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NEW HIGH YIELDING ITALIAN *DURUM* WHEAT VARIETIES

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About twelve years ago when this work was planned very few breeders believed in the possibility to increase significantly the yielding capacity of the *Triticum durum* cultivars. The superiority in this sense of *T. aestivum* was apparently unquestionable. Indeed, generally speeking almost in every place the *durum* wheat varieties were yielding much less than the bread wheat ones (fig. 1).

The statistical data on countries production were showing even greater difference between these two species because as a whole, the *durum* wheat varieties were and are still grown in regions with rather poor soils and scarce rainfall. This is quite true in Italy as well as in the Mediterranean and Near East regions, where for centuries the crop was socially and economically associated with a rather poorly developed agriculture (Vallega, 1968; Bandini, 1969).

The species *T. durum* finds quite favourable conditions in the Mediterrenean area for its natural development but not always for the highest expression of its yielding capacity.

In big producer countries like Canada, USA, Argentina where both *durum* and bread wheats are grown in appropriated regions extensively and supported by an efficient breeding work, the difference is not so significant.

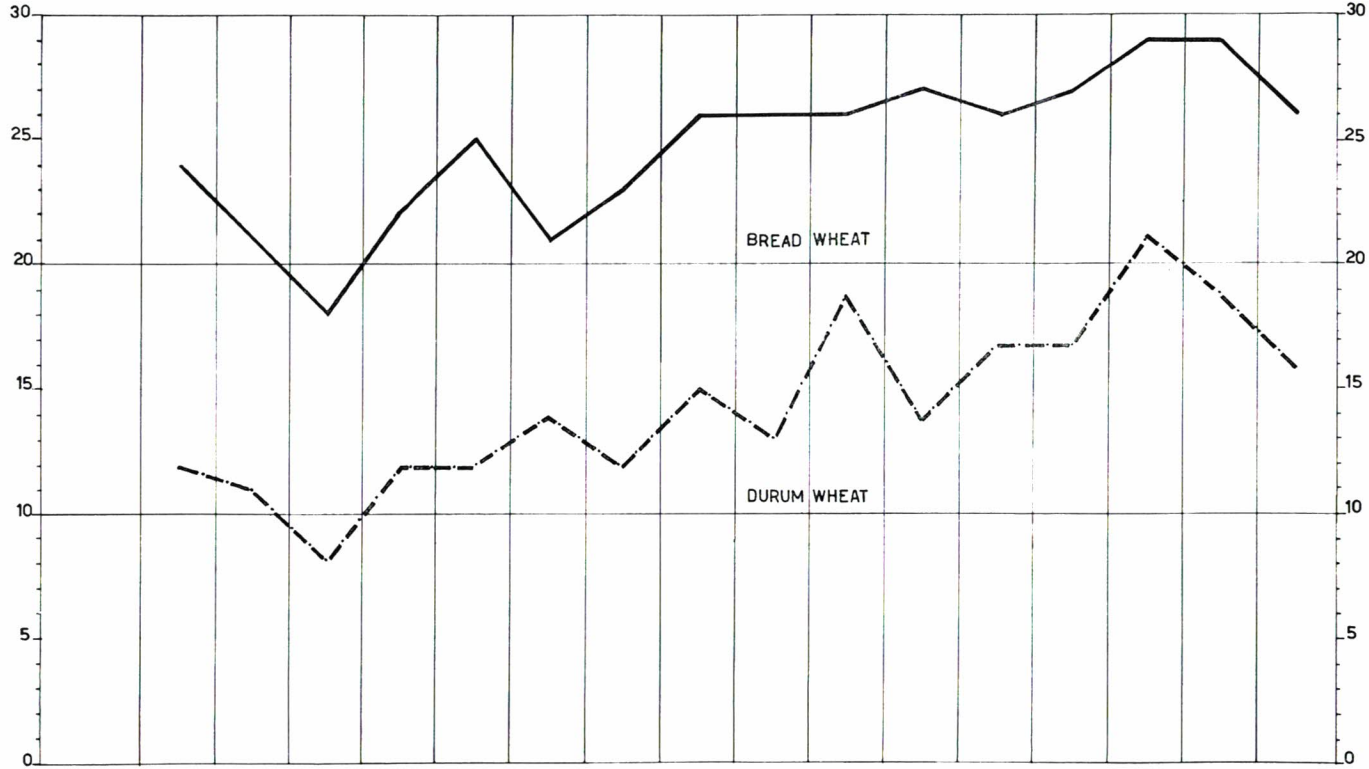
Moreover, negative characters put in evidence by the commonly cultivated *durum* wheat forms as low fertility of the spike, sensibility of the stem to lodging, together with the generalized belief of the limited genetic variability in *T. durum*, represented during years a great handicap to the breeding work and it was therefore neglected. Indeed, what was really missing was a sufficient basic research which, obviuosly, was heavily concentrated on *T. aestivum* which represents more than 95% of the total wheat world area.

No doubt that the genetic potentiallity of *T. durum* has not been sufficiently explored, not only through the study of the multiple forms which is possible to select (Vavilov, 1930) but even less through the possible combination that can be obtained by crossing among them and with other compatible species (Heuzè, 1896; De Rosa, 1919; De Cillis, E. 1927; Marro and Succi, 1931; De Cillis U., 1942; Ciferi and Bonvicini, 1959).

The autochtonous material « land varieties » during centuries cultivated in the Italian peninsula and its islands has suffered an inevitable

Fig. 1 - BREAD AND *DURUM* WHEAT PRODUCTION, QUINTALS PER Ha, IN ITALY - PERIOD 1958 - 1972

YEARS / WHEAT	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	AVERAGE
Bread	24	21	18	22	25	21	23	26	26	26	27	26	27	29	29	25
Durum	12	11	8	12	12	14	11	15	13	19	14	17	17	21	19	15
% D/B	50-	52-	44-	54 5/10	48-	66 6/10	47 8/10	57 7/10	50-	73 1/10	51 9/10	65 3/10	62 9/10	72-	65 5/10	



genetic erosion. This means that today, unfortunately, it will not be possible to recover but a minimum part of the genetic richness of the original material.

A revision of the results obtained in Italy in the *durum* breeding work indicated clearly that almost all of the old varieties were obtained through genealogical selections done in the « land varieties » (Todaro, 1921; Strampelli, 1932; Conti, 1948; De Cillis, 1964; etc). A number of crosses also have been made by several breeders, starting by Strampelli, but as a whole, within a very close genetic circle which included only few Italian varieties (fig. 2). Perphaps, it is for this reason that very little improvement has been obtained in connection with yielding capacity.

Strampelli (1932) in a little extent but mainly Forlani (1954) followed later by other breeders (Maliani, 1964; Rusmini, 1961) tried to use also interspecific crosses. This line of work was developed with big success in different countries through important programs (Washington and N. Dakota States; Rockefeller Foundation; Cimmyt; etc).

The breeding work carried on in Italy till the first part of the sixties, gave as a stricking result an outstanding variety: Capeiti (= Patrizio) which largely exceeded in yielding not only the « old populations » but also the improved varieties as Aziziah, Bidi, Dauno, Russello, Timilia, etc. including the famous Strampelli's variety Cappelli.

On the other side, Capeiti has a mediocre quality from the pastificable point of view (Cubadda, Fabriani and Lombardi, 1968).

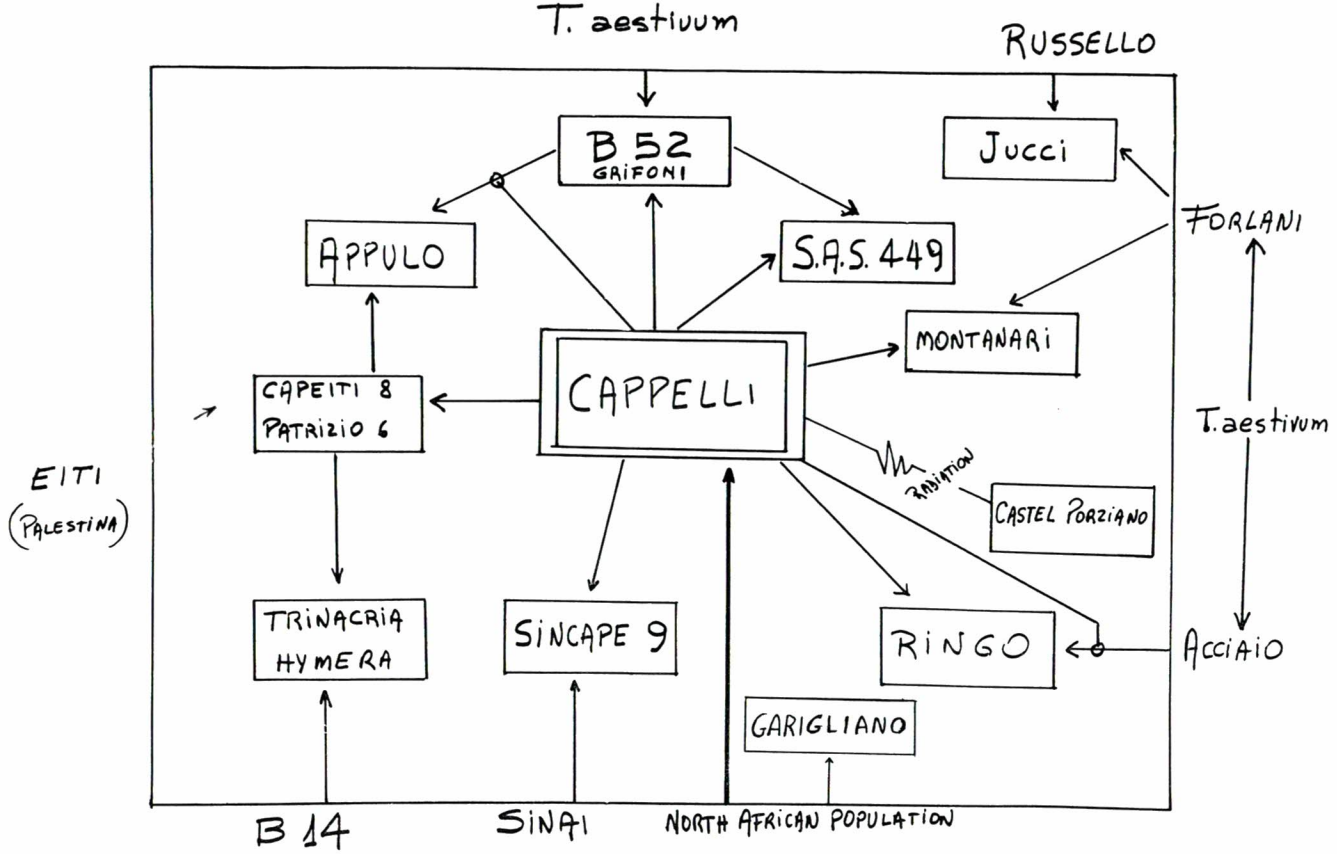
Cappelli, was selected in 1915 from a « land variety » introduced from the Northern African Regions and became the most important variety in Italy, as well as in many other countries. It covered for years, more than the 60% of the *durum* area. Cappelli has been very widely used also in the breeding work all over the world because its good agronomic character and good pastificable quality.

The inevitable replacement of Cappelli by Capeiti (fig. 3) is due to the higher yielding of the latter but provoked a considerable deterioration in the quality of the Italian production as a whole. This fact was aggravated when *durum* varieties selected for the traditional regions were cultivated in less adequate ones. This situation tends to be modified but this will not happen until the new varieties obtained by several breeders will be extensively cultivated.

As consequence of the mentioned situation the authors of the present paper decided, in 1961, to attack the problem directly trying to show through practical achievements the possibility to breed *durum* wheat varieties similar in yielding to the bread ones. In the meantime, it was also decided to support continously the breeding work with researches on genetic characters related to yielding, resistance to lodging and diseases, and quality. Under this situation, the following program was adopted:

1) Find out genetic combinations which could provide a significant improvement of the yielding capacity in *T. durum* forms.

Fig. 2 - PEDIGREE OF SOME ITALIAN *DURUM* WHEATS



2) Orientate the selections towards plants, which for their structure, for instance: good root system, strong and rather short culm resistant to lodging and spikes with numerous high fertile spikelets, could facilitate the maximum expression of their yielding capacity.

Fig. 3. — « DURUM » VARIETIES CULTIVATED IN ITALY IN 1971

Varieties	% of acreage	Yield q/ha
Capeiti 8 }	56	21
Patrizio 6 }		
Cappelli	23	15
Russello	6	17
Garigliano	4	16
Grifoni	4	20
Maliani	1	19
Timilia	1	15
S.A.S. 449	—	19
Others	5	16

Data from « Boll. Mensile di Statistica », n. 3, 1972.

3) Incorporate to the selections, genetic resistant factors to *P. graminis*, *P. recondita*, *E. graminis* in order to minimize the effect of the parasites, that could originate fluctuations in yielding and quality.

SELECTION PROCESS (figs. 4, 5, and 6) (*).

According to the planned scheme and considering that the final scope was to obtain varieties which besides their high yielding capacity, should have good quality either from the commercial than from the industrial point of view, it was considered opportune to adopt Cappelli as the basic variety to be included in the crossing.

Cappelli has been crossed with many varieties in order to increase the chance to find the right genetic combination mainly for high yielding, using wheats from different origin, but particularly those resulting from crosses with *T. aestivum*. Among these, preference was given to F_2 plants selected in a field close to Rome (Roman Selection) from several segregating populations sent to us by Dr. N. Borlaug from Mexico (fig. 4). The purpose was to take advantage of the countless interesting forms existing in these

(*) The Figs. 4, 5 and 6 schematically show the selections process related to the « new varieties » presented in this paper. However, for obvious reasons of simplification, the great amount of material studied, in a high proportion discarted in early generations, is not indicated in the diagrams. On the other side, in the upper part of the graphic 5 and 6, the main selective pressure that has been applied in each step all along the breeding process, is outpointed.

Fig. 4

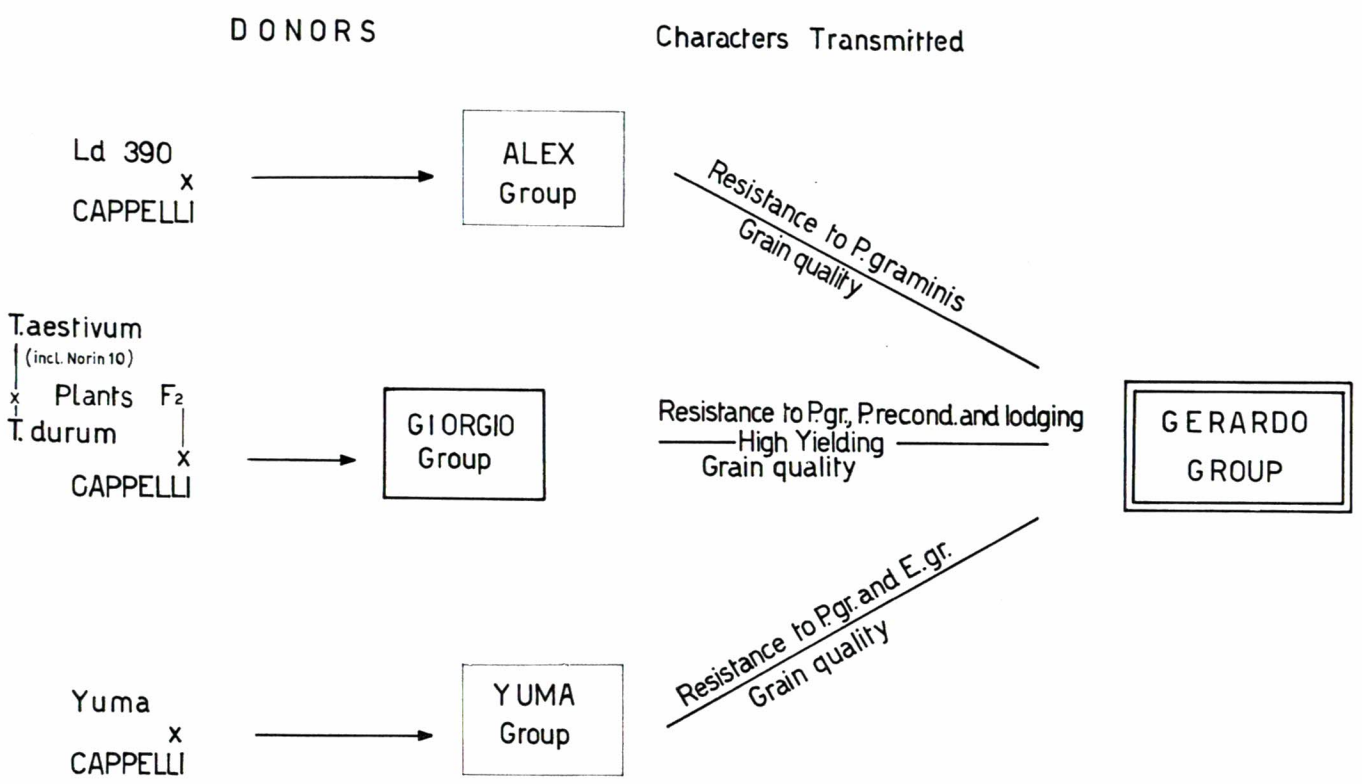

DONORS
Characters Transmitted
Ld 390
x
CAPPELLI
ALEX
Group
Resistance to P. graminis
Grain quality
T. aestivum
(incl. Norin 10)
x
Plants F2
T. durum
x
CAPPELLI
GIORGIO
Group
Resistance to P.gr., P.recond. and lodging
High Yielding
Grain quality
GERARDO
GROUP
Resistance to P.gr. and E.gr.
Grain quality
Yuma
x
CAPPELLI
YUMA
Group

Fig. 5 - PEDIGREE OF GIORGIO SELECTIONS

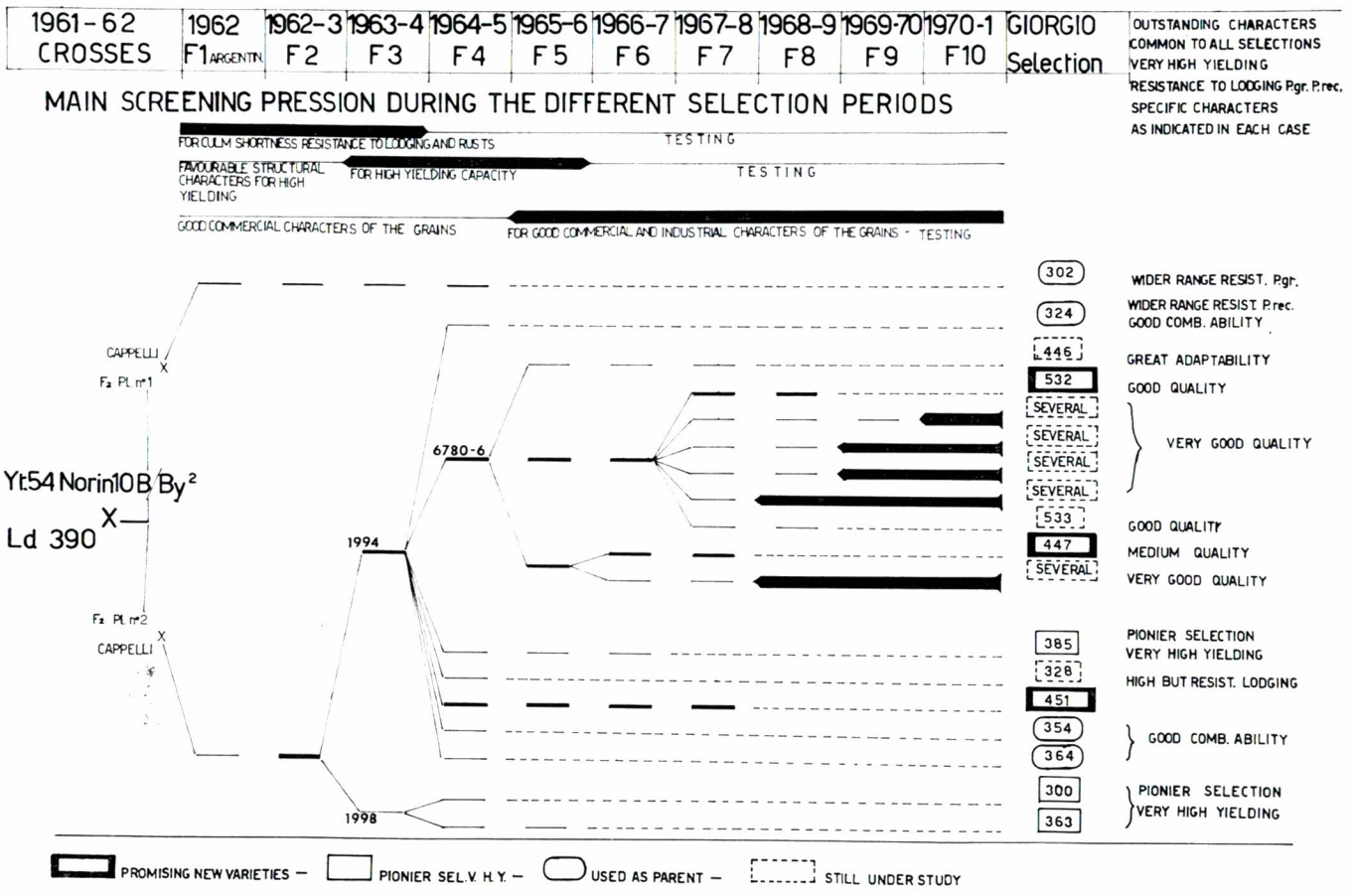
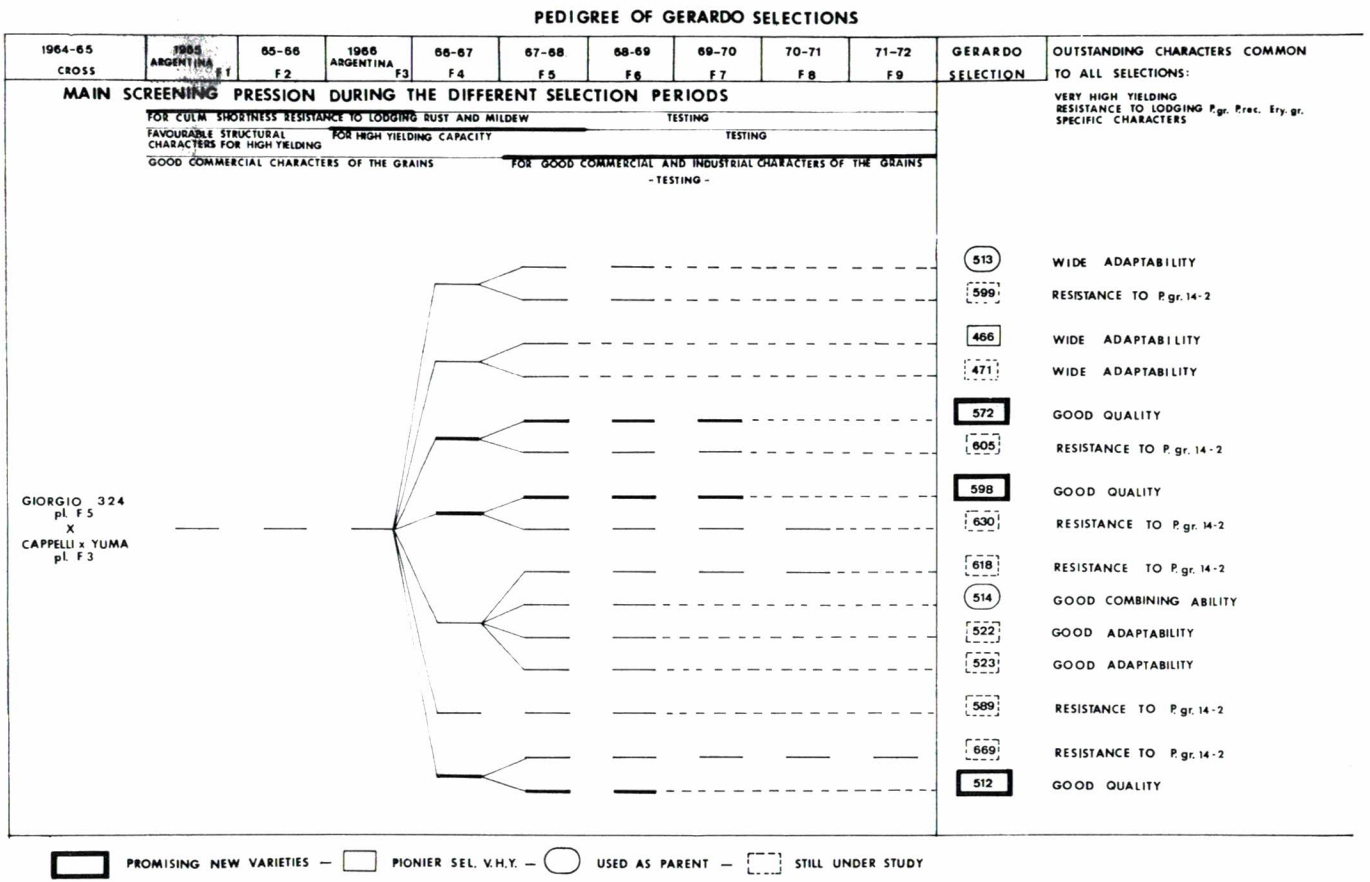


Fig. 6


PEDIGREE OF GERARDO SELECTIONS
1964-65 CROSS
1965 ARGENTINA F1
65-66 F2
1966 ARGENTINA F3
66-67 F4
67-68 F5
68-69 F6
69-70 F7
70-71 F8
71-72 F9
GERARDO SELECTION
OUTSTANDING CHARACTERS COMMON TO ALL SELECTIONS:
VERY HIGH YIELDING
RESISTANCE TO LODGING P.gr. P.rec. Ery. gr.
SPECIFIC CHARACTERS
MAIN SCREENING PRESSION DURING THE DIFFERENT SELECTION PERIODS
FOR CULM SHORTINESS RESISTANCE TO LODGING RUST AND MILDEW
TESTING
FAVOURABLE STRUCTURAL CHARACTERS FOR HIGH YIELDING
FOR HIGH YIELDING CAPACITY
TESTING
GOOD COMMERCIAL CHARACTERS OF THE GRAINS
FOR GOOD COMMERCIAL AND INDUSTRIAL CHARACTERS OF THE GRAINS
- TESTING -
GIORGIO 324 pl. F5
X
CAPPELLI x YUMA pl. F3
513 WIDE ADAPTABILITY
599 RESISTANCE TO P.gr. 14-2
466 WIDE ADAPTABILITY
471 WIDE ADAPTABILITY
572 GOOD QUALITY
605 RESISTANCE TO P.gr. 14-2
598 GOOD QUALITY
630 RESISTANCE TO P.gr. 14-2
618 RESISTANCE TO P.gr. 14-2
514 GOOD COMBINING ABILITY
522 GOOD ADAPTABILITY
523 GOOD ADAPTABILITY
589 RESISTANCE TO P.gr. 14-2
669 RESISTANCE TO P.gr. 14-2
512 GOOD QUALITY
PROMISING NEW VARIETIES — PIONIER SEL. V.H.Y. — USED AS PARENT — STILL UNDER STUDY

segregating populations (Vallega and Zitelli, 1964 and 1968; Vallega, 1972) which apparently were offering a big possibility to find out the proper genetic combination with the Strampelli variety for high yielding.

The mentioned F_2 populations were a result from crosses between a *T. aestivum* selection, which included Norin 10, with a Mexican *T. durum* and then backcrossed with a North Dakota *durum* wheat, Ld 390 resistant to *P. graminis* (Vallega and Zitelli, 1964 and 1968). Norin 10, besides offering interesting genes for high yield, carries several factors for short culm that can be easily handled in the breeding work (Vallega and Zitelli, 1971; Vallega, 1972; Mariani and Zitelli, 1972; Zitelli and Mariani, 1973) and which do not affect other important characters of the plant as happens with some other dwarfing factors.

The study through several generations of the numerous crosses carried on in 1961-62, between Cappelli and the F_2 plants, considered as the best for their vigour, short culm, resistance to lodging, high fertility and apparently resistant to the stem and leaf rusts, put in evidence that only very few of these selections combine properly with Cappelli, or other wheats. The best of them (fig. 5) derived almost exclusively from the cross: [(Yt54 — N10B) BY^2] Ld 390 (= II 14587). The first generation (plants F_2 Cappelli) logically segregating, permitted a rigorous selection particularly for resistance to rusts. The tests under controlled conditions and in the field, were carried on in Argentina (Instituto de Fitotecnia, Castelar) *.

In 1962/63 the F_2 plants, which showed to be resistant in the seedling stage after being infected in the greenhouse with the most common stem rust races found in Italy, were transplanted in the experimental field of the Istituto Sperimentale per la Cerealicoltura, close to Rome. Among them the most vigorous plants with short or semishort culm, resistance to lodging, were selected.

In the F_3 (1963/64) and next generations, the selections for resistance to *P. graminis* and *P. recondita* were carried on either with respect to individual races under controled infections, or to local populations in the field.

In the meantime, a study of inheritance of the resistant factors involved has been done. The most interesting families also were genetically analized in order to find out in which one the different factors involved were accumulated or partially erosioned through the selection process (Vallega and Zitelli, 1968; Vallega and Zitelli, 1971 and unpublished data). This was done in view of the fact that the resistance expression of some of them were masked by others.

In the Giorgio group some families, like Giorgio 302, inherited all necessary factors to give resistance to all races examined but several others lost resistant factors, at least, to race 116.

(*) We deeply thank the Director of the Institute Ing. E. FAVRET for his collaboration and very particularly Mr. H. FRECHA, who carried on these tests.

In the Giorgio group some families, like 324, as well as other selections demonstrated being resistant carrying not only vertical but also horizontal resistance to *P. recondita* (Vallega and Zitelli, 1968; Zitelli, 1972; Vallega and Zitelli, 1973).

With respect to the right genetic combination for high yielding, it was rather easy to pick up in F_3 and F_4, through a preliminary test, the most conspicuous families. Then, the results were confirmed in the following generations considering the yielding capacity of individual selections as well as those of the sister line, as a group. Among all of the selected F_3 families, the 1994/63-64 gave without exception lines of high yielding, short or semishort culm, resistance to lodging but segregating for resistance to rust and commercial and industrial quality of the grains.

Some F_4 or F_5 families homogeneous in characters like height, heading, types of spike and rusts resistance have been early tested in different places and conditions . They were considered « pioneer selections » (fig 5), as they permitted to have, in spite of their rather low quality, an early idea about the production capacity of the sister lines still segregating but of great interest because of their promising good quality. Among these « pioneer » varieties can be mentioned Giorgio 385, as well as Giorgio 300 and 363, the last two derived from the F_3 family 1998/63-64. These three Giorgio selections proved, inside and outside Italy, a very high yielding capacity under normal cultivation conditions (Fig. 10) and an exceptional capacity to take profit of high fertilized soil. These characters are supported by their resistance to lodging and diseases (Results of tests made by FAO, IAEA, CIMMYT, as well as Universities, CNR, CNEN, and other Italian institutions). A second group of Giorgio selections: 446, 447, 449 and 451 indicated the possibility to improve the quality of the grains. However, the great chance appeared through a plant selected in F_4 from the family 6780, always under the group of the high yielding families, resistant to lodging but segregating for resistance to rusts and grain quality. It was easy, working inside of this family, to select and obtain homogeneous lines for resistance to rusts but not for quality, even if most of the selections are giving vitreous kernels, with good colour and low percentage of yellowberry. Finally, the test for gluten quality was done considering not only the individual selections but the group of selections coming from the same or very close family. In this way, it was possible to have an interesting aproximative idea about the industrial quality characteristics of each particular selection supported by the performance of the sister lines. In order to identify the best selections it was mainly taking in consideration the quantity and quality (limited extensibility) of the gluten and in some cases resistance to cooking.

The Giorgio selections 532, 533 and 534 have shown to have a very high gluten content. The first one, cultivated at Foggia (1972), side by side with Cappelli and Capeiti, gave better quality of « pasta » than these two varieties (Istituto Nazionale della Nutrizione). Finally, a group of fami-

lies in F_{10} generation, still under study, also deriving from the 6780 family evidenced an even superior quality to those above mentioned.

In the course of a second stage of the breeding work (fig. 4), it has been tried to improve the quality of some of the Giorgio selections, crossing them with those of the so called Alex group, which is the results of Ld 390 backcrossed twice with Cappelli. The Alex selections are very similar to Cappelli in agronomical and qualitative aspects but higher in yielding and resistant to *P. graminis*, character inherited from Ld 390 (Zitelli, 1968).

Alex 281 has demonstrated in international tests to be resistant to stem rusts in many countries. Therefore, it was suggested and it is very often used in breeding programs (CIMMYT).

The selections obtained by crossing Giorgio and Alex groups till now did not reached the yielding level of Giorgio ones, but they are still under study in view of other scopes.

On the other hand, simultaneously (1962) another plan was carried on with the purpose to transfer to Cappelli resistance to *P. graminis* and immunity to *E. graminis* from Yuma (figs. 4 and 6).

The plants of each generation of this cross were infected under controlled conditions with all avaible races of *P. graminis* and different populations of *E. graminis* and, at the same time, examined their behaviour in the field. According to some genetic studies (Vallega and Zitelli, 1968) the resistance to *P. graminis* of Yuma and some selected families of the cross Cappelli × Yuma, depends at least on four genetic factors and, to *E. graminis* only one principal factor.

The families obtained from Cappelli × Yuma evidenced good commercial quality of the kernel but the plants put in evidence to be sensible to lodging, while their yielding did not overcome significantly Cappelli. Nevertherless, the material was considered adequate to be crossed with the Giorgio group, in order to incorporate to it the resistance to *E. graminis* and improve, in some cases, the commercial quality of the kernel.

Many different crosses were carried out among selections of Cappelli-Yuma and Giorgio group. They were carefully tested until finding those combinations which, at least, equal or overcome the yielding capacity of the best Giorgio selections.

The results which were obtained exceeded any forecast. Selections like Gerardo 512, 572, 598, 522 and 523 which equalled the best Giorgio in grain production by unity area, overcoming also the actually cultivated varieties in Italy, under normal cultivation conditions and even more significantly when high amount of fertilizers are used.

The excellent reaction to fertilizers of the Giorgio and Gerardo selections is due to their evident specific capacity of taking profit from them, supported by their high resistance to lodging and diseases (*P. graminis*, *P.recondita*, *E. graminis*) which permit them to avoid the losses that directly, or indirectly, are caused by the use of fertilizers when susceptible varieties are cultivated.

Some of the selections of the Gerardo group, have good colour and medium to large kernel size (Cappelli type), furthermore, they do not tend to produce starchy kernels.

From the industrial point of view, these selections are characterized by the high content and excellent quality of the gluten (fig. 7). Pastificable tests carried on with Valgerardo (Gerardo 512), and few others, demonstrated also their good quality (tests made by the Istituto Nazionale della Nutrizione).

In the fig. 8, as an example, the result of the analysis on percentage of basic aminoacids (Udy method), wet gluten, dry gluten, elasticity and extensibility of the gluten, as well as pastificable quality of Valgerardo, are graphically shown. The samples studied were taken in 1972 from five different places: Matera, Taranto, Torreinpietra, Malafede and Foggia, then compared with Cappelli and Capeiti from Foggia.

When cultivated side by side with Cappelli and Capeiti at Foggia, and in spite of being a little lower in basic aminoacids content, Valgerardo is significantly superior to both in gluten quantity (measured independently by different laboratories and methods) as well as quality (low gluten extensibility) (fig. 7 and 8). The same can be said about the pastificable quality (fig. 8).

It is very interesting to see (fig. 8) the wide variation in gluten quantity and quality of Valgerardo according to the place where this wheat was cultivated, and how can be reached high quality when cultivated in the right place. The same wide variation, but on different levels, has been observed in other varieties and selections.

As a result of the work done, it was considered that the opportunity has come to present as « new varieties » several selections of the Giorgio and Gerardo groups.

List of the New Varieties Presented

Valfiora	(= Giorgio 532)
Valgiorgio	(= Giorgio 447)
Valsacco	(= Giorgio 451)
Valgerardo	(= Gerardo 512)
Valselva	(= Gerardo 572)
Valnova	(= Gerardo 598)

Pioneer selections

Giorgio 300
Giorgio 385
Giorgio 363

A short description of the « new varieties » is given in the fig. 9.

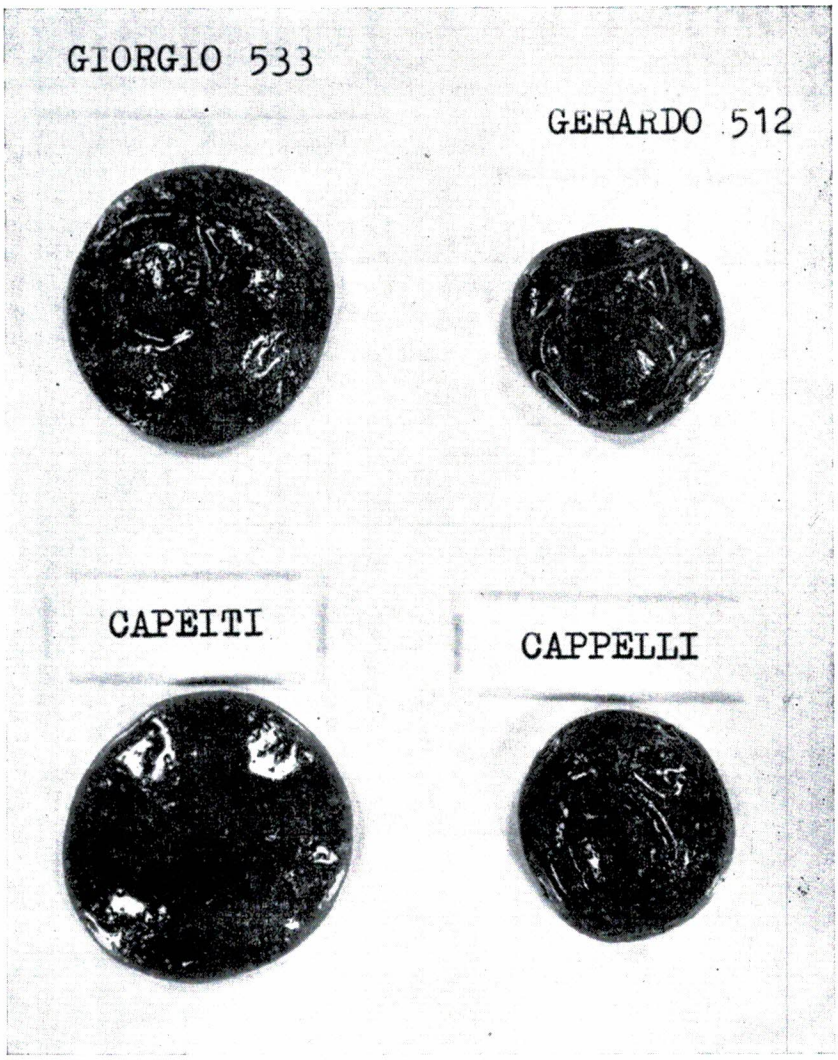
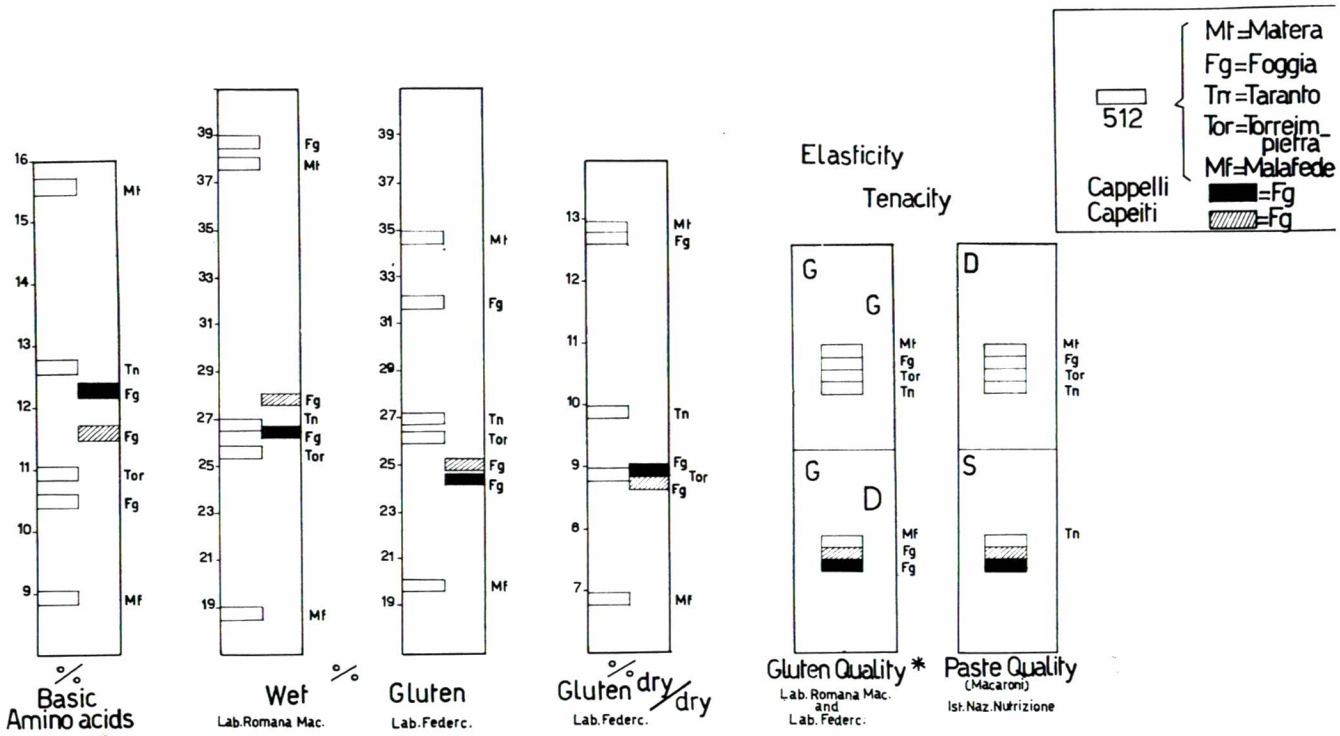


Fig. 7

Test on gluten extensibility. Quick practica. method applied by many of the Italian millers to test the gluten quality. Balls are making with the same amount of gluten and putting on glasses where they remain for fixed period of time. Tke measure of the diameter gives an indication of the gluten extensibility.

Valgerardo (Gerardo 512), shows to be at least equal to Cappelli and both superior to Capeiti and Giorgio 533. All were cultivated at Foggia in 1971-72.

Fig 8 - RESULT OF ORIENTATIVE TEST ON THE QUALITY OF GERARDO 512 (= *VALGERARDO*) CULTIVATED IN 5 LOCALITIES COMPARED WITH CAPPELLI AND CAPEITI



* The gluten quality related to its elasticity and tenacity has been tested with the ball method or handling it directly. Both ways are commonly used by the millers.

(G = good ; D = discrete ; S = poor).

Fig. 9 — NEW VARIETIES DESCRIPTIONS

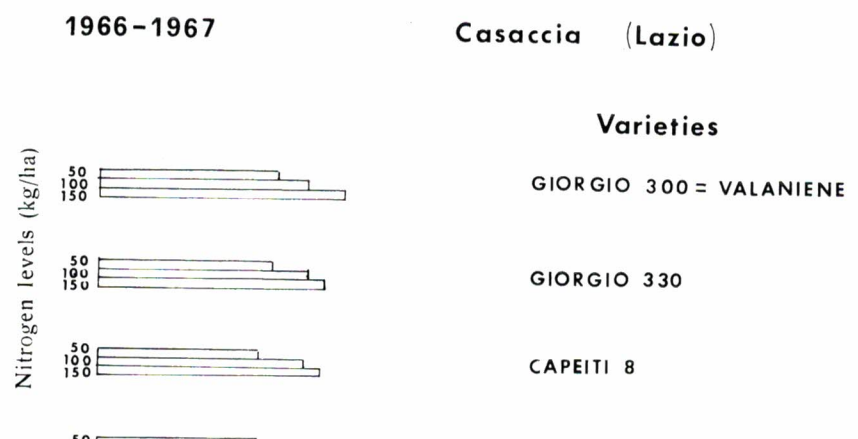
Name	Origin	Plant Height	Lodging	Spike	Heading	Shape and color	KERNEL				Diseases			Productibility	gluten	
							Weight		Resistance		P. Gr.	P. Rec.	E. Gr.		Quantity	Quality
							Il	1000 seeds	Yellow-berry	Shrivel-ling						
Valfiora (= Giorgio 532)	Cappelli × Sel. Romana 156	± 80	VR	Yellow Oblong Block awans	Medium Late	Elliptic amber pale	± 83	± 54	R	R	VR	VR	S	WHY	M	VG
Valsacco (= Giorgio 451)	Cappelli × Sel. Romana 156	± 75	VR	Yellow-rose oblong Black awns	Medium	Oval amber	± 80	± 50	MR	MR	VR	VR	S	WHY	H	G
Valgiorgio (= Giorgio 447)	Cappelli × Sel. Romana 156	± 70	VR	Yellow oblong black awns	Medium early	Oval amber	± 80	± 50	MR	MR	VR	VR	S	WHY	H	VG
Valnova (= Gerardo 598)	Giorgio 324 × F_1 Cappelli-Yuma	± 70	VR	Yellow fusiform Yellow-rose awns	Medium early	Oval amber	± 83	± 51	VR	R	VR	VR	I	WHY	H	VG
Valselva (= Gerardo 572)	Giorgio 324 × F_1 Cappelli-Yuma	± 80	VR	Yellow fusiform black awns	Medium	Oval	± 83	± 53	R	R	VR	VR	I	WHY	M	VG
Valgerardo (= Gerardo 512)	Giorgio 324 × F_1 Cappelli-Yuma	± 80	VR	Yellow fusiform black awns	Medium	Oval amber	± 82	± 52	MR	MR	VR	VR	I	WHY	H	VG

V = Very; R = Resistant; S = Susceptible; H = High; G = Good; M = Medium or Moderate; Y = Yield;

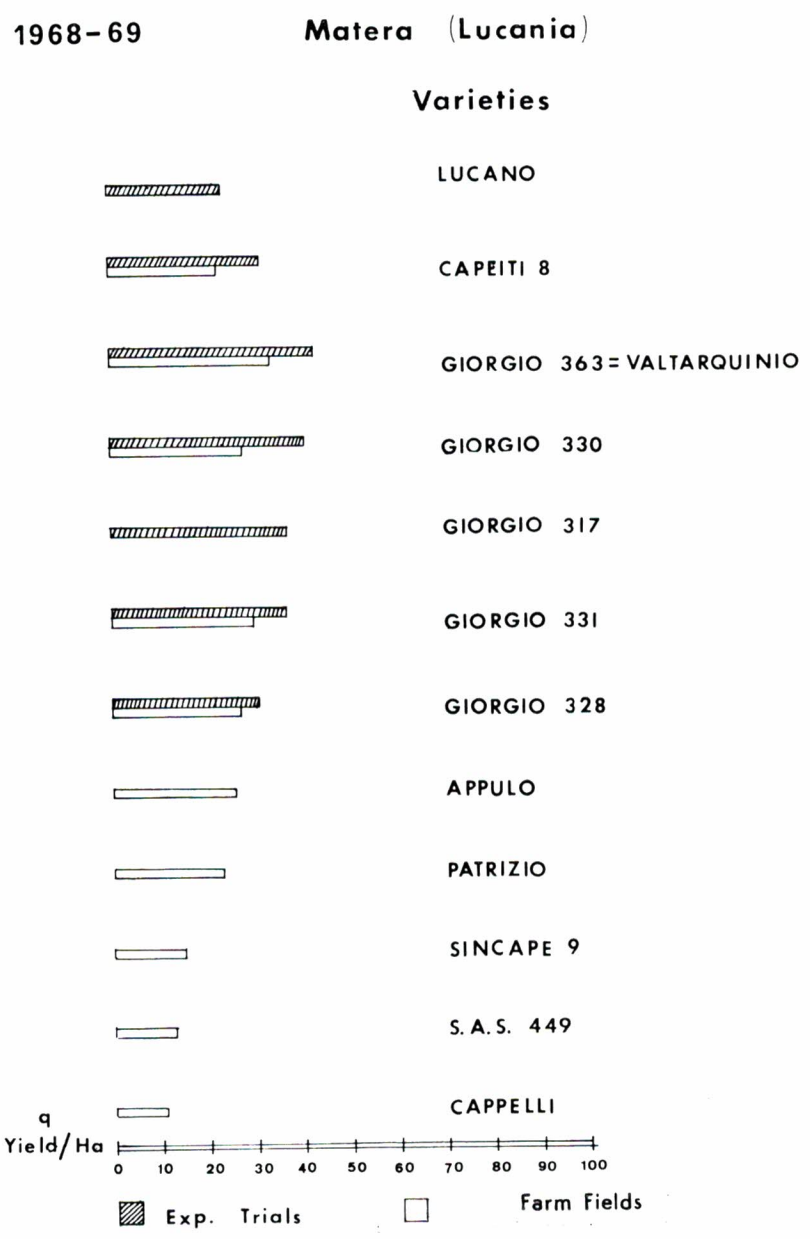
Summarizing, it can be affirmed that the six « new varieties » have a yielding capacity significantly superior to all the varieties actually extensively cultivated in Italy (fig. 10). They also have rather good commercial and industrial quality, mainly Valfiora (Giorgio 532) and Valgerardo (Gerardo 512), very similar to Cappelli; besides, all of them are very resistant to *P. graminis* and *P. recondita* even under artificial infection and, three of them (Valgerardo, Valnova, Valselva), are immune to *Erysiphe graminis*.

The varieties presented are definitely replacing the « pioneer selections » Giorgio 300, 363 and 385 that played a very important role. Indeed, they allowed a first apreciation on the general characteristics of the genetic material handled, as a whole, mainly with respect to its yielding capacity, extraordinary resistance to lodging and to rusts. These « pioneer selections », on the other hand, can be considered, yet, as a very valuable basic material for breeding purpose. Same results already obtained with the material under study let suppose that the « new varieties » presented today will be replaced within a few years by other selections superior in quality.

Fig. 10 - RESULTS OF DIFFERENT YELD TRIALS



continued: Fig. 10



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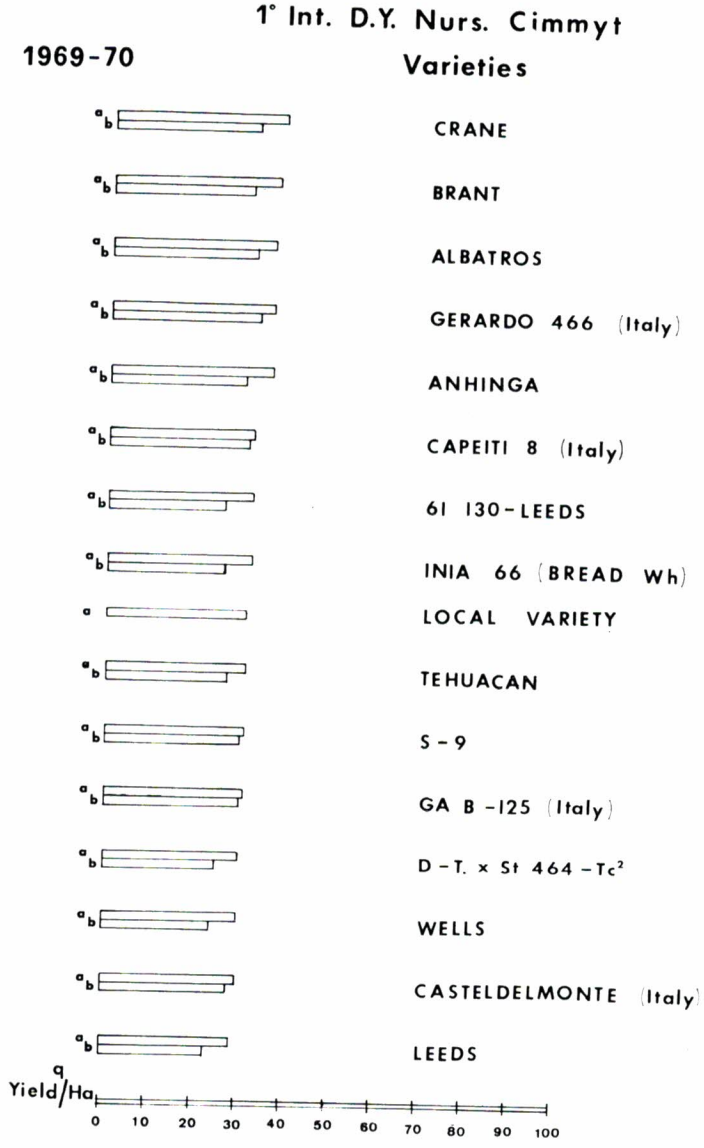
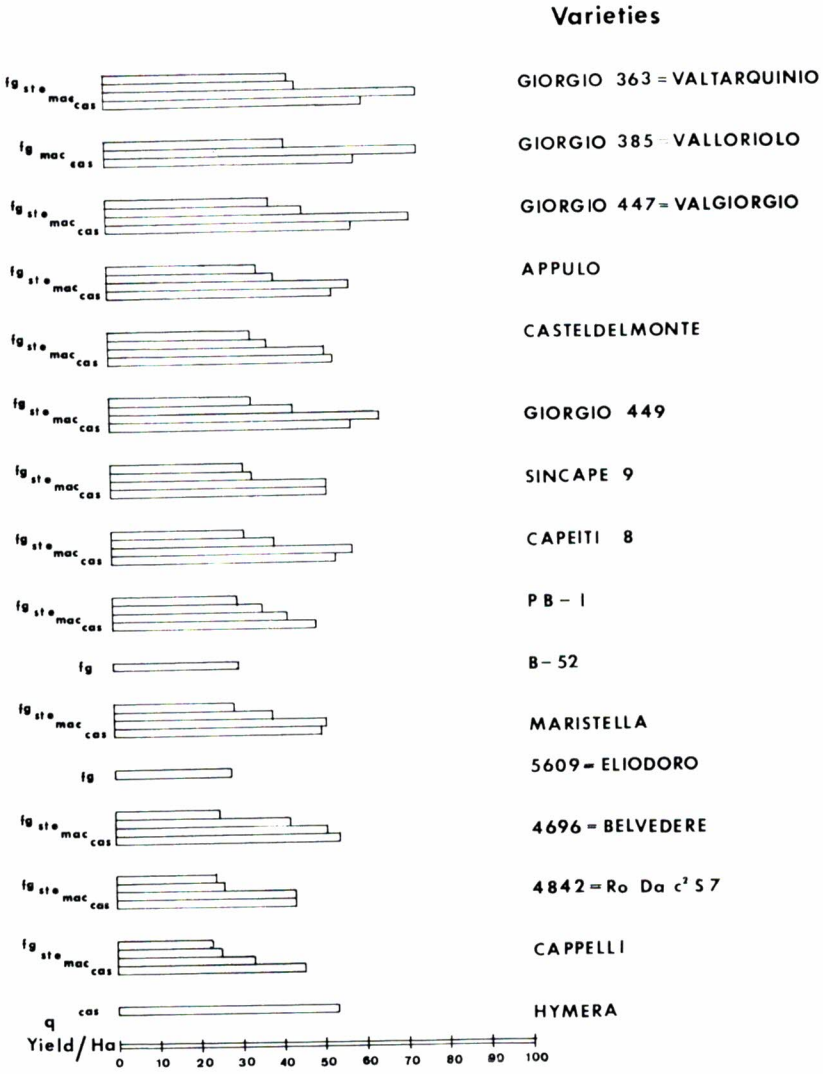


a = Averages over 22 localities
b = Averages over 22 localities (Mediterranean Basin)

continued: Fig. 10

Foggia, Santeramo (Puglia)

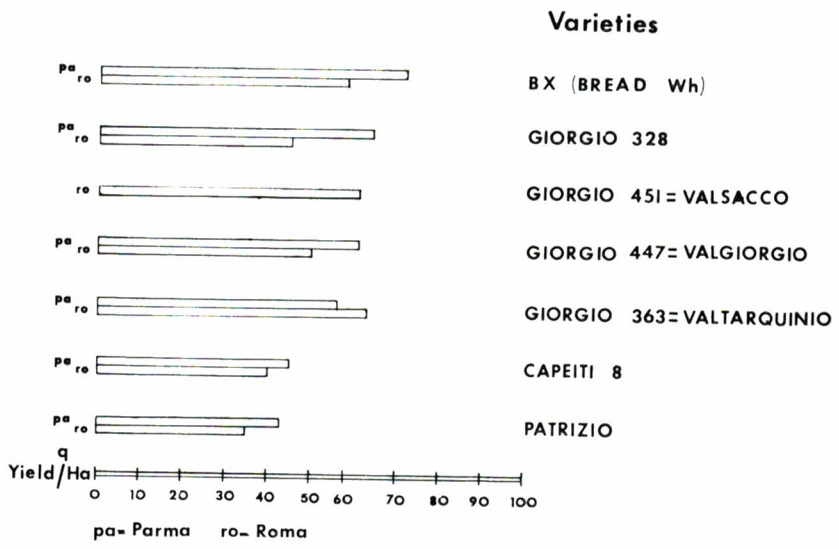
1970-71 **Maccarese, Casaccia (Lazio)**



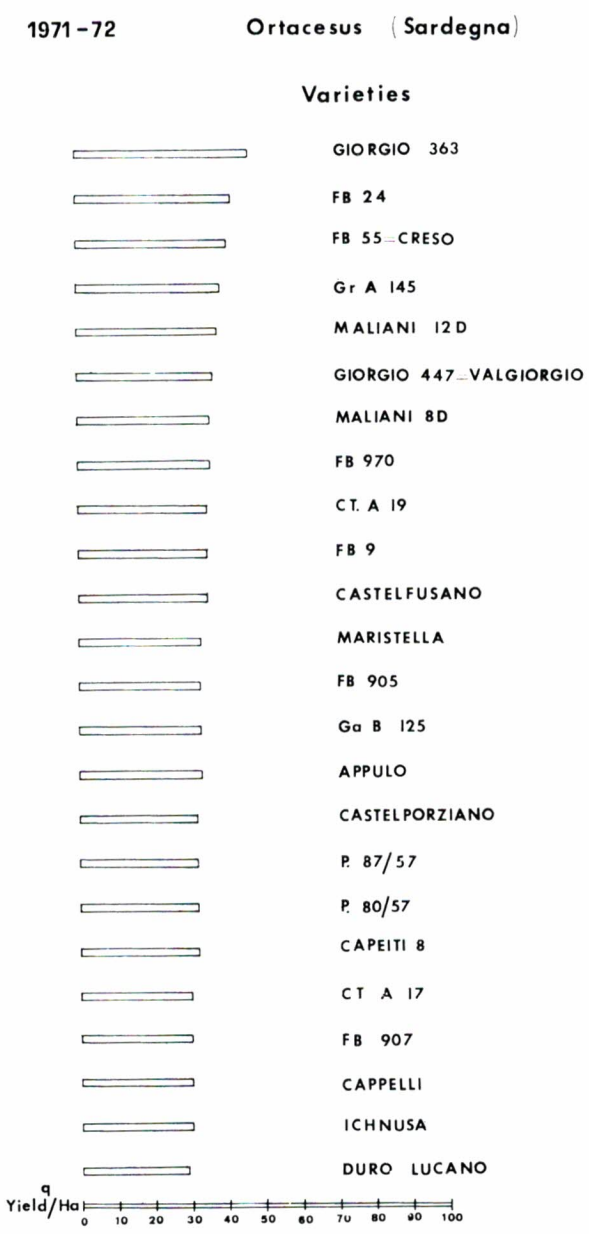
fg = Foggia ste = Santeramo mac = Maccarese cas = Casaccia

continued: Fig. 10

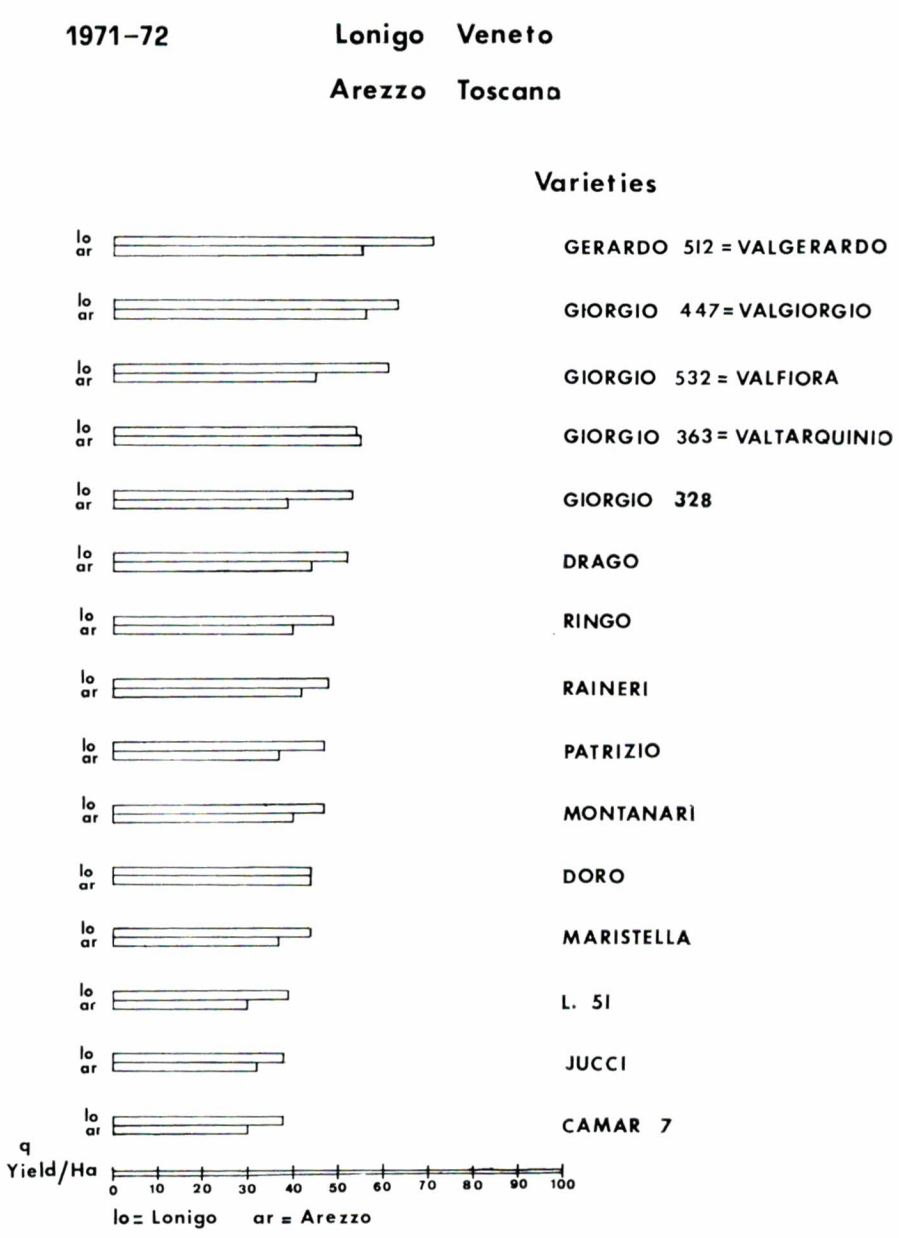
1970-71 **Parma** (Emilia)
Roma (Lazio)



continued: Fig. 10

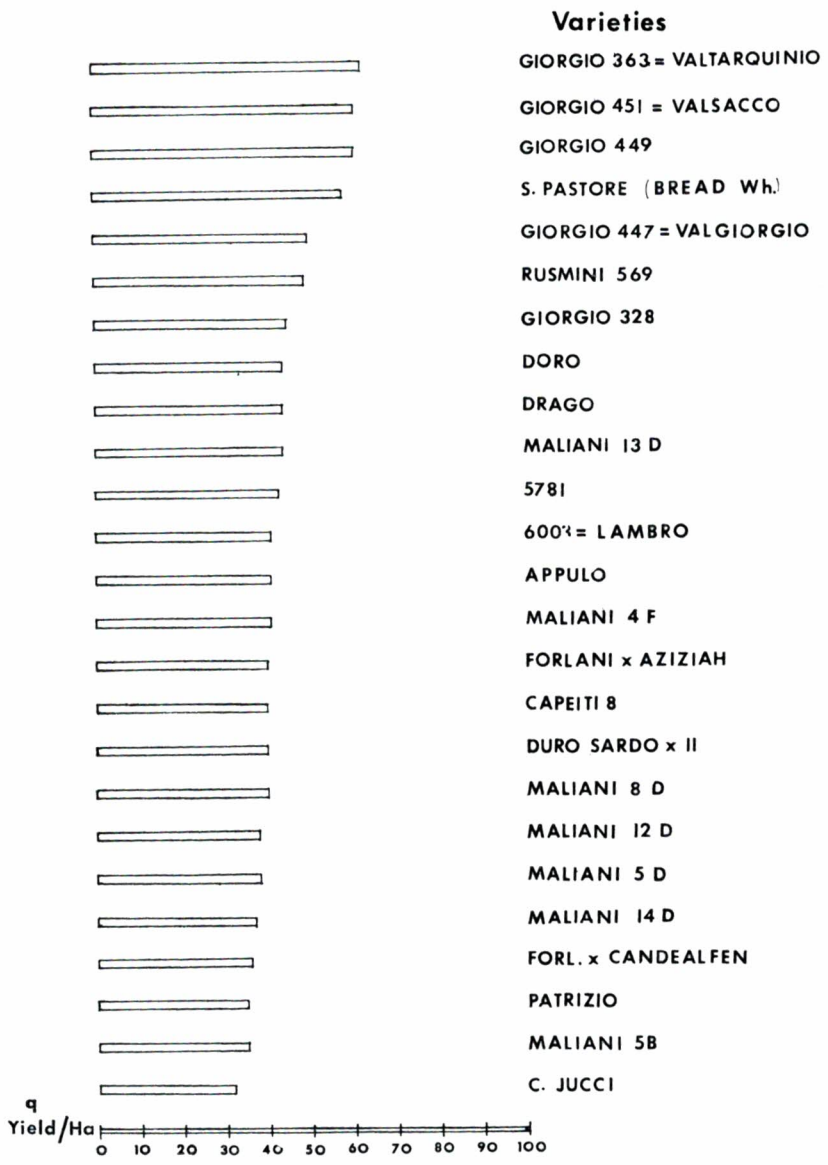


continued: Fig. 10

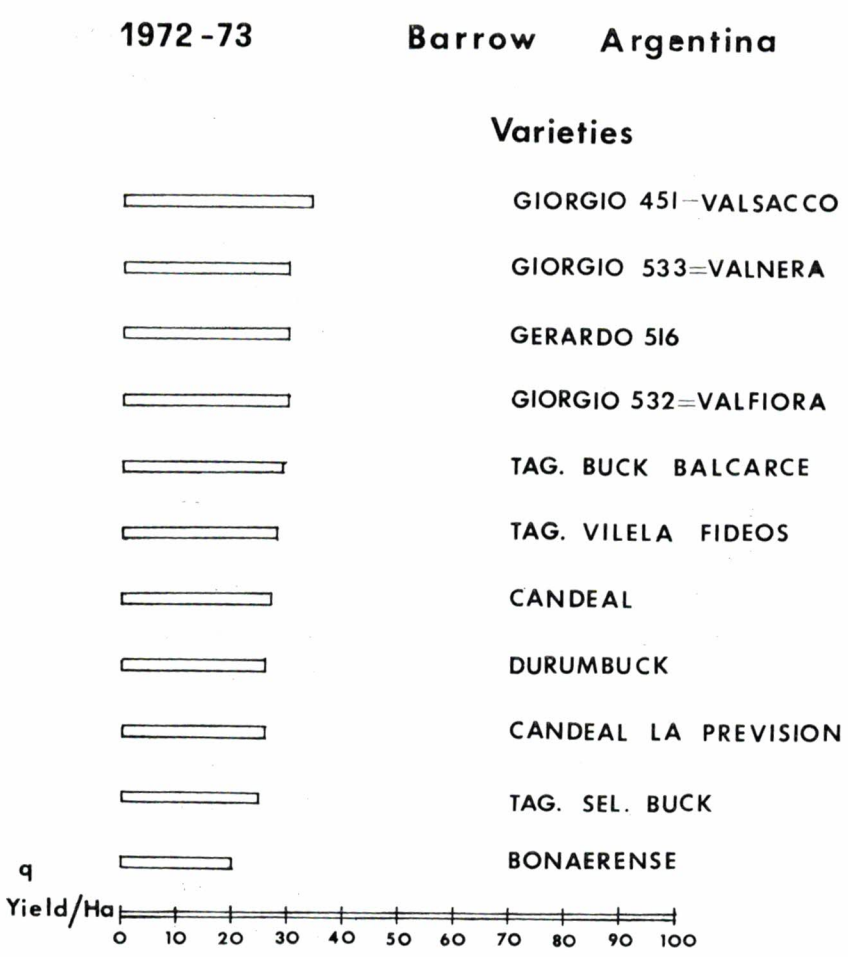


continued: Fig. 10

1971-72 **Ponte Galeria (Lazio)**



continued: Fig. 10



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ABSTRACT

No more than 10 years ago the possibility to breed *durum* wheat varieties with yielding capacity close to bread wheats was still considered an almost utopian task. As a response to this challenge, to find out to what extent it would be possible to elevate the ceiling for grain production in *durum* wheats, a program was started by the authors in 1962.

The model put in front of us was a plant having very good root system, high fertile heads able to make the utmost profit of soil fertility and water availability; furthermore resistant to lodging and main diseases.

A review of the work done in the past, indicated quite clearly that crosses among the actually cultivated Italian varieties could offer little chance for our purpose. This induced us to apply for other sources to have the right material to cross with the local wheats in order to obtain better genetic combinations for yield.

In 1966, already, several families from these crosses put in evidence their high yielding capacity. The plants were very resistant to lodging (tested under extreme conditions) and to stem and leaf rusts (tested in greenhouse and natural conditions); with long and high fertile heads, rather short stem (between 70 and 90 cm.) and very well developed roots. In fertilizer trials they showed high response.

In a second step, through further backcrossing with Cappelli and crossing with wheats carrying resistant factors to different pathogenic entities of *Erysiphe graminis*, the mentioned selections already high yielding and resistant to rusts, were improved as to resistance to mildew as well as for commercial and industrial quality.

Valgiorgio (Giorgio 447), Valfiora (Giorgio 532), Valgerardo (Gerardo 512), Valselva (Gerardo 572), Valnova (Gerardo 598), Gerardo 466, among others, are very yielding. They showed very good response to fertilizers. Nevertheless, their performance, when cultivated under normal conditions, always was very outstanding if compared with the already extensively cultivated varieties.

CARATTERISTICHE DI NUOVI FRUMENTI DURI ITALIANI AD ALTA PRODUTTIVITA'

RIASSUNTO

Soltanto poco più di dieci anni fa veniva considerata una utopia la possibilità di ottenere varietà di frumento duro con capacità produttive simili a quelle del frumento tenero.

Gli autori nel 1962 dettero inizio ad un programma per aumentare il livello delle produzioni di frumento duro. Il modello prestabilito da raggiungere era una pianta che possedesse i seguenti caratteri: ottimo sistema radicale, alta fertilità di spiga e capacità di usufruire al massimo della fertilità del suolo e della disponibilità dell'acqua, combinati insieme alla resistenza all'allettamento ed alle principali malattie.

Una revisione dei lavori fatti nel passato indicò abbastanza chiaramente che incroci tra le varietà italiane presentemente coltivate avrebbero offerto scarse possibilità al nostro programma. Questo ci indusse ad usare altre fonti per avere il materiale adatto da incrociare con i frumenti locali in modo da ottenere migliori combinazioni genetiche per produttività.

Già nel 1966 molte famiglie derivate da tre incroci misero in evidenza la loro capacità di elevate produzioni. Le piante risultarono molto resistenti all'allettamento (provate in condizioni estreme) e alle ruggini nera e bruna (provate in serra e in condizioni naturali), con spighe lunghe e fertili, piuttosto basse (tra i 70 e 90 cm) e con radici ben sviluppate. Inoltre dimostrarono una ottima risposta in prove replicate di concimazione.

In una seconda tappa, attraverso ulteriori reincroci con Cappelli e incroci con frumenti portatori di fattori di resistenza a differenti entità patogene di *Erysiphe graminis tritici*, le menzionate selezioni, già altamente produttive e resistenti alle ruggini, furono migliorate per resistenza all'oidio e per qualità commerciale e industriale della granella.

Valgiorgio (= Giorgio 447), Valfiora (= Giorgio 532), Valgerardo (= Gerardo 512), Valselva (= Gerardo 572), Valnova (= Gerardo 598), Gerardo 466, tra gli altri, sono molto produttive e mostrano un'ottima risposta alle elevate concimazioni. Tuttavia il loro comportamento, quando vengono coltivate in normali condizioni, è sempre superiore se paragonato a quello delle varietà estensivamente coltivate.