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RESULTS OF THE FIRST INTERNATIONAL SPRING WHEAT YIELD NURSERY 1964-1965

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Results of the First International Spring Wheat Yield Nursery, 1964-1965 [1]

Charles F. Krull, Norman E. Borlaug, Carlos Meza, Ignacio Narváez [2]

INTRODUCTION

Adaptation is perhaps the most elusive concept in plant breeding. Not only is there surprisingly little information concerning the performance of varieties over a broad range of environments in even the major crop plants, but there is considerable confusion among plant breeders as to whether broad adaptation is desirable or not. Even in wheat, the most extensively seeded crop in the world, there is remarkably little systematic data concerning the adaptation of the major varietal types in different areas of the world.

Adaptation in wheat can be considered from many points of view. It may be measured by e. g. flowering date, maturity date, resistance to important diseases or pests, winter survival and yield. Grain yield is the most comprehensive gauge of adaptation, but it is cumbersome to measure and influenced by many inter-related factors. Yield, however, is the most meaningful measure of adaptation in terms of world food needs.

The United States Department of Agriculture's International Spring Wheat Rust Nursery has obtained a lot of very valuable information concerning resistance to pathogens throughout the world's important wheat regions. Disease losses can lower yields markedly, and if yield is to be used as the measure of adaptation, disease resistance plays a very important role. Disease is, however, only one of the factors affecting yield.

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[1] The distribution and management of the nursery in the Near East is handled cooperatively with the Near and Middle East Wheat and Barley Improvement Project of the Food and Agriculture Organization of the United Nations.

[2] Respectively: Resident Coordinator, CIMMYT Wheat Program; Head, CIMMYT Wheat Program; Head of Biometry Department, Instituto Nacional de Investigaciones Agrícolas (INIA), Secretaria de Agricultura y Ganaderia, Mexico; and Head, INIA Cereals Program. A special acknowledgement is given to the 1964 FAO trainees who helped in the preparation of seed for the nursery. These include: Mohamed Ahmed Khalifa, Salah'el-Dine A. Attia, Mohammad Dadain, Shamoon Issa Bekou, Thul Kife Shihada Ghousha, Cemali Ozer and Mohamed Zeini Juwanah. Also acknowledgement is made to Reyes Vega and Miguel Martinez for their help in preparing the nurseries, to Mrs. Guillermina Hardy in preparation of the tables and to Miss Judith Franco for typing the tables and manuscript.

Beginning in 1960 a series of Inter-American yield trials were conducted to test the main varieties of the hemisphere throughout the principal spring wheat regions of the Americas. The results of these nurseries (1, 2, 3, 8) indicated that certain varieties showed very wide adaptation while others — particularly the North American ones — were very poorly adapted outside their areas of origin. A parallel series of yield nurseries were run in cooperation with the Food and Agriculture Organization throughout the Near East. The results (4, 5, 7) were quite similar to those from the Inter-American series, and many of the same varieties, such as Pitic 62, were high yielding in both sets. It was therefore decided to combine these into a single International Spring Wheat Yield Nursery in order to study adaptation wherever spring wheat is grown. This report covers the first of these combined nurseries.

MATERIALS AND PROCEDURES

General

The trial consisted of 25 varieties representing the principal types seeded throughout the spring wheat regions of the world. Plots consisted of three five-meter rows with four replications arranged in a randomized block design. Seed was packeted for each row using a seeding rate equivalent to 100 kg/ha for the variety Penjamo 62. Adjustments were made for each variety so that the number of seeds per row was approximately the same as for Penjamo 62.

Seed for the nursery was produced in increase plots at the Centro de Investigaciones Agricolas del Noroeste (CIANO) at Ciudad Obregon, Sonora, Mexico. The nursery was prepared as part of the training of a group of FAO trainees under the supervision of Dr. N. E. Borlaug. The seed was treated with an organic mercurial seed disinfectant prior to being packaged. Instructions concerning seeding, nursery management and note taking as well as data sheets were included in each seed box. All nurseries sent out of Mexico were shipped by air.

Data were obtained from 34 locations in 23 countries representing the major wheat regions of the world. These trials were seeded under both dryland and irrigated conditions, both fertilized and unfertilized, from approximately 35°S latitude in Argentina, Chile, South Africa and Australia through 0° in Ecuador to 45°N in the United States and Rumania. They were seeded at elevations from 226 meters below sea level in the Jordan Valley to 3,058 meters above sea level in Ecuador. A list of the cooperating stations and scientists as well as supplementary information are given in the appendix.

Choice of varieties

The twenty-five varieties (*Triticum aestivum*) in the nursery included the principal varietal types that are presently grown in the spring wheat regions of the world. Most of the varieties had been included in previous nurseries, but some new ones were included in an attempt to keep the nursery as current and meaningful as possible. The varieties included were:

United States and Canadian varieties:

1. Selkirk—a Canadian-developed variety that is still the most extensively grown variety in the moist parts of the northern hard spring wheat areas.
2. Thatcher—a Minnesota variety that was widely grown for many years in the northern United States and Canada and that is still widely grown in the drier areas of this region. It has been used as a standard for spring wheat quality and for that reason has been widely used in the parentage of many of the newer United States and Canadian lines.
3. Justin—one of the newer, commercial spring wheat varieties of the United States. It was developed in North Dakota.
4. Crim—a new Minnesota variety that is now in commercial production. It was included in the nursery before the variety was named and was carried by its experimental designation of Minn. II-53-404.
5. CT244—a promising new line from Canada that was never released because of quality considerations.

Argentine varieties:

1. Gaboto—one of the most important soft varieties in the northern part of the Argentine wheat belt.
2. Magnif 41—a promising semi-commercial soft variety.
3. Klein Rendidor—the most widely cultivated hard wheat variety in Argentina. It is representative of the long cycle or facultative winter types that are widely grown in Argentina.

Mexican varieties:

1. Nainari 60—an important tall commercial variety in Mexico from 1960 through 1962 and still widely used in crosses. It has also shown good adaptation in several Near Eastern countries as well as in the Near Eastern and Inter-American international yield nurseries.
2. Lerma Rojo 64A—a semi-dwarf version of the original Lerma Rojo, derived through backcrossing. It has shown good adaptation in the Near East as well as Mexico.
3. Pitic 62—the first semi-dwarf variety released in Mexico. It has yielded well in the Inter-American nurseries and was the highest yielder in all three Near East-American nurseries but is currently grown on only a limited commercial average in Mexico because of low test weight and its susceptibility to new races of stem rust.

4. Penjamo 62—one of the first semi-dwarf varieties released in Mexico. It has occupied over half of the Mexican wheat area for the past several years.

5. Sonora 64—the shortest strawed variety that has been commercially released in Mexico to date. It is currently recommended only for areas where leaf rust is not a serious problem.

6. Penjamo sib × Gabo 55 (white grain)—a dwarf Mexican line of very high yield capacity, that was originally entered as (Frontana × Kenya 58-Newthatch) Norin 10-Brevor × Gabo 55. Although it has not been widely grown in Mexico because of partial rust susceptibility, it and its red seeded sister (both with the pedigree of II-8156-1M-2R-4M) have been widely grown under various names including Siete Cerros, Super X, Kalyan, S-227, PV-18, Indus 66 and Mexipak 65.

Colombian varieties:

1. Nariño 59—the most important commercial variety in Colombia from 1960 through 1962 when a new race of stripe rust ended its usefulness in southern Colombia. It is still widely used in the departments (i. e. states) of Cundinamarca and Boyacá and was the highest yielding variety in the first Inter-American Spring Wheat Yield Nursery.

2. Bonza 55—an important commercial variety. It has maintained an effective level of field resistance to stripe rust for over 10 years which is almost unique with the explosive race situation of Colombia.

3. Napo 63—presently an important variety in both Colombia and Ecuador. It has very good stripe rust resistance to the extremely virulent races of those two countries.

Australian varieties:

1. Gabo—a variety of very wide adaptation both in Australia and many other countries. It is susceptible to stripe rust.

2. Triple Dirk—a short strawed variety; susceptible to stripe rust.

Egyptian varieties:

1. Giza 144—a widely adapted variety representative of the present commercial varieties used in Egypt.

2. Giza 150—a new representative of the Egyptian wheats.

Brazilian varieties:

1. Carazinho—an important commercial variety reported to be able to produce relatively good yield on acid soils. It has good stripe rust resistance under most conditions.

Indian and Pakistani varieties:

1. C-518—an old, pre-partition Indian white seeded wheat still grown on a substantial acreage.
2. C-271—a tall, awnleted, pubescent white seeded variety grown on a considerable acreage in West Pakistan.
3. C-273—a tall, awned, pubescent white seeded variety grown commercially in the Punjab areas of India and Pakistan.

Data handling and summarization

As far as possible, data were converted to metric units or percentages for presentation in this report. Every effort was made to assure the correctness of such conversions as well as the accuracy of translations of terms from other languages and the interpretation of supplementary information. The authors, however, take full responsibility for any errors that might have been made. Data are not presented in the tables nor were analyses run for traits where no differential varietal effect was observed.

Yield data were requested from the central row of each three-row plot. All three rows were harvested by some cooperators in order to have sufficient grain for test weight and 1000 grain weight. Yields were converted from the units reported by the cooperator to kilograms per hectare. For readers more accustomed to yield in bushels per acre, 1000 kilograms of wheat per hectare is equivalent to approximately 15 bushels per acre.

Both test weight and 1000 grain weight data were requested as a measure of grain quality because some cooperators do not have test weight equipment. In some cases the cooperator had to combine seed from the four replications to have enough seed to take a test weight determination. Test weight is reported in kilograms per hectoliter, and 1000 grain weights are reported in grams. For readers more accustomed to test weight expressed in pounds per bushel, one kilogram per hectoliter = 0.8018 pounds per bushel, i. e. 75 kilograms per hectoliter is approximately 60 pounds per bushel.

For statistical analysis the rust notes were converted to a coefficient of infection as used by Dr. W. Q. Loegering in the United States Department of Agriculture's International Rust Nurseries. This coefficient is calculated by multiplying the percentage of infection by a "response value" for each infection type. Thus, the coefficient combines both the amount of infection and the reaction type. The response values are as follows: 0 = 0; VR (very resistant) and R (resistant) = 0.2; MR (moderately resistant) = 0.4; M (intermediate) = 0.6; MS (moderately susceptible) = 0.8; and S (susceptible) and VS (very susceptible) = 1.0. The coefficients can be analyzed statistically as well as correlated with yield and other traits to estimate the degree of association between rust attack and other traits. To avoid handling of fractional values, coefficients less than 1.0 and more than 0 were rounded to 1.0, and all other values were rounded to the nearest whole number.

In the case of cooperators who reported only percentage of rust, this was used directly as the coefficient, and for the occasional case where only the infection type was reported, the response value was used as the coefficient. Due to the fact that 0 values were common and that the coefficients do not usually fit a normal distribution, the coefficients were routinely transformed as $\sqrt{\text{coefficient} + 1}$, i. e. $\sqrt{X + 1}$, for analysis. While other transformations may have been more appropriate in specific cases, the $\sqrt{X + 1}$ transformation considerably improved the normality of the distributions. The $\sqrt{X + 1}$ values were the ones used for all statistical analysis and are the ones presented in the tables of results for locations in which data for the trait were reported in more than one replication. Where the rust note was taken in only a single replication, the actual notes are presented in tables, but the coefficients transformed to $\sqrt{X + 1}$ were used for correlations.

Throughout this report, the terms ***stripe rust, stem rust*** and ***leaf rust*** are used instead of *yellow rust, black rust* and *brown rust* such as are used in the Near East and instead of the scientific names of the causal organisms. Stripe rust readings are normally taken on the leaves, but under severe conditions an additional note can be taken on the attack in the head or spike. This is usually taken as the average percentage of infected spikelets in the plot. Two locations reported this type of data in addition to the usual leaf note, and these data were also transformed to $\sqrt{\% + 1}$.

Lodging was recorded as percentage of lodged plants, and shattering was recorded as average percentage of shattered spikelets or percentage of yield lost due to shattering. Both lodging and shattering data were transformed into $\sqrt{\% + 1}$ to normalize their distribution. Some data were reported as a score, and these were not converted to percentages nor used in averages with data from other locations. The cooperators were urged to include data for any other factor for which differential data could be recorded, and such additional factors were often the most important ones in influencing yield at that site. These were analyzed and presented wherever available.

Statistical treatment

At any given location, an analysis of variance was performed for all traits on which data were reported from more than one replication. Pertinent information from these analyses of variance are presented for each trait as well as the mean for each variety for each trait in Tables 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 61, 63 and 65.

The information from these analyses includes the mean of the trait, statistical level of significance, coefficient of variation, standard error and the least significant difference at the 5% level.

The statistical level of significance includes from 0.5% to 25% (10) rather than just the usual 5% and 1% levels. "NS" indicates non-significance at even the 25% level. The standard error is the standard error of a plot i. e. $\sqrt{EMS}$ (6).

The least significant difference (LSD) for the 5% level is also presented (10). The disadvantages of this test as compared, for example to the Duncan or other tests as well as the mis-uses that are frequently made of the LSD are fully appreciated. Nevertheless, LSD values are presented because: it remains the best understood statistical test in many countries, it still serves as a reasonably reliable basis of comparison, and it lends itself to more concise presentation in the tables than the various sequential range tests. Readers wishing to use the Duncan multiple range test, for example, may compute the appropriate standard error from the standard error presented in the tables.

Considerable understanding as to which factors are influencing yield and the interactions between these factors may be gained by studying the correlations presented in Tables 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 62, 64 and 66. The correlations are between the means of all traits for which data were reported. Correlations were calculated between the means rather than using the raw data first because this appeared to be somewhat more meaningful genetically and second because some types of data were frequently reported for only one replication.

The means of each character for each variety were also used to compute a multiple regression for yield considering all other variables for which differential data were reported as "independent" variables. It is realized that many of these variables are not truly independent from etiher a statistical or a biological viewpoint. The multiple regression analyses for each location are presented in the same tables as the correlation values, and both partial regression coefficients and "t" values are presented for each variable. In computing multiple regressions it is often customary to begin with the variable explaining the largest amount of variance of the dependent variable (in this case, yield) and continue adding variables that account for the next most amount of variance until the "t" values for additional variables are no longer significant. When this point is reached, no more additional variables are included. It will be noted, however, that coefficients and "t" values are included for all "independent" variables. This was done partially because the magnitude of the "t" value (sign ignored) may be a measure of the relative importance of a variable in determining yield. Such interpretations should be made with some care, however, particularly when there are two variables that are not truly independent or that may measure much the same thing (e. g. heading date and maturity date).

For readers who have not had much experience with multiple regression, the R^2 value is the amount of the variance for yield that can be accounted for by the regression equation. This regression equation consists of a constant term plus coefficients to be multiplied by the values for each of the independent variables. The equation can be used to calculate an expected yield for each variety based on the values for each of the independent traits that were measured. That is, we may compute an expected yield for a variety on the basis of its maturity, rust reaction, straw strength, etc. For example, the expected yield of variety 16 at Beirut, Lebanon can be calculated as (see data in Table 42 and coefficients and constant term in Table 43): $Y = 16610 - 46.9633(155) - 33.7534(208) - 112.0620\ (1.36) = 2157$.

For the reader's convenience, expected (i. e. calculated) yields using the multiple regression equations are presented in Table 69 for all locations reporting more than one independent variable. The differences between observed and calculated yields are presented in Table 70. In attempting to verify any of the figures in these two tables, it should be remembered that variations may be due to difference in the procedure for rounding off. Incidentally, as Ostle (9, p223) suggests, R (i. e. $\sqrt{R^2}$) may be thought of as a linear correlation between the expected and observed yields. While many workers will find the multiple regression analyses interesting and useful, a full understanding is not essential to the interpretation of the yield data or the factors influencing yield.

The overall summary of the data reported for all varieties is presented in Table 67. These are the means for all traits averaged over all locations from which differential data were reported. As will be noted, the number of locations differs between traits. No combined analysis of variance over all locations was attempted due to some disparity in data recording, heterogeneity of variances and to the fact that the data were incomplete at some locations particularly for varieties that are sensitive to short day lengths.

The correlation values in Table 68 were calculated from the means of the traits averaged over all locations where both traits were measured. These are perhaps the best estimates of the relationship between traits.

Because of the unique nature of the data reported being representative of a diverse group of varieties tested over a sizable part of the world's spring wheat area, the philosophy of the authors has been to try to provide the reader with a maximum amount of usable information. No attempt has been made to "digest" the data and explore all of its ramifications, but it is hoped that students and scientists alike will continue to find applications and interpretations that cannot be visualized today.

RESULTS AND DISCUSSION

As can be seen from Table 67 the highest yielding five varieties over the 34 locations were:

	kg/ha
Pitic 62	3526
Nainari 60	3422
Penjamo 62	3417
Pj sib × Gb 55 (white grain)	3312
Lerma Rojo 64 A	3253

These are to a remarkable degree the same varieties that have perfomed well in the previous Inter-American and Near Eastern yield trials (1, 2, 3, 4, 5, 7, 8). Pitic 62, for example, previously had the highest average yield in all three Near Eastern trials and the highest in two of the three Inter-American nurseries in which it was entered.

The mean yield averaged over such a wide range of environmental conditions might not be too meaningful if the same varieties do not also tend to yield the best at individual sites. Pitic 62, however, was among the five highest yielding varieties in 23 of the 34 locations reported in this bulletin. Its poor yield in several locations can be accounted for by inadequate disease resistance indicating that its yield potential is indeed impressive. This has also been the tendency in previous nurseries. Nainari 60 and Penjamo 62 were also among the five highest yielding varieties in over half of the locations. Pitic 62, Nainari 60, Penjamo 62, the Penjamo sib × Gabo 55 selection or Lerma Rojo 64A were among the five highest varieties in 33 of the 34 reporting locations.

Thatcher, Justin and Selkirk are just as consistent in their low yield. Thatcher was among the lowest five yielding varieties in 25 out of the 34 locations, and Justin and Selkirk, respectively, were among the five poorest yielding varieties in 20 and 22 locations. This same trend has been noted in previous nurseries (8, p 12).

As in two previous yield trial publications (7, 8), multiple regression analyses were carried out for each location and the resultant equations were used to calculate a predicted or calculated yield for each variety at each location. These predicted yields are reported in Table 69, and the differences between actual and predicted yields are presented in Table 70. The predicted yields may be thought of as what a variety might be expected to yield on the basis of its data for the various independent variables that are known to affect yield under certain conditions. For example, disease resistance is very closely related to yield under severe epiphytotic conditions such as for stripe rust in Ecuador (see Tables 11 and 12). Flowering and maturity are usually inversely related to yield at locations with short daylengths because a number of daylength sensitive varieties are included in the test. Height and lodging are also usually inversely related to yield at locations where fertilization and rainfall are adequate.

The highest yielding varieties in the nursery tended, as would be expected, to have the highest predicted yields. That is, you would expect them to yield well because their maturity, disease resistance, straw strength, height, etc., were adequate at most locations. Thatcher, the lowest yielding variety in the trial, also had the lowest predicted yield due to its heigth, susceptibility to lodging and extreme lateness at locations with short day lengths.

As was suggested previously (7, p13), the difference between actual and predicted yields might be useful in identifying varieties that possess "yield genes" apart from those that can be explained by disease resistance, straw strength, etc. A variety might have a high yield but actually yield very poorly due to e. g. poor straw strength. If, however, such a variety consistently yielded more than its predicted yield, it might suggest that the variety actually had a high yield potential and might be useful as a parent. Lerma Rojo was given as an example of just such a variety.

This point has, however, not been discussed further until more data could be accumulated and it could be seen if given varieties tend to outyield their predicted yields from one year to the next and over a wide range of environments. A multiple regression analysis with so many independent variables would have uncertain value if only taken from a few locations but becomes more meaningful from a large number of locations.

With the data reported herein plus those from previous nurseries (7, 8), multiple regression analyses have been carried out for 65 locations representing the major areas of spring wheat production around the world. In general varieties have behaved consistently in relation to their predicted yield in the three nurseries.

Varieties that had a positive value in Table 70 for the average over 34 locations in this test and that have appeared in at least one of the two other trials (7, 8) in which multiple regression analyses were calculated are as follows:

Variety	Difference between observed and calculated yield (observed-calculated) in kg/ha. 1st ISWYN 34 loc.	3rd NE-American (7) 19 loc.	4th Inter-American (8) 12 loc.
Pitic 62	601	293	536
Lerma Rojo 64A	123	341	118
Penjamo 62	219	29	160
Triple Dirk	81	6	[1]
Nainari 60	417	107	144
Gaboto	74	[1]	66
Pj sib X Gb 55	445	154	[1]

[1] Not entered.

As will be noted, the varieties that yielded more than their calculated yield in the trial reported in this bulletin had *all* yielded better than their calculated yields in previous trials. This would seem to indicate that these varieties have a high yield potential apart from what can be explained by resistance, maturity and straw strength. They have in fact all been very useful in crosses in the Mexican-CIMMYT wheat program.

It should be remembered, however, that while the ability to out-yield the calculated or predicted yield implies a good yield potential apart from what can be explained by the independent variables, it does not indicate how easily this yielding ability can be recovered in crosses. Both Pitic 62 and the Penjamo sib X Gabo 55 selection are short, strong strawed varieties that out-yield their calculated yield by a large amount. In hundreds of crosses in the Mexican program, however, the yield potential has been found to be much easier to recover in crosses with Pitic 62 than with the Penjamo sib X Gabo 55 selection. This is apparently due to the fact that the inheritance of the yield potential of the Penjamo sib X Gabo 55 line is controlled by multiple recessives while that of Pitic 62 is more simply inherited. Even the disease resistance of Pitic 62 appears to be more simply inherited thereby allowing the selection of a larger number of desirable types in F_2 populations.

Of the independent variables rust plays a very important role in determining yield. Within recent years there has been considerable interest in tolerance and other non-specific types of rust resistance. Material with this type of rust resistance yields well despite having a high rust note. This type of resistance is effective against a broad spectrum of rust races and tends to remain effective over a greater number of years than the hyper-sensitive genes commonly employed. Unfortunately the trait is difficult to identify and evaluate. The multiple regression technique might be useful in identifying lines with rust tolerance as they would tend to yield better than you would expect on the basis of their rust notes. Such a technique would not be practical in identifying the trait in segregating populations but would be of interest in identifying fixed lines that carry tolerance. Indeed, several of the above lines that consistently out-yielded their predicted yields have been found to carry such genes.

To make this nursery as useful as possible, suggestions are welcomed concerning improvements in the design and management of the nurseries, number of varieties, plot type, presentation of results, analyses, etc. So that the nursery can be kept as current as possible and thereby of more immediate usefulness, breeders are urged to submit their best new commercial varieties and/or most promising experimental lines for including in the nursery. Seed of such material should arrive in Mexico by September 15 for planting in the seed plots in Ciudad Obregon, Sonora. It is requested that 400-500 grams of seed be sent although less can be used if necessary. Obviously, the total number of entries that can be included in such a test is limited, but it is hoped that the best representative of each of the major spring wheat regions of the world can be included.

SUMMARY

Twenty five wheat varieties representing the major types grown throughout the spring wheat regions of the world were entered into a replicated international yield trial. Results were obtained from 34 locations in 23 countries from Argentina and Chile to the United States and from South Africa through the Near and Middle East to Australia. These included both irrigated and rainfed conditions from 226 meters below sea level in the Jordan valley to 3,058 meters above sea level in Ecuador and from approximately 35°S latitude to 45°N.

In addition to yield, wherever possible data were obtained on disease reaction, height, flowering and maturity date, lodging, shattering, 1000 grain weight and test weight. The data from all traits were analyzed statistically when data were reported on more than one replication, and correlations were calculated between the means of all traits measured at each location. A multiple regression analysis of yield on the other variables was also calculated for each location.

The varieties having the highest average yield over 34 locations were Pitic 62, Nainari 60, Penjamo 62, a Penjamo sib × Gabo 55 selection (grown under several names in the Near East and Mexico) and Lerma Rojo 64A. All five are of Mexican origin and are all dwarf or semi-dwarf in growth habit with the exception of Nainari 60 which is also fairly

strong strawed. As have previous international yield nurseries both in the Americas and through the Near East, the results show that is possible to breed varieties that have a much wider range of adaptation than is usually believed possible. There was a marked tendency for varieties to maintain their relative rankings at all locations whether they were fertilized or not fertilized, irrigated or rainfed and over a wide range of environments.

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Cooperating Stations and Scientists with Supplementary Data as Supplied by the Cooperators

ARGENTINA

Instituto de Fitotecnia, *Castelar*
Cooperators: Hugo P. Cenoz and Noe Horovitz (Jr.)
Latitude: 34° 36′ S
Longitude: 58° 40′ W
Elevation: 24 meters above sea level
Date of planting: August 14, 1964
Fertilizer used: none
General description of weather conditions during time of test: Rainfall was light but well distributed, and there was no damage due to frost or cool spring. It was a good wheat year.
Disease development: very late
The data are presented in Tables 1 and 2.

Marcos Juarez

Cooperators: Benito Petersen and Rogelio Fogante
Latitude: 32° 41′ S
Longitude: 62° 07′ W
Elevation: 110 meters above sea level
Date of planting: August 19, 1964.
Fertilizer used: none
General description of weather conditions during time of test:
- August: 36 mm. precipitation, 3 frosts
- September: 68 mm. precipitation, 2 frosts
- October: 62 mm. precipitation
- November: 164 mm. precipitation
- December: 123 mm. precipitation

Disease development: good
Weed, insect and pest problems: none
Date when different notes were taken:
- Heading: October 16-21
- Rust: November 1-12
- Height: December 6-10

The data are presented in Tables 3 and 4.

Pergamino, Province of Buenos Aires

Cooperators: Jose Rath and Hector Conta
Latitude: 33° 52′ 58″ S
Longitude: 60° 35′ 15″ W

Elevation: 68 meters above sea level
Date of planting: August 27, 1965
General description of weather conditions during time of test: Climatic conditions were favorable for wheat, and there was no damage due to frosts, high temperature or hail. Rainfall during the vegetative period (July-November) was slightly less than normal.

Precipitation:

January	7.9 mm.	July	8.3 mm.
February	239.9 mm.	August	49.4 mm.
March	201.0 mm.	September	60.2 mm.
April	108.7 mm.	October	24.1 mm.
May	92.4 mm.	November	61.0 mm.
June	19.6 mm.	December	42.8 mm.

The data are presented in Tables 5 and 6.
Estación Experimental Agropecuaria, *Parana* (E. R.)
Cooperators: A. L. Chabrillon and V. Ramos
Latitude: 31° 50′ S
Longitude: 60° 31′ W
Elevation: 110 meters above sea level
Date of planting: July 29, 1964 (germination August 6, 1964)

Precipitation:

January	40 mm.	July	0 mm.
February	60 mm.	August	16 mm.
March	286 mm.	September	81 mm.
April	192 mm.	October	19 mm.
May	14 mm.	November	52 mm.
June	18 mm.	December	103 mm.

Yearly totals:	1964	886.7 mm.
	1963	863.1 mm.
	1962	531.7 mm.
Long time average		950 (approx.)

To insure good germination, a light irrigation equivalent to 5 to 10 mm. was applied at seeding time.
The data are presented in Tables 7 and 8.

CHILE

Estación Experimental Central, *"La Platina"*, Santiago
Cooperators: Cereals program
Latitude: 33° 34′ S
Longitude: 70° 38′ W
Elevation: 629 meters above sea level
Date of planting: August 10, 1964
Precipitation: 65.8 mm. plus 5 irrigations

General description of weather conditions during time of test: It was a dry year with low humidity and relatively high temperatures during the spring.

Fertilizer used: 128 kg/ha of N and 160 kg/ha of P applied as sodium nitrate (salitre) and triple superphosphate

Disease development: There was a heavy stripe rust attack and also good development of leaf and stem rust

Weed, insect and pest problems: none. Weeds were controlled with 2, 4-D.

Dates when different notes were taken:

Stripe rust: October 27, 1964
Leaf rust: November 27, 1964
Stem rust: January 1, 1965
Lodging and shattering (none encountered): January 1, 1965
Flowering: October 20 to November 9, 1964
Height: January 12, 1965

The data are presented in Tables 9 and 10.

ECUADOR

"Santa Catalina", *Quito*

Cooperators: Department of Cereals, INIAP

Latitude: 0° 22′ S

Longitude: 78° 33′ W

Elevation: 3,058 meters above sea level

Date of planting: February 22, 1965 (effective germination March 1, 1965)

Precipitation during cycle of test: 722 mm. (February 22 to September 20, 1965)

General description of weather during time of test: It was a year of average climatic conditions.

Fertilizer used: 30 kg/ha of N, 120 kg/ha of P_2O_5 and 30 kg/ha of K_2O applied as 10-30-10 fórmula

Disease development: average with light attack of stem rust

Weed, insect and pest problems: none of importance

Dates in which different notes were taken:

Stripe rust, first note: May 21, 1965 (not analized nor presented in tables)
Stripe rust, second note: June 28, 1965
Stripe rust in the head: June 28, 1965
Leaf rust: June 28, 1965
Stem rust: June 28, 1965

The data are presented in Tables 11 and 12.

COLOMBIA

Tibaitata, Sabana de Bogota
Cooperators: Mario Zapata B., Rafael Lopez O., Daniel Varela M.
Latitude: 4° 35′ N
Longitude: 74° W
Elevation: 2,600 meters above sea level
Date of planting: April 22, 1965
Precipitation during cycle of test: 300 mm.
General description of weather conditions during time of test: very wet during harvest time
Fertilizer used: 25 kg/ha of N, 75 kg/ha of P_2O_5 and 25 kg/ha of K_2O applied on a 10-30-10 formula
Disease development: good
Weed, insect and pest problems: none
Dates when different notes were taken:
Heading: June 27 through August, 1965
Stripe rust, leaf: July and August 1965
Stripe rust, head: October, 1965
Leaf rust: August and September, 1965
Stem rust: October, 1965
Lodging and shattering: October, 1965
(The above notes were taken on different dates according to growth stage of the variety)
The data are presented in Tables 13 and 14.

GUATEMALA

Labor Ovalle, *Quezaltenango,* Guatemala, C. A.
Cooperators: Astolfo Fumagalli, Salvador Cruz and Jorge Luis Juarez
Latitude: 14° 52′ N
Longitude: 91° 30′ W
Elevation: 2,380 meters above sea level
Date of planting: August 10, 1964
Precipitation during cycle of test: 411 mm
General description of weather conditions during time of test: There was a constant high humidity due to frequent rains thus favoring the development of diseases particularly stripe rust and Septoria.
Disease development: severe
Weed, insect and pest problems: none. Weeds were controlled by 2, 4-D and by hand weeding.
Dates when different notes were taken:
Stripe rust: October 7, 1964
Leaf rust: October 7, 1964
Septoria: October 21, 1964
Heading: beginning October 5, 1964
Maturity: beginning December 21, 1964
The data are presented in Tables 15 and 16.

MEXICO

Centro de Investigaciones Agricolas del Bajio (*CIAB*), El Roque, Guanajuato. (Two nurseries were seeded at this location with a difference of approximately one month in planting date)
Cooperators: Gregorio Vázquez, Ricardo Urbina, Rodolfo Moreno G.
Latitude: 20° 34′ N
Longitude: 100° 28′ W
Elevation: 1,650 meters above sea level
Irrigation: yes
Date of planting:
Early: November 17, 1964
Late: December 16, 1964
Fertilizer used: Early planting date 120 kg/ha of N and 60 kg/ha of P_2O_5 were applied at planting, and another 60 kg/ha of N were applied in the first irrigation after seeding. Despite the application of a total of 180 kg/ha of N, the plots appeared to be short of nitrogen judging by the appearance and height of the ends of the rows as compared with the central part of each plot. The previous crop was maize
Late planting date — an application of 80-60-0 kg/ha, respectively, of N, P_2O_5 and K_2O was made at planting, and an additional 60 kg/ha of N were applied in the first irrigation. The previous crop was alfalfa
Notes: Early planting — The stem rust arrived too late to take good differential notes. Two notes were taken for stripe rust, but only the second (generally the more severe) was analyzed and presented in the tables.
Late planting — Two notes were taken for stripe rust but only the second (and more severe) was analyzed and presented in the tables. It was difficult to take meaningful notes in leaf rust in some varieties as the leaf had been killed by stripe rust. Stem rust arrived too late to lower yields appreciably.
The data for the early planting are presented in Tables 17 and 18 and for the late planting in Tables 19 and 20.

Campo Agricola Experimental "El Horno" *Chapingo,* Mexico
Cooperators: Jose Luis Maya, Marco Quiñones, Rodolfo Moreno G.
Latitude: 19° 31′ N
Longitude: 98° 53′ W
Elevation: 2,249 meters above sea level
Irrigation: no
Fertilizer used: A total of 120-60-0 kg/ha of N, P_2O_5 and K_2O were applied
The data are presented in Tables 21 and 22.

UNITED STATES

University of California, *Davis,* California
Cooperators: J. C. Williams and John D. Prato

Latitude: 38° 32′ N
Longitude: 121° 45′ W
Elevation: 15 meters above sea level
Date of planting: December 26, 1964
Precipitation during cycle of the test: 330 mm.
General description of weather conditions during time of test: It was wet during first 6 weeks (254 mm.) but becoming very dry before an additional 76 mm of rain fell at early flowering. Hot, dry winds occurred during and after flowering.
Fertilizer used: none
Disease development: moderately severe stripe rust and traces of stem rust and barley yellow dwarf
Weed, insect and pest problems: none
Dates when different notes were taken:
Stripe rust: May 10, 1965
Lodging: June 1, 1965
Harvested: June 10, 1965
Shattering (on border rows): June 21, 1965
The data are presented in Tables 23 and 24.

Minnesota Agricultural Experiment Station, *St. Paul Minnesota*
Cooperators: D. R. Johnston, E. C. Gilmore, E. R. Ausemus
Latitude: 45° 0′ N
Longitude: 93° 10′ W
Elevation: 273 meters above sea level
Date of planting: May 6, 1965 (emerged May 13, 1965)
Irrigation: no
The data are presented in Tables 25 and 26.

SOUTH AFRICA

Stellenbosch, South Africa
Cooperators: F. X. Laubscher, F. Gillie and Johanna Theron
Latitude: 33° 56′ S
Longitude: 18° 51′ E
Elevation: 91 meters above sea level
Date of planting: May 12, 1965
Precipitation during cycle of test:

	1965	5 yr. ave.
May	71.5	
June	62.0	157.8
July	48.0	92.9
August	126.5	110.7
September	39.0	47.4
October	34.0	54.9
Total	381.0	463.7 (5 months)

(Test not irrigated)

Weed, insect and pest problems: slight bird damage
Dates when different notes were taken:
Heading: January, 1965
Maturity: February and March, 1965
Harvest and threshing: March and April, 1965
Weighing of grain: May, 1965
The data are presented in Tables 31 and 32.

LIBYA

Sidi Mesri, Tripoli
Cooperators: A. Najar and H. A. Al-Jibouri
Latitude: 32° 53′ N
Longitude: 13° 11′ E
Elevation: 19 meters above sea level
Date of planting: November 29, 1964
Irrigation: Plots were irrigated 13 times during the growing season
Fertilizer used: "3 quintals/hectare of 12/24/8 NPK" (36-72-24 kg/ha of N - P_2O_5 - K_2O)
General description of weather conditions during time of test: normal
Disease development: only leaf rust
Weed, insect and pest problems: plots were weeded 7 times during the growing season
The data are presented in Table 33.

CYPRUS

Prastio
Cooperators: Department of Agriculture, Cyprus
Latitude: 35° 6′ N
Longitude: 32° 25′ E
Elevation: 152 meters above sea level
Date of planting: December 15, 1964
Precipitation during cycle of test: 380 mm
General description of weather conditions during time of trial: generally favorable for cereal development
Fertilizer used: 192 kg/ha each of ammonium sulphate and super phosphate (40-31-0 kg/ha of N - P_2O_5 - K_2O?)
Disease development: slight attack of stem rust
Weed, insect and pest problems: Birds attacked the trial at ripening. Wild oats were a problem but were removed.
The data are presented in Tables 34 and 35.

SAUDI ARABIA

Kharj
Cooperator: Mohamed Zeini Jowana
Latitude: 24° 15′ N
Longitude: 47° 15′ E

General description of weather conditions during time of test: Less than normal rainfall

Disease development: Slight except for some *Septoria nodorum* on some Indian and Pakistani varieties

Weed, insect and pest problems: none

Dates when different notes were taken:

Leaf rust	October 27, 1965
Stem rust	October 27, 1965
Stem rust (artificial inoculation)	October 19, 1965
Septoria tritici	October 13, 1965
Septoria nodorum	October 28, 1965
Lodging	October 28, 1965
Height	October 28, 1965

The data are presented in Tables 27 and 28.

ETHIOPIA

Central Agricultural Experiment Station, *Debre Zeit*

Cooperators: Tesfaye Tesemma and Dagnatchew Yirgou

Latitude: 8° 55′ N

Longitude: 38° 58′ E

Elevation: 1,894 meters above sea level

Date of planting: July 27, 1965

Precipitation during cycle of test: 410 mm

General description of weather conditions during time of test: The weather was excellent for wheat. The rainfall was adequate throughout the growing season, and there was plenty of sunshine toward the time of maturity.

Disease development: Stem and leaf rust were the major diseases observed

Dates when different notes were taken:

Germination: August 3, 1965

Heading: September 10 through November 30, 1965

Lodging, height and maturity: November 11 through December 12, 1965

Diseases: October 19, 1965

The data are presented in Tables 29 and 30.

SUDAN

Hudeiba Agricultural Research Station, *Ed Damer*

Cooperators: George Ishag George and Mahgoub Mohd. Mahgoub

Latitude: 17° 35′ N

Longitude: 33° 27′ E

Elevation: 107 meters above sea level

Date of planting: November 28, 1964

Irrigations: 8. November 28, December 3, December 10, December 12 (1964) and January 3, January 15, January 29 and February 8 (1965)

Fertilizer used: 70 kg/ha of N applied as 333 kg/ha of ammonium sulphate (21% N)

Elevation: 430 meters above sea level
Date of planting: December 31, 1964
Irrigation: The experiment was irrigated every 10-13 days
General description of the weather conditions during time of test: normal and without frost
Fertilizer used: 50 kg/dunum of 13-13-21 (26-26-42 kg/ha of N - P_2O_5 K_2O? Editor's note: The dunum is a unit of land measure that may be 2,500 m^2 or 1,000 m^2 depending on the area. The 2,500 m^2 figure was used for the above calculation).
Weed, insect and pest problems: none
The data are presented in Tables 36 and 37.

JORDAN

Deir Alla Research Station
Cooperators: Z. Ghosheh and J. A. Quliziwi
Latitude: 32° 11′ N
Longitude: 35° 50′ E
Elevation: 226 meters *below* sea level
Date of planting: December 5, 1964 (germination December 17, 1964)
Precipitation during the cycle of the test: 298.9 mm. plus 4 irrigations.
General description of the weather conditions during time of test: normal with some eastern winds
Fertilizer used: none
Weed, insect and pest problems: hand weeded 2-3 times. Precautions were taken to prevent bird injury by planting early plots.
Dates when different notes were taken:
Diseases: January 10-April 20, 1965
Heading: April, 1965
Harvesting: May 29-30, 1965
The data are presented in Tables 38 and 39.

SYRIA

Kjarabo (near Damascus)
Cooperators: A. K. Koueider and G. S. Murty
Latitude: 33° 20′ N
Longitude: 36° 28′ E
Elevation: 617 meters above sea level
Date of planting: November 30, 1964
Precipitation during the cycle of the test: 150 mm plus 6 irrigations
General conditions of weather during time of test: "During the early part of the growing season the weather was good, later it was windy with frost; in the end was normal."
Fertilizer used: 500 kg/ha each of ammonium nitrate and super phosphate (105-80-0 kg/ha of N - P_2O_5 - K_2O?)
Disease development: "There was infection with different diseases like rust and bunt"
Weed, insect and pest problems: Field was hand worked 3 times. No other problem
Dates when different notes were taken:

Flowering: April 15 to May 6, 1965
Maturity: June 1 to 18, 1965
Height: May 28, 1965
Lodging: May 28, 1965
Harvesting: June 6 to 24, 1965

The data are presented in Tables 40 and 41.

LEBANON

Faculty of Agricultural Sciences, American University of Beirut, *Beirut*
Cooperator: W. W. Worzella
Latitude: 33° 28′ E
Longitude: 35° 28′ E
Elevation: 950 meters above sea level
Precipitation during time of test: 517 mm. (about 100 mm. above normal)
General description of weather conditions during time of test: "A late spring frost (March 31, 1965) injured a few of the early strains that were in the boot stage, greatly affecting the final yields.
Disease development: a very slight infection of rust making note taking not worthwhile
The data are found in Tables 42 and 43.

TURKEY

Plant Improvement Station, *Eskisehir*
Cooperators: Hüseyin Kutlak and Erol Karma
Latitude: 36° 45′ N
Longitude: 30° 95′ E
Elevation: 789 meters above sea level
Date of planting: November 6, 1964
General description of weather conditions during time of test: rainy spring and cool summer
Fertilizer used: 6 kg/decare of P_2O_5 applied as superphosphate (60 kg/ha of P_2O_5?)
Disease development: rather severe stripe rust
Dates when different notes were taken:

Frost damage: March 15, 1965
Height: July 1, 1965
Stripe rust: May 15, 1965
Leaf rust: May 30, 1965
Stem rust: June 15, 1965

The data are presented in Tables 44 and 45.

RUMANIA

The *Brasov* Agricultural Experiment Station of the Research Institute for Cereals and Industrial Plants
Cooperators: Balasoiu Alexandru and Stefanescu Adrian
Latitude: 45° 42′ N
Longitude: 25° 33′ E

Elevation: 496 meters above sea level
Date of planting: April 7, 1965 (emergence April 21-23)
Precipitation during the cycle of the test: 280.6 mm. "Although the precipitation quantity recorded during the April-July period was by 92.9 mm below the 49 year average recorded in this locality, the plants did not suffer from lack of water due to the moisture accumulated into the soil in autumn and winter and to a better distribution of rainfall during the growing period."
General description of weather conditions during time of test: early, cool spring followed by a normal summer favoring the growth of spring wheat.
Disease development: severe leaf rust, considerable stem rust and light stripe rust
Weed, insect and pest problems: weed eradication by hand
Dates when different notes were taken:
- Heading: June 1-25, 1965
- Maturity: July 15-31, 1965
- Stripe rust: July 5 and 15, 1965
- Leaf rust: June 25 and July 15, 1965
- Stem rust: July 15 and 28, 1965
- Powdery mildew: June 4 and 16, 1965
- Lodging: July 28 and August 4, 1965
- Shattering: August 19 and 26, 1965

The data are presented in Tables 46 and 47.

IRAQ

Abu-Ghraib Experiment Station, *Baghdad*
Cooperator: Omar Ali Ameen
Latitude: 33° 20′ N
Longitude: 44° 24′ E
Elevation: 34.1 meters above sea level
Date of planting: November 23, 1964 (germination December 7, 1964)
Precipitation during the cycle of test: 60 mm plus 4 irrigations
Fertilizer used: none
Weed, insect and pest problems: "Varieties C-271 and Napo were little sensitive to the birds." Plots were hand weeded 10 times.
Dates when different notes were taken:
- Heading: March 6-April 15, 1965
- Maturity: May 2-18, 1965
- Height: April 28, 1965
- Harvest: May 10-18, 1965

The data are presented in Tables 48 and 49.

IRAN

Ahwaz
Cooperator: M. Dadain
Latitude: 31° 20′ N
Longitude: 48° 40′ E
Elevation: 20 meters above sea level

Date of planting: November 6, 1964
Precipitation during cycle of the test: 125 mm plus 6 irrigations of approximately 100 mm each
General description of weather conditions during time of test: normal
Fertilizer used: none
Disease development: some
Weed, insect and pest problems: none
Dates when different notes were taken:
Stripe rust: March 15, 1965
Leaf and stem rust: March 30, 1965
Height, lodging and shattering: May 15, 1965
Harvest: May 17, 1965
The data are presented in Tables 50 and 51.

PAKISTAN

Agricultural Research Institute, *Tandojam*
Cooperators: Z. A. Munshi and wheat staff
Latitude: 25° 2′ N
Longitude: 63° 38′ E
Elevation: 191 meters above sea level
Irrigated: yes
The data are presented in Tables 52 and 53.

Ayub Agricultural Research Institute, *Lyallpur*
Cooperator: M. A. Aziz
Latitude: 31° 30′ N
Longitude: 73° 10′ E
Elevation: 213 meters above sea level
Date of planting: November 16, 1964
Precipitation during cycle of the test: 76 mm plus 5 irrigations of approximately 75 mm each
General description of the weather conditions during time of test: generally dry with light showers
Fertilizer used: 53 kg/ha of both N and P_2O_5 (i. e. 60 lb./A.) applied as ammonia sulphate and superphosphate, respectively
Disease development: some infection of stripe, leaf and stem rusts but not enough to cause low yields
Weed, insect and pest problems: no noticeable bird damage. "Wheat weevil caused small damage at germination stage and was controlled by dusting". Weeds controlled by hand
Dates when different notes were taken:
Stripe rust: February 28 and March 5, 1965
Leaf rust: March 18 and 31, 1965
Stem rust: March 31 and April 8, 1965
Frost damage (not analyzed): February 28, 1965
Height: April 12, 1965
Lodging: March 31, 1965
Shattering: May 8, 1965
The data are presented in Tables 54 and 55.

Agricultural Research Institute, *Tarnab*
Cooperator: Economic Botanist
Latitude: 33° 34′ N
Longitude: 67° 34′ E
Elevation: 338 meters above sea level
Date of planting: November 20, 1964 (germination November 30)
Precipitation during cycle of the test: heavy
General description of weather conditions during time of test: heavy rain delayed maturity
Fertilizer used: 18 kg/ha (i. e. 20 lb./A.) N and 27 kg/ha (i. e. 30 lb./A.) of P_2O_5 applied at sowing. An additional 18 kg/ha of N were applied later.
Disease development: abundant stripe and leaf rust
Weed, insect and pest problems: none
Dates when different notes were taken:
Yellow rust: March 10, 1965
Leaf and stem rust: May 8, 1965
Lodging: April 3 and 20, 1965
Harvesting and threshing: May 9-10, 1965
The data are presented in Tables 56 and 57

INDIA

Botanical Sub-Station, *Pusa, Bihar*
Cooperators: P. N. Narula and cooperators
Latitude: 25° 59′ N
Longitude: 85° 40′
Elevation: 165.7 meters above sea level
Date of planting: November 16, 1964 (germination November 22, 1964)
Precipitation during cycle of test: 25 mm plus 3 irrigations
General description of weather conditions during time of test:

	Temperature			
	Morning		Evening	
	Max.	Min.	Max.	Min.
November	80.0°	50.5°	88.0°	59.0°
December	80.0°	41.0°	80.0°	46.0°
January	80.0°	43.0°	80.0°	45.0°
February	85.0°	43.5°	85.0°	48.0°
March	95.0°	47.0°	94.0°	55.0°

Disease development: severe leaf and stem rust. Alternaria blight less severe than last year
Fertilizer used: 53 kg/ha (i. e. 60 lb./A.) N applied as ammonium sulphate and 36 kg/ha (i. e. 40 lb./A.) of P_2O_5 applied as superphosphate
Weed, insect and pest problems: severe bird damage in late varieties
Dates when notes were taken:
Leaf rust: first week on February
Stem rust: first week of March
Agronomical performance: middle of January and final week of March

The data are presented in Tables 58 and 59.
New Pusa (*Delhi*)
Cooperators: S. P. Kohli and staff
Latitude: 28° 24′
Longitude: 77° E
Elevation: 229 meters above sea level
Irrigations: 5 after planting
Fertilizer used: approximately 107-53-36 kg/ha of N - P_2O_5 - K_2O applied at planting and an additional 18 kg/ha of N later.
The data are presented in Table 60
College of Agriculture, Punjab Agricultural University, ***Ludhiana***
Cooperators: D. S. Athwal and staff
Latitude: 30° 33′ N
Longitude: 75° 24′ E
Elevation: 242 meters above sea level
Irrigations: 8
Fertilizer used: approximately 143 kg/ha of N and 32 kg/ha of P_2O_5
The data are presented in Tables 61 and 62.

AUSTRALIA

Agricultural Research Institute, *Wagga Wagga, N.S.W.*
Coopeartors: A. T. Pugsley and J. R. Syme
Latitude: 35° S
Longitude: 148° E
Elevation: 197 meters above sea level
Date of planting: June 28, 1965
Precipitation during cycle of the tests: 267 mm
General description of weather conditions during time of test: "Sown later than normal due to dry conditions, thereafter rainfall poor to medium
Fertilizer used: 17.6 kg/ha of P_2O_5 applied as 90 lb./A. of 22% superphosphate
Disease development: none
Weed, insect and pest problems: none
Dates when different notes were taken: straw strength and height taken at harvest on December 14, 1965
The data are presented in Tables 63 and 64.
Waite Agricultural Research Institute
Cooperators: K. W. Finlay and A. Rathjem
Latitude: 34° 58′ S
Longitude: 138° 38′ S
Elevation: 122 meters above sea level
Date of planting: August 14, 1966 (approximately 2 months later than average for this location because of dry weather)
Precipitation during cycle of the test: 178 mm
General description of weather conditions during time of test: no spring rains (causing late planting), soil dried out, unfavorable conditions.
Fertilizer used: 27 kg/ha (?) P_2O_5 applied as 140 lb./A. superphosphate (22% ?)
The data are presented in Tables 65 and 66.

TABLES

TABLE 1. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Castelar, ARGENTINA, 1964-65.

Variety or cross	Origin	Variety number	Yield kg/ha	Test wt. kg/hl	Days to flowering	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height cms.	1000 grain weight gms.
Pitic 62	Mexico	2	4316	78.3	75	1.10	3.45	3.00	86	36.5
Penjamo 62	Mexico	6	3949	81.1	69	1.00	1.47	1.00	76	39.7
Nainari 60	Mexico	19	3733	78.5	72	2.54	3.47	1.00	91	43.1
Pj sib x Gb 55 (White grain)	Mexico	24	3691	80.6	74	1.90	7.25	1.00	79	31.9
Giza 144	Egypt	9	3624	83.0	75	1.58	4.11	1.10	101	39.7
Nariño 59	Colombia	11	3558	82.4	69	1.00	8.52	5.19	98	38.9
Napo 63	Colombia	16	3508	80.3	65	1.00	6.70	1.00	95	37.9
CT-244	Canada	25	3474	81.0	83	1.10	1.00	1.00	108	36.0
Gaboto	Argentina	21	3358	82.4	77	1.00	1.00	1.46	106	32.2
Klein Rendidor	Argentina	17	3324	81.4	81	1.10	2.20	1.10	105	36.2
Giza 150	Egypt	5	3316	84.0	75	2.70	1.41	1.00	94	40.3
C-273	Pakistan	14	3299	84.4	68	1.00	7.79	5.59	103	42.5
Carazinho	Brazil	12	3241	81.7	75	1.36	2.96	3.80	108	38.8
Gabo	Australia	20	3191	77.8	69	8.84	1.00	1.00	89	38.7
Triple Dirk	Australia	8	3183	81.2	75	9.10	2.04	1.58	103	45.0
Crim	U.S.A.	22	3116	81.2	79	1.00	1.00	1.00	111	35.8
Sonora 64	Mexico	10	3049	79.8	63	1.58	1.00	1.00	73	35.7
Lerma Rojo 64A	Mexico	4	3024	80.7	68	1.10	9.53	3.28	85	37.1
Bonza 55	Colombia	18	2983	78.7	71	1.10	7.46	1.90	96	35.6
C-518	India	13	2974	84.1	70	1.00	8.97	6.26	94	38.4
Magnif 41	Argentina	1	2958	80.9	68	1.00	1.00	1.00	111	44.5
C-271	Pakistan	3	2783	79.8	67	1.00	8.75	7.46	86	39.8
Justin	U.S.A.	15	2483	78.3	86	1.00	6.98	1.00	106	32.4
Selkirk	Canada	7	2366	75.0	87	1.00	2.31	1.21	115	35.7
Thatcher	U.S.A.	23	1999	76.3	88	1.00	7.12	3.13	114	25.5
Mean			3220	80.5	74	1.88	4.34	2.28	97	37.5
Statistical level of significance			0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Coefficient of variation			10.8%	0.7%	1.8%	56.0%	34.3%	80.7%	4.7%	3.7%
Standard error			346	.60	1.36	1.05	1.49	1.84	4.6	1.4
Least significant difference, 5%			488	.85	1.92	1.48	2.10	2.59	6.5	2.0

TABLE 2. Correlations between the means of 8 variables and the multiple regression of yield on the means of 7 variables for the "1st International Spring Wheat Yield Nursery" grown at Castelar, ARGENTINA, 1964-65.

Correlations (r); d.f. = 23

	Yield	Test wt.	Days to flowering	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height
Test wt.	.40*						
Days to flowering	-.39	-.39					
Stripe rust $\sqrt{X+1}$	.04	-.10	-.11				
Leaf rust $\sqrt{X+1}$	-.22	.06	-.18	-.31			
Stem rust $\sqrt{X+1}$	-.15	.27	-.28	-.22	.67**		
Height	-.48*	-.07	.66**	-.10	-.16	-.07	
1000 grain wt.	.38	.42*	-.56**	.35	-.18	.12	-.13

Multiple regression
R^2 = .528
7 "independent" variables
constant term = -2834.014

	Partial regression coef.(b)	"t" d.f. = n-k-1 = 17
Test wt.	73.5104	1.736
Days to flowering	19.6432	.846
Stripe rust $\sqrt{X+1}$	-39.6049	-.900
Leaf rust $\sqrt{X+1}$	-24.4594	-.623
Stem rust $\sqrt{X+1}$	-48.4525	-.771
Height	-26.6477	-2.530*
1000 grain wt.	41.7710	1.404

* = Significant at the 5% level
** = Significant at the 1% level

TABLE 3. Yield, agronomic and disease data for the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Marcos Juarez, ARGENTINA, 1964-65.

Variety or cross	Origin	Variety number	Yield kg/ha	Test weight kg/hl	Days to: flowering	Days to: maturity	Stripe rust	Leaf rust	Stem rust	Height cms.	Lodging %	1000 grain weight gms.
Penjamo 62	Mexico	6	3333	75.0	61	107	0	5 MS	0	65	10	36.0
Crim	U.S.A.	22	3199	79.9	71	108	5 S	T S	0	100	10	33.6
Nariño 59	Colombia	11	3133	77.7	68	102	0	20 S	T	80	20	35.2
Nainari 60	Mexico	19	3116	72.5	68	110	5 S	5 S	T S	70	10	39.5
Pitic 62	Mexico	2	3083	66.0	66	105	0	100 S	0	70	0	28.4
Carazinho	Brazil	12	3058	78.2	68	108	5 S	30 S	50 S	80	30	35.6
Gaboto	Argentina	21	3050	80.4	69	106	0	5 S	T	85	25	31.4
CT-244	Canada	25	3000	79.0	72	105	10 S	0	0	90	5	31.4
Pj sib x Gb 55 (White grain)	Mexico	24	2983	73.7	70	112	10 S	30 S	5 S	60	0	27.0
Napo 63	Colombia	16	2924	78.2	58	108	0	50 S	0	75	0	31.6
Magnif 41	Argentina	1	2850	75.9	64	106	0	0	0	85	50	42.2
Triple Dirk	Australia	8	2849	78.4	70	108	80 S	20 S	0	95	20	36.0
Sonora 64	Mexico	10	2833	78.2	56	100	5 S	0	0	60	0	31.9
Gabo	Australia	20	2724	70.1	61	106	60 S	20 S	T	70	15	31.6
Giza 144	Egypt	9	2699	75.9	66	106	30 S	80 S	0	90	20	34.0
Giza 150	Egypt	5	2683	78.2	60	104	20 S	100 S	0	70	15	31.3
Bonza 55	Colombia	18	2408	70.8	66	110	0	50 MS-S	T	75	0	27.5
C-273	Pakistan	14	2333	80.8	61	109	0	15 S	10 S	85	40	37.2
Lerma Rojo 64 A	Mexico	4	2324	74.1	61	106	0	100 S	0	75	20	32.0
C-271	Pakistan	3	2316	69.6	61	106	0	80 S	40 S	80	50	30.0
Selkirk	Canada	7	2308	72.8	73	108	10 S	30 S	0	90	0	30.5
Justin	U.S.A.	15	2191	77.9	74	109	0	40 S	0	90	15	25.6
Klein Rendidor	Argentina	17	2041	73.2	71	108	5 S	90 S	15 S	80	30	25.4
C-518	India	13	2033	77.7	66	108	0	20 MS	20 S	60	40	30.8
Thatcher	U.S.A.	23	1666	70.3	76	110	0	100 S	30 S	105	0	19.0
Mean			2685	75.4	66	107	2.48[1/]	5.51[1/]	2.14[1/]	79	3.72[1/]	31.8
Statistical level of significance			0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)
Coefficient of variation			8.3%									
Standard error			224									
Least significant difference, 5%			316									

[1/] Mean of coefficient or percentage transformed to $\sqrt{X+1}$

TABLE 4. Correlations between the means of 10 variables and the multiple regression of yield on the means of 9 variables for the "1st International Spring Wheat Yield Nursery" grown at Marcos Juarez, ARGENTINA, 1964-65.

Correlations (r); d.f. = 23

Multiple regression
R^2 = .623
9 "independent" variables
constant term = 3182.514

	Yield	Test wt.	Days to flowering	Days to maturity	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height	Lodging $\sqrt{\%+1}$	Partial regression coef. (b)	"t" d.f. = n-k-1 = 15
Test wt.	.24									7.9828	.351
Days to flowering	-.22	-.06								22.0013	1.010
Days to maturity	-.28	-.17	.49*							-35.5113	-1.099
Stripe rust $\sqrt{X+1}$	.15	.03	.03	-.05						7.1089	.215
Leaf rust $\sqrt{X+1}$	-.52**	-.51**	.02	.13	-.02					-4.6483	-.139
Stem rust $\sqrt{X+1}$	-.44*	-.15	.13	.27	-.23	.28				4.0314	.081
Height	-.23	.18	.60**	.19	.11	.05	.06			-8.2790	-1.058
Lodging $\sqrt{\%+1}$	-.13	.30	-.16	-.09	-.02	-.07	.37	.09		-99.2033	-1.996
1000 grain wt.	.60**	.40*	-.40*	-.24	.14	-.58**	-.27	-.11	.45*	71.2945	2.796*

* = Significant at the 5% level
** = Significant at the 1% level

TABLE 5. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Pergamino, ARGENTINA, 1964.

Variety or cross	Origin	Variety number	Yield kg/ha	Days to flowering	Stripe rust	Leaf rust	Stem rust	Height cms.	1000 grain weight gms.	Septoria %
Sonora 64	Mexico	10	5249	83	10	0	0	85	34.0	20
Pitic 62	Mexico	2	5241	92	5	20	0	90	36.8	40
Pj sib x Gb 55 (White grain)	Mexico	24	4957	94	0	10	0	85	36.0	40
Napo 63	Colombia	16	4783	79	0	60	20	105	32.0	20
Nainari 60	Mexico	19	4616	92	10	0	0	110	40.0	30
Penjamo 62	Mexico	6	4316	89	10 R	5 R	0	90	39.6	20
Gabo	Australia	20	4232	90	60	VR	0	105	40.0	20
Triple Dirk	Australia	8	3982	95	60	10	5	120	38.0	20
Nariño 59	Colombia	11	3958	91	0	20	0	105	40.0	10
Bonza 55	Colombia	18	3841	93	20	80	0	115	36.0	5
Carazinho	Brazil	12	3716	97	20	20	80	115	36.0	10
Klein Rendidor	Argentina	17	3674	98	5	40	60	110	34.0	20
Gaboto	Argentina	21	3666	96	0	0	20	110	32.0	20
Giza 150	Egypt	5	3616	92	0	20	0	100	38.0	20
Crim	U.S.A.	22	3458	97	10	5 R	0	115	34.0	10
CT-244	Canada	25	3458	102	0	0	0	115	28.0	40
Giza 144	Egypt	9	3449	94	0	60	0	120	37.6	20
Lerma Rojo 64 A	Mexico	4	3433	85	0	80	0	95	30.8	30
Magnif 41	Argentina	1	3250	86	0	0	0	100	40.2	40
C-273	Pakistan	14	3216	88	0	10	80	115	38.0	10
C-271	Pakistan	3	3174	86	0	10	80	100	36.0	20
C-518	India	13	2641	91	10	30	80	100	32.4	30
Selkirk	Canada	7	2533	106	0	10	0	120	32.0	30
Justin	U.S.A.	15	2375	106	10	40	0	120	30.0	10
Thatcher	U.S.A.	23	2341	108	0	80	0	125	28.0	10
Mean			3727	93	2.44[1]	4.20[1]	2.89[1]	107	35.2	4.64[1]
Statistical level of significance			0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)
Coefficient of variation			13.1%							
Standard error			487							
Least significant difference, 5%			686							

[1] Mean of coefficients or percentages transformed to $\sqrt{X+1}$

TABLE 6. Correlations between the means of 8 variables and the multiple regression of yield on the means of 7 variables for the "1st Internationl Spring Wheat Yield Nursery" grown at Pergamino, ARGENTINA, 1964.

Correlations (r); d.f. = 23

Multiple regression: $R^2 = .572$; 7 "independent" variables; constant term = 9322.747

	Yield	Days to flowering	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height	Septoria $\sqrt{\%+1}$	Partial regression coef. (b)	"t" d.f. = n-k-1 = 17
Days to flowering	-.56**							-31.9121	-1.130
Stripe rust $\sqrt{X+1}$	.19	.04						95.7563	1.349
Leaf rust $\sqrt{X+1}$	-.28	.10	-.13					-19.3711	-.349
Stem rust $\sqrt{X+1}$	-.22	-.17	-.01	.07				-57.8746	-1.309
Height	-.63**	.65**	.17	.26	.08			-30.3943	-1.713
Septoria $\sqrt{\%+1}$	.26	-.16	-.23	-.34	-.18	-.49*		1.3004	.009
1000 grain wt.	.43*	-.46*	.27	-.35	-.05	-.28	.00	18.0197	.403

* = Significant at the 5% level

** = Significant at the 1% level

TABLE 6. Correlations between the means of 8 variables and the multiple regression of yield on the means of 7 variables for the "1st Internationl Spring Wheat Yield Nursery" grown at Pergamino, ARGENTINA, 1964.

Correlations (r); d.f. = 23

Multiple regression: R^2 = .572; 7 "independent" variables; constant term = 9322.747

	Yield	Days to flowering	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height	Septoria $\sqrt{\%+1}$	Partial regression coef. (b)	"t" d.f. = n-k-1 = 17
Days to flowering	-.56**							-31.9121	-1.130
Stripe rust $\sqrt{X+1}$	.19	.04						95.7563	1.349
Leaf rust $\sqrt{X+1}$	-.28	.10	-.13					-19.3711	-.349
Stem rust $\sqrt{X+1}$	-.22	-.17	-.01	.07				-57.8746	-1.309
Height	-.63**	.65**	.17	.26	.08			-30.3943	-1.713
Septoria $\sqrt{\%+1}$	.26	-.16	-.23	-.34	-.18	-.49*		1.3004	.009
1000 grain wt.	.43*	-.46*	.27	-.35	-.05	-.28	.00	18.0197	.403

* = Significant at the 5% level

** = Significant at the 1% level

TABLE 7. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Parana, ARGENTINA, 1964.

Variety or cross	Origin	Variety number	Yield kg/ha	Test wt. kg/hl	Days to: flowering	Days to: maturity	Stripe rust	Leaf rust	Stem rust %	Height cms.	1000 grain weight gms.
Nainari 60	Mexico	19	2999	73.9	70	110	10 S	0	4	85	40.0
Triple Dirk	Australia	8	2725	78.4	72	120	80 S	0	1	95	39.5
Pitic 62	Mexico	2	2599	72.5	71	111	5 S	60 S	1	81	29.6
Magnif 41	Argentina	1	2541	77.0	67	110	5 S	0	1	96	40.1
Gaboto	Argentina	21	2458	79.5	73	114	0	0	40	93	32.3
Giza 150	Egypt	5	2449	79.7	67	114	10 S	20 MS	5	74	33.0
C-273	Pakistan	14	2366	82.0	71	114	0	40 S	30	93	34.5
Gabo	Australia	20	2350	71.2	89	112	40 S	T S	10	80	31.2
CT-244	Canada	25	2316	80.2	84	122	T R	0	1	83	30.4
Nariño 59	Colombia	11	2308	77.0	68	110	0	20 MS	0	85	35.2
Giza 144	Egypt	9	2249	80.8	73	120	10 S	10 S	5	85	38.7
Penjamo 62	Mexico	6	2233	74.6	68	110	20 S	0	0	74	36.0
Pj sib x Gb 55 (White grain)	Mexico	24	2216	74.8	71	111	5 R-5S	20 S	1	78	29.5
Lerma Rojo 64 A	Mexico	4	2158	77.3	64	110	0	60 S	0	76	30.1
Carazinho	Brazil	12	2158	78.2	75	120	0	5 MS	10	89	37.5
Sonora 64	Mexico	10	2149	75.9	62	108	5 S	0	1	60	30.1
Napo 63	Colombia	18	2149	76.1	60	108	0	40 S	0	84	33.7
Crim	U.S.A.	22	2141	79.3	77	114	0	5 MS	0	94	33.7
Klein Rendidor	Argentina	17	1858	78.2	79	122	5 S	30 S	80	78	31.6
C-518	India	13	1816	78.4	72	114	0	5 MR	30	76	30.0
C-271	Pakistan	3	1808	74.8	67	114	0	60 S	50	76	35.1
Bonza 55	Colombia	18	1766	72.5	71	111	0	15 S	2	90	29.7
Justin	U.S.A.	15	1724	77.7	92	125	0	5 MR	0	85	30.1
Selkirk	Canada	7	1641	73.7	92	125	0	10 MS	0	88	32.5
Thatcher	U.S.A.	23	1449	74.3	90	125	0	50 S	20	104	22.1
Mean			2185	76.7	73.0	114.9	2.2[1]	3.7[1]	2.8[1]	84	33.0
Statistical level of significance			0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	0.5%	(only 1 rep.)
Coefficient of variation			17.0							9.1%	
Standard error			372							7.6	
Least significant difference, 5%			524							10.7	

[1] Mean of data transformed $\sqrt{X+1}$

TABLE 8. Correlations between the means of 9 variables and the multiple regression of yield on the means of 8 variables for the "1st International Spring Wheat Yield Nursery" grown at Parana, ARGENTINA, 1964.

Correlations (r); d.f. = 23

Multiple regression
R^2 = .709
10 "independent" variables
constant term=2606.269

	Yield	Test wt.	Days to flowering	Days to maturity	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height	Partial regression coef. (b)	"t" d.f. = n-k-1 = 16
Test wt.	.14								52.1198	2.160
Days to flowering	-.50*	.05							30.4238	1.361
Days to maturity	-.46*	.26	.89**						-71.5881	-2.331
Stripe rust $\sqrt{X+1}$	.52**	.17	-.22	-.06					118.9120	2.910
Leaf rust $\sqrt{X+1}$	-.30	-.13	-.15	-.09	-.38				17.2640	.639
Stem rust $\sqrt{X+1}$	-.25	.20	.08	.23	-.14	.20			-3.8655	-.160
Height	-.02	.13	.44*	.39*	-.10	.00	.03		2.7936	.431
1000 grain wt.	.62**	.26	-.36	-.19	.38	-.35	-.13	.09	31.4273	1.873

* = Significant at the 5% level
** = Significant at the 1% level

TABLE 9. Yield, agronomic and disease data for the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at "La Platina", Santiago, CHILE, 1964-65.

Variety or cross	Origin	Variety number	Yield kg/ha	Days to flowering	Stripe rust %	Leaf rust	Stem rust	Height cms.	Lodging %
Lerma Rojo 64 A	Mexico	4	7878	87	5	0	T R	92	20
Nainari 60	Mexico	19	7424	87	10	0	0	104	5
Napo 63	Colombia	16	6887	84	10	90 S	0	104	10
Bonza 55	Colombia	18	6670	87	0	10 S	0	116	30
Nariño 59	Colombia	11	6615	86	0	0	T R	107	15
Giza 144	Egypt	9	6445	87	20	60 S	0	114	10
Penjamo 62	Mexico	6	6328	86	10	40 S	0	92	10
Klein Rendidor	Argentina	17	6253	93	T	0	5 MS-MR	114	20
Carazinho	Brazil	12	6083	91	10	0	30 MS-MR	114	50
CT-244	Canada	25	5007	95	10	0	0	120	15
Magnif 41	Argentina	1	5841	82	15	0	0	115	15
Gaboto	Argentina	21	5558	94	15	0	T MS	113	50
Crim	U.S.A.	22	5528	88	60	0	0	121	30
C-273	Pakistan	14	5437	84	0	0	90 S	115	10
Justin	U.S.A.	15	5245	100	0	0	15 MS	125	0
C-518	India	13	5216	85	0	15 S	60 S	101	5
Pj sib x Gb 55 (White grain)	Mexico	24	5182	88	50	30 S	0	98	5
Selkirk	Canada	7	5178	99	0	30 S	0	130	5
Giza 150	Egypt	5	5032	86	70	100 S	0	105	15
Pitic 62	Mexico	2	4978	89	80	30 S	0	90	10
Sonora 64	Mexico	10	4832	86	50	30 S	0	80	5
Triple Dirk	Australia	8	4549	87	80	0	0	120	5
Gabo	Australia	20	4307	86	90	0	T MS	102	15
Thatcher	U.S.A.	23	4107	100	20	90 S	T MS	125	15
C-271	Pakistan	3	3912	85	0	80 S	80 S	89	10
Mean			5656	89	4.10[1]	3.79[1]	2.29[1]	108	3.76[1]
Statistical level of significance			0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)
Coefficient of variation			13.3%						
Standard error			751						
Least significant difference, 5%			1058						

[1] Mean of data transformed $\sqrt{X+1}$

TABLE 10. Correlations between the means of 7 variables and the multiple regression of yield on 6 variables for the "1st International Spring Wheat Yield Nursery" grown at "La Platina", Santiago, CHILE, 1964-65.

Correlations (r); d.f. = 23

	Yield	Days to flowering	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height
Days to flowering	-.20					
Stripe rust $\sqrt{X+1}$	-.40*	-.18				
Leaf rust $\sqrt{X+1}$	-.29	-.05	.13			
Stem rust $\sqrt{X+1}$	-.29	-.18	-.47*	-.01		
Height	-.03	.58**	-.22	-.28	-.10	
Lodging $\sqrt{\%+1}$	.22	.01	.00	-.25	-.11	.15

* = Significant at the 5% level
** = Significant at the 1% level

Multiple regression
R^2 = .715
6 "independent" variables
constant term = 15865.000

Partial regression coef. (b)	"t" d.f. = n-k-1 = 18
-84.1827	-2.656**
-277.7083	-5.392**
-66.3076	-1.628
-287.4489	-4.941**
-8.8959	-.698
75.7943	.832

TABLE 11. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Quito, ECUADOR, 1965.

Variety or cross	Origin	Variety number	Yield kg/ha	Test wt. kg/hl	Days to: flowering	Days to: maturity	Stripe rust[1/] Leaf $\sqrt{X+1}$	Stripe rust[1/] head $\sqrt{\%+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height cms.	Lodging $\sqrt{\%+1}$	1000 grain weight gms.
Napo 63	Colombia	16	6138	75.1	70	190	1.41	1.00	2.23	1.00	115	1.00	44.4
Justin	U.S.A.	15	4103	75.0	108	211	1.41	2.62	1.00	1.10	141	1.72	34.1
Bonza 55	Colombia	18	3852	77.1	100	199	1.82	1.41	1.00	1.00	144	3.09	42.2
Nariño 59	Colombia	11	3816	74.6	79	191	3.80	1.41	1.00	2.23	118	1.00	39.3
Pitic 62	Mexico	2	3791	68.4	102	209	6.23	5.07	1.41	1.10	122	4.19	37.5
Gaboto	Argentina	21	2838	67.4	106	199	2.90	7.46	1.00	1.82	152	6.59	27.5
C-271	Pakistan	3	2451	77.8	86	184	2.23	1.41	1.31	7.64	119	1.00	36.3
Nainari 60	Mexico	19	2206	69.2	99	195	6.77	7.25	1.00	3.84	128	1.00	38.3
Selkirk	Canada	7	2108	77.9	106	205	1.00	1.00	1.31	1.00	150	2.88	37.1
CT-244	Canada	25	1920	73.7	106	209	3.35	6.38	1.00	2.03	125	1.72	33.4
C-518	India	13	1531	81.4	88	199	1.00	1.41	1.00	5.63	120	1.00	37.3
C-273	Pakistan	14	1482	80.7	88	195	1.21	1.41	1.10	4.71	115	1.00	42.4
Magnif 41	Argentina	1	1383	68.1	86	186	2.90	6.54	1.00	1.00	140	1.00	35.9
Penjamo 62	Mexico	6	1290	66.1	86	180	7.80	9.13	1.00	1.31	99	1.00	31.3
Klein Rendidor	Argentina	17	955	69.7	124	217	5.32	6.59	1.00	2.51	130	1.00	34.3
Thatcher	U.S.A.	23	928	67.1	113	211	5.67	7.80	1.00	1.41	137	1.00	25.2
Lerma Rojo 64A	Mexico	4	582	51.6	86	180	8.85	9.65	1.00	1.00	102	1.00	19.6
Pj sib x Gb 55 (White grain)	Mexico	24	560	57.0	97	197	6.19	9.40	1.00	1.41	94	1.00	25.3
Giza 144	Egypt	9	523	60.8	95	205	3.31	9.40	1.00	1.00	143	1.58	26.5
Giza 150	Egypt	5	475	58.2	88	186	4.83	8.99	1.00	1.21	120	1.00	25.7
Carazinho	Brazil	12	413	63.9	106	215	7.96	8.55	1.00	1.41	145	3.87	26.4
Gabo	Australia	20	340	60.3	89	195	7.95	9.53	1.00	1.82	105	1.00	24.0
Triple Dirk	Australia	8	201	52.9	93	211	8.09	9.76	1.00	1.00	136	1.00	18.4
Sonora 64	Mexico	10	122	55.2	78	186	8.85	9.99	1.00	1.00	91	1.00	17.6
Crim	U.S.A.	22	82	57.5	88	201	6.19	8.73	1.00	1.00	127	1.00	22.5
Mean			1763	67.4	95	198	4.68	6.07	1.09	2.01	124	1.71	31.3
Statistical level of significance			0.5%	0.5%	(only 1	(only 1	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Coefficient of variation			18.7%	2.9%	rep.)	rep.)	11.9%	9.2%	6.6%	26.7%	4.5%	34.5%	7.7%
Standard error			329	2.0			.56	.56	.07	.54	5.6	.59	2.4
Least significant difference, 5%			464	2.8			.79	.79	.10	.76	7.9	.83	3.4

[1/] Two notes were taken, but only the second was used for analysis.

TABLE 12. Correlations between the means of 11 variables and the multiple regression of yield on the means of 10 variables for the "1st International Spring Wheat Yield Nursery" grown at Quito, ECUADOR, 1965.

Correlations (r); d.f. = 23

Multiple regression
R^2 = .811
10 "independent" variables
constant term = 2641.393

	Yield	Test wt.	Days to flowering	Days to maturity	Stripe rust, leaf $\sqrt{X+1}$	Stripe rust, head $\sqrt{\%+1}$	Leaf rust $\sqrt{X+1}$	Stem rust $\sqrt{X+1}$	Height	Lodging $\sqrt{\%+1}$	Partial regression coef. (b)	"t" d.f. = n-k-1 = 14
Test wt.	.65**										-23.4270	-.275
Days to flowering	-.10	.12									5.4464	.178
Days to maturity	-.02	.12	.79**								-12.3218	-.392
Stripe rust, leaf $\sqrt{X+1}$	-.59**	-.82**	-.03	.08							38.0062	.256
Stripe rust, head $\sqrt{\%+1}$	-.74**	-.91**	.08	-.02	.83**						-238.5594	-1.483
Leaf rust $\sqrt{X+1}$	.65**	.31	-.35	-.12	-.33	-.46*					1644.9984	1.680
Stem rust $\sqrt{X+1}$	.05	.53**	-.10	-.17	-.34	-.45*	.00				-209.4184	-1.374
Height	.20	.31	.56**	.59**	-.44*	-.24	-.07	-.13			-4.6848	-.258
Lodging $\sqrt{\%+1}$	.28	.13	.41*	.33	-.14	-.07	.03	-.19	.54**		257.0980	1.534
1000 grain wt.	.76**	.90**	-.01	-.01	-.73**	-.86**	.46*	.38	.22	.07	85.1896	1.328

* = Significant at the 5% level
** = Significant at the 1% level

TABLE 13. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Tibaitata, COLOMBIA, 1965.

Variety or cross	Origin	Variety number	Yield kg/ha	Days to flowering	Root rot (scale)	Stripe rust Leaf $\sqrt{X+1}$	Stripe rust Head $\sqrt{\%+1}$	Stem rust $\sqrt{X+1}$	Bird damage $\sqrt{\%+1}$	Height cms.	Lodging $\sqrt{\%+1}$	Shattering $\sqrt{\%+1}$	1000 grain wt. gms.
Napo 63	Colombia	16	4283	70	1.75	1.21	1.00	1.41	1.36	93	2.62	1.00	43.9
Lerma Rojo 64 A	Mexico	4	4212	75	2.25	6.33	4.96	1.31	1.36	89	5.86	1.00	40.0
Penjamo 62	Mexico	6	3995	77	1.25	2.13	2.57	1.21	2.08	81	4.18	1.08	42.5
Nainari 60	Mexico	19	3795	83	2.25	4.26	5.21	3.45	1.00	98	4.69	1.06	43.9
C-273	Pakistan	14	2916	74	2.50	1.31	3.27	2.36	1.36	95	6.20	1.00	43.1
Pj sib x Gb 55	Mexico	24	2708	83	2.00	3.74	6.73	1.00	1.72	76	1.72	1.03	34.4
Bonza 55	Colombia	18	2453	86	2.00	1.31	1.67	1.21	5.17	110	6.84	1.00	42.6
C-271	Pakistan	3	2066	72	2.50	1.21	5.56	5.28	1.36	84	2.50	1.00	44.8
Gaboto	Argentina	21	1904	94	2.00	2.91	4.29	2.41	7.49	119	9.23	1.00	33.4
C-518	India	13	1762	77	3.50	1.10	2.44	2.60	1.94	86	6.25	1.00	33.4
Pitic 62	Mexico	2	1737	88	3.25	8.11	6.38	1.41	1.36	93	8.97	1.03	28.5
Nariño 59	Colombia	11	1683	71	2.25	1.00	1.00	3.49	3.61	93	3.85	1.23	41.4
CT-244	Canada	25	1600	89	2.00	2.57	3.58	2.25	4.22	100	6.42	1.03	35.5
Selkirk	Canada	7	1562	93	2.00	5.10	3.04	1.00	4.41	115	4.36	1.00	37.9
Gabo	Australia	20	1466	77	4.50	8.27	7.71	1.86	1.00	83	1.00	1.00	31.0
Carazinho	Brazil	12	1412	101	2.50	2.84	3.30	3.73	5.07	119	8.61	1.00	39.9
Giza 144	Egypt	9	1124	83	2.75	2.95	7.49	1.10	2.08	86	2.47	1.00	38.1
Magnif 41	Argentina	1	1029	75	3.25	7.18	9.88	1.10	1.00	95	1.90	1.00	31.6
Justin	U.S.A.	15	787	101	1.75	1.76	1.10	1.10	9.18	111	6.27	1.00	35.6
Giza 150	Egypt	5	770	80	4.00	5.77	9.13	1.21	1.00	86	1.94	1.00	35.6
Klein Rendidor	Argentina	17	629	118	2.75	2.08	1.00	7.51	5.86	98	8.70	1.00	36.5
Thatcher	U.S.A.	23	541	103	2.00	3.47	1.36	1.31	9.25	110	5.32	1.00	30.4
Sonora 64	Mexico	10	241	72	5.00	8.85	10.00	1.70	1.00	69	1.00	1.00	23.8
Crim	U.S.A.	22	233	82	5.00	8.28	9.88	1.00	1.00	98	2.86	1.00	27.4
Triple Dirk	Australia	8	162	81	5.00	9.26	10.00	1.21	1.00	88	1.00	1.00	30.5
Mean			1803	84	2.80	4.12	4.90	2.13	3.04	95	4.59	1.02	36.2
Statistical level of significance			0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	25.0%	0.5%
Coefficient of variation			37.4%	2.4%	17.0%	28.2%	21.7%	27.8%	41.3%	8.6%	39.4%	8.1%	8.5%
Standard error			674	2.04	.48	1.16	1.06	.59	1.25	8.2	1.81	.08	3.09
Least significant difference, 5%			950	2.87	.68	1.63	1.41	.83	1.76	11.6	2.55	.11	4.35

TABLE 14. Correlations between the means of 11 variables and the multiple regression of yield on the means of 10 variables for the "1st International Spring Wheat Yield Nursery" grown at Tibaitata, COLOMBIA, 1965.

Correlations (r); d.f. = 23

Multiple regression
R^2 = .898
10 "independent" variables
constant term = 11322.000

	Yield	Days to flowering	Root rot	Stripe rust, leaf $\sqrt{X+1}$	Stripe rust, head $\sqrt{\%+1}$	Stem rust $\sqrt{X+1}$	Bird damage $\sqrt{\%+1}$	Height	Lodging $\sqrt{\%+1}$	Shattering $\sqrt{\%+1}$	Partial regression coef. (b)	"t" d.f. = n-k-1 = 14
Days to flowering	-.38										-40.1504	-1.963
Root rot	-.61**	-.24									-805.4787	-3.502**
Stripe rust, leaf $\sqrt{X+1}$	-.39	-.16	.76**								242.6621	2.610*
Stripe rust, head $\sqrt{\%+1}$	-.38	-.38	.78**	.82**							-168.8282	-2.075
Stem rust $\sqrt{X+1}$	-.04	.34	-.10	-.39	-.33						-25.8220	-.229
Bird damage $\sqrt{\%+1}$	-.25	.77**	-.49*	-.43*	-.63**	.14					-170.1711	-1.379
Height	-.10	.64**	-.43*	-.30	-.49*	.07	.74**				-19.2741	-1.105
Lodging $\sqrt{\%+1}$	.13	.62**	-.46*	-.41*	-.61**	.36	.58**	.66**			130.2162	1.767
Shattering $\sqrt{\%+1}$	.19	-.26	-.24	-.25	-.28	.15	-.03	-.12	-.04		-4979.3320	-1.778
1000 grain wt.	.71**	-.14	-.69**	-.72**	-.57**	.31	.00	.17	.17	.28	77.3889	1.596

* = Significant at the 5% level
** = Significant at the 1% level

TABLE 15. Yield, agronomic and disease data for the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at Quezaltenango, GUATEMALA, 1964.

Variety or cross	Origin	Variety number	Yield kg/ha	Days to: flowering	Days to: maturity	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	Height cms.	Lodging %	Shattering %	1000 grain wt. gms.	Septoria	Frost	"Raquis" %
Napo 63	Colombia	16	3093	56	120	1.00	7.64	95	5	5	29	2.00	1	0
Nariño 59	Colombia	11	2735	59	135	1.00	1.00	110	10	25	30	0	2	10
Lerma Rojo 64 A	Mexico	4	2274	60	125	5.74	1.21	90	0	5	27	1.75	2	1
Penajmo 62	Mexico	6	1929	63	130	1.00	1.00	85	0	5	23	2.00	1	0
Nainari 60	Mexico	19	1712	73	140	4.83	1.00	105	5	0	20	2.00	2	0
C-273	Pakistan	14	1552	64	140	1.00	1.00	115	20	0	23	2.00	3	5
Magnif 41	Argentina	1	1242	66	135	4.19	1.00	110	10	0	25	2.00	2	25
C-271	Pakistan	3	1222	67	145	1.10	1.21	115	5	0	20	1.75	4	5
Pitic 62	Mexico	2	1214	81	157	1.00	1.00	105	0	0	16	0	3	0
Pj sib x Gb 55 (White grain)	Mexico	24	1014	69	145	6.75	1.00	70	0	0	14	2.00	2	0
Selkirk	Canada	7	880	87	150	1.00	1.00	125	10	0	18	0	4	0
Crim	U.S.A.	22	838	74	145	5.32	1.00	120	30	0	16	2.00	3	1
Giza 150	Egypt	5	843	67	140	7.48	1.00	115	35	0	21	2.00	2	0
Giza 144	Egypt	9	788	78	150	4.57	1.00	120	10	1	21	1.25	3	0
Sonora 64	Mexico	10	749	56	120	9.65	1.00	80	0	1	16	2.00	1	0
Bonza 55	Colombia	18	738	77	145	1.00	1.00	125	60	1	13	1.50	3	0
Gabo	Australia	20	709	68	145	8.53	1.00	85	0	0	15	2.00	2	0
Triple Dirk	Australia	8	639	69	145	9.99	1.00	110	25	1	17	2.00	3	0
C-518	India	13	593	71	145	1.31	1.10	110	0	0	19	2.00	3	0
Gaboto	Argentina	21	544	86	155	8.41	1.00	125	20	0	13	1.25	2	0
Carazinho	Brazil	12	425	88	160	6.35	1.00	125	80	0	15	1.00	3	1
CT-244	Canada	25	416	83	155	3.07	1.00	105	10	0	15	2.00	3	0
Justin	U.S.A.	15	274	92	160	1.00	1.00	115	5	0	12	2.00	4	1
Thatcher	U.S.A.	23	104	94	160	3.37	7.94	110	0	0	8	1.25	4	0
Klein Rendidor	Argentina	17	(No data available)			—	—	—	—	—	—	—	—	—
Mean			1105	73	144	4.11	1.58	107	3.20[1/]	1.42[1/]	18.6	1.57	2.58	1.46[1/]
Statistical level of significance			0.5%	0.5%	(only 1 rep.)	0.5%	0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)	0.5%	(only 1 rep.)	(only 1 rep.)
Coefficient of variation			17.2%	1.6%		20.2%	11.8%					19.8%		
Standard error			190	1.1		.83	.19					.31		
Least significant difference, 5%			268	1.6		1.17	.26					.44		

1/ Mean of data transformed $\sqrt{\%+1}$

TABLE 16. Correlations between the means of 12 variables and the multiple regression of yield on 11 variables for the "1st International Spring Wheat Yield Nursery" grown at Quezaltenango, GUATEMALA, 1964.[1]

Correlations (r); d.f. = 23

Multiple regression: R^2 = .905; 11 "independent" variables; constant term = 1706.438

	Yield	Septoria	Days to flowering	Days to maturity	Stripe rust $\sqrt{X+1}$	Leaf rust $\sqrt{X+1}$	"Raquis" $\sqrt{\%+1}$	Height	Lodging $\sqrt{\%+1}$	Shattering $\sqrt{\%+1}$	1000 grain wt.	Partial regression coef. (b)	"t" d.f. = n-k-1 = 13
Septoria	-.09											-139.4451	-.980
Days to flowering	-.71**	-.33										-4.0623	-.204
Days to maturity	-.73**	-.33	.92**									-1.7690	-.099
Stripe rust $\sqrt{X+1}$	-.33	.31	-.10	-.07								-52.5591	-1.788
Leaf rust $\sqrt{X+1}$	.19	.02	.06	-.09	-.19							57.5700	1.419
"Raquis" $\sqrt{\%+1}$	.29	-.05	-.28	-.20	-.21	-.14						-61.4114	-.725
Height	-.32	-.36	.55**	.54**	-.25	-.09	.15					-11.3919	-1.048
Lodging $\sqrt{\%+1}$	-.22	-.08	.23	.27	.12	-.21	.07	.69**				38.4845	.722
Shattering $\sqrt{\%+1}$	.73**	-.33	-.50*	-.49*	-.24	.10	.26	-.18	-.11			77.4721	.639
1000 grain wt.	.88**	-.03	-.74**	-.72**	-.26	-.01	.48	-.14	-.11	.66**		88.8241	3.076**
Frost damage	-.56**	-.29	.71**	.76**	-.34	-.01	-.02	.63**	.20	-.40*	-.48	-109.2671	-.732

* = Significant at the 5% level
** = Significant at the 1% level
[1] Variety 17, Kelin Rendidor, was not used in any of the correlations or the multiple regression

TABLE 17. Yield, agronomic and disease data of the 25 varieties in the "1st International Spring Wheat Yield Nursery" grown at El Roque (CIAB), Guanajuato, MEXICO, 1964-65 (early planting).

Variety or cross	Origin	Variety number	Yield kg/ha	Days to: flowering	Days to: maturity	Stripe rust [1]	Height cms.	Lodging %
Nariño 59	Colombia	11	5574	91	140	5 R	120	100
Pitic 62	Mexico	2	5391	101	147	100 S	100	0
Bonza 55	Colombia	18	5249	102	145	20 MR	135	100
Napo 63	Colombia	16	5066	80	132	5 R	110	0
C-273	Pakistan	14	4857	97	141	5 R	120	100
C-518	India	13	4666	97	147	T R	110	100
C-271	Pakistan	3	4307	90	135	20 MR	105	100
Nainari 60	Mexico	19	4099	99	145	100 S	110	0
Gaboto	Argentina	21	4049	106	155	100 S	135	50
CT-244	Canada	25	3866	115	157	40 MR	135	0
Crim	U.S.A.	22	3749	103	149	80 S	140	100
Giza 144	Egypt	9	3741	100	147	80 S	125	100
Pj sib x Gb 55 (White grain)	Mexico	24	3707	102	151	80 MS	85	0
Magnif 41	Argentina	1	3507	93	137	40 MS	125	100
Penjamo 62	Mexico	6	3483	89	135	100 S	95	0
Giza 150	Egypt	5	3441	93	137	100 S	105	0
Thatcher	U.S.A.	23	3008	125	159	30 MR	140	60
Justin	U.S.A.	15	2816	122	158	T R	135	0
Gabo	Australia	20	2616	93	140	100 S	100	0
Sonora 64	Mexico	10	2583	78	130	100 S	75	0
Klein Rendidor	Argentina	17	2474	122	160	100 S	125	100
Carazinho	Brazil	12	2349	106	153	100 S	110	100
Selkirk	Canada	7	2333	120	155	T R	135	0
Lerma Rojo 64A	Mexico	4	2225	92	137	100 S	95	0
Triple Dirk	Australia	8	2158	100	147	100 S	115	0
Mean			3652	101	146	6.44 [2]		5.11 [2]
Statistical level of significance			0.5%	(only 1 rep.)	(only 1 rep.)	(only 1 rep.)		(only 1 rep.)
Coefficient of variation			11.0					
Standard error			401					
Least significant difference, 5%			565					

[1] Two notes were taken, but only the second was used for analysis.

[2] Mean of coefficient or percentage transformed $\sqrt{X+1}$