND PROTEIN CONTENT FOR 29 CULTIVARS GROWN IN THE IWWPN AT SIX SITES IN ROMANIA, TURKEY, IRAN, AND IRAQ IN 1965

Cultivar	Protein content %	Grain yield q/ha	Cultivar	Protein content %	Grain yield q/ha
Fertodi 293	14.3	32.1	Arthur	13.4	25.8
Bezostain	13.3	31.3	Shawnee	13.6	25.7
Sturdy	14.3	31.1	Heine VII	15.8	25.0
San Pastore	13.8	31.0	Cappell Desprez	17.1	24.7
Scout 66	13.5	30.8	Yung Kwang	13.7	24.5
Parker	14.1	30.7	Lerma Rojo 64	13.9 ¹⁾	24.5 ²⁾
Lancer	13.4	30.3	Winalta	13.4	24.3
Blueboy	13.7	30.1	Yorkstar	12.3	22.9
Bankuti 1201	15.0	29.4	Stadler	13.1	22.6
Timwin	14.2	29.1	Atlas 66	17.7	22.4
Triumph 64	14.1	27.6	Felix	16.1	22.3
Benhur	13.7	26.7	Purdue 28-2-1	15.8	21.9
Gage	13.5	26.5	Odin	16.7	21.4
NB67730	15.9	26.1	Jaines	13.2	18.3
Riley 67	14.0	26.0			

1) Mean value based on 5 sites only
 2) 0 yield at Fundulea (variety failed to survive winter)

Table 15

MEAN WINTER SURVIVAL, PLANT HEIGHT, AND LODGING FOR 29 CULTIVARS GROWN IN THE IWWPN AT SIX SITES IN ROMANIA, TURKEY, IRAN, AND IRAQ IN 1969

Cultivar	Winter survival (3 sites) %	Plant height (6 sites) cm	Lodging (3 sites) %
Fertodi 293	98	118	13
Bezostain	95	97	1
Sturdy	99	79	0
San Pastore	99	95	0
Scout 66	99	112	6
Parker	99	99	Tr.
Lancer	99	105	18
Blueboy	99	94	2
Bankuti 1201	99	123	18
Timvin	98	87	2

Table 15 (continued)

Triumph 64	99	106	7
Benhur	99	98	1
Gage	99	105	16
NB67730	99	118	27
Riley 67	99	103	2
Arthur	99	97	3
Shawnee	99	108	8
Heine VII	93	93	0
Cappell Desprez	99	89	0
Yung Kwang	99	99	3
Lerma Rojo 64	56	95 ¹⁾	17
Winalta	99	110	7
Yorkstar	99	97	1
Stadler	99	103	3
Atlas 66	98	116	18
Felix	99	88	0
Purdue 28-2-1	99	113	9
Odin	99	99	0
Gaines	99	68	0

1) Mean values based on one less site than indicated

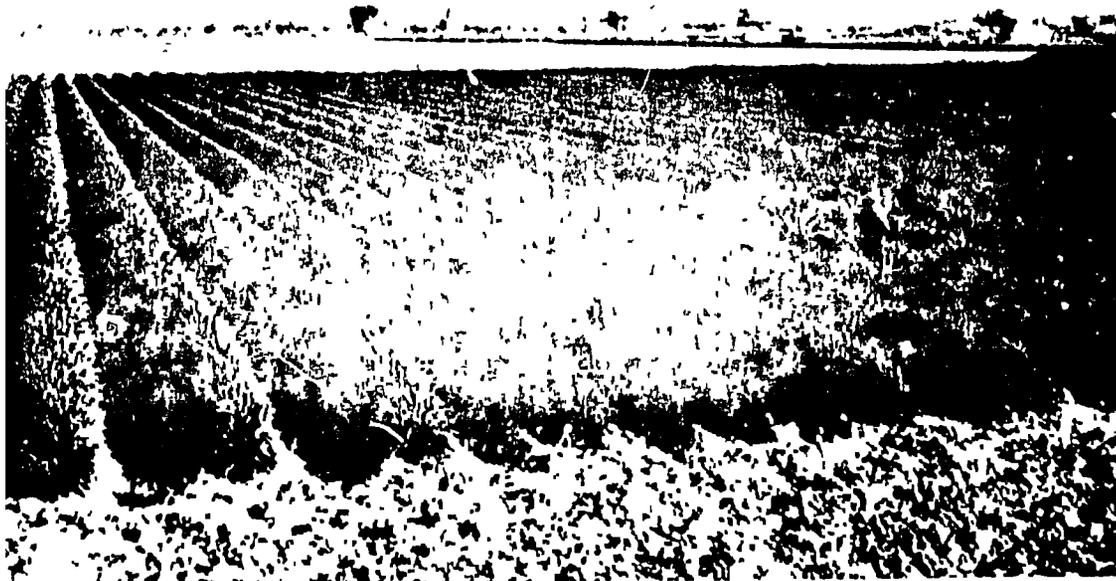


Figure 1. - International Winter Wheat Performance Nursery seed increase plots at Yuma, Arizona, on 12 February 1970.