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D- W H E A T I M P R O V E M E N T

HISTORICAL PERSPECTIVE OF WHEAT BREEDING IN ITALY 1/

by

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In a country such as Italy, where wheat has been cultivated by many civilizations throughout the centuries, it is understandable that a considerable amount of selective work will have been carried out on this crop.

In ancient literature (Virgil, Pliny, Varrone, Colunella, etc.,) there are indications of a "preference" for certain "kinds of wheat". On the other hand, very well adapted "land varieties" (old populations) were still being cultivated at the beginning of the present century in Italy; these showed some homogenecity which was undoubtedly the consequence of intervention by man.

Towards the end of the last century and the beginning of the present, wheat breeding carried out in Italy as elsewhere was based mainly on genealogical selection in the old cultivated population in order to improve them. The renowned agronomist and wheat breeder, F. Todaro, was the unquestionable leader on the application of these methods in Italy. He released some good varieties such as Gentilrosso 48, Rieti 11, Cologna 12, Novantasei, etc. all coming from very well known "land varieties". Other breeders followed his example by carrying out similar work.

In 1900, N. Strampelli, made his first cross between Rieti and Noé, two famous wheats extensively cultivated during that period. He worked entirely independently from the rediscoveries of Mendel's Law: De Vries, Correns, Tschermak and others. Nevertheless, his own observations on dominance, segregation and recombination of genetic characters gave him a clear idea as to the application of this knowledge to plant genetic improvement.

N. Strampelli was primarily an agronomist and as such he became a breeder who was able to see wheat improvement in Italy as a part of an integral agricultural problem. His statements, comments and results enable us to have a clear idea about his thinking during the period around 1900. It can be seen how similar to present successful breeders was his conception on applied genetics, as well as on the method he proposed and actually used to solve breeding problems.

He wrote: "To obtain a high production in wheat it is not enough to work the land properly and to use fertilizer, but it is indispensable to breed varieties able to take advantages of this favourable condition. "He was also looking mainly (USDA Yearbook 1936, and others) for the right combinations to obtain better yield, as well as plants resistant to lodging and parasites, in order to avoid losing what they were capable of producing. He considered earliness to be a very important character, so as to increase the chances of escaping rust attacks and the effects of high temperatures during grain development, etc.

1/ Brief outline of some relevant aspects of wheat breeding carried out in Italy, with special reference to N. Strampelli

Ways and means used by Strampelli in wheat breeding:

a) building up of a large collection of cultivated wheats and widely related species from Italy and elsewhere, studying this material as a source of useful genetic characters from inclusion in his breeding programme;

b) making hundreds of interspecific crosses over the years, in order to try to combine in new forms the most important characters, but primarily to discover the best genetic combination for yield. He made a large number of different crosses with each type of wheat, and his analysis of their descenents enabled him to weigh and compare the genetic combined ability of each cross and to place special emphasis on the most promising;

c) making many interspecific and intergeneric crosses, trying to introduce into the cultivated species interesting characters, mainly for resistance to adverse climatic conditions and parasites;

d) using the classical pedigree method and also the backcross in order to retain the desirable germplasm of the recurrent parent or to increase the possibility of success in remote crosses;

e) giving preference to those crosses where "selection" from the very well known superior "old land varieties" were involved, trying to increase their yield capacity and correct their deficiencies. Among the "land varieties", Rieti was mainly used by Strampelli because of its high adaptability, rusticity, resistance to rusts, etc. Through many combinations with quite different wheats he was able to select the best for yield and later to incorporate factors for resistance to diseases and lodging, short culm, earliness and so on, through new crosses;

f) studying the behaviour of all new selections mainly through comparative agronomic field testing under quite different ecological conditions, as well as their response to fertilizers.

Some successful examples of intraspecific crosses made by Strampelli: (See Figure 1).

Variety, APULIA (T. aestivum) from Rieti (T. aestivum) and Spelta aristato (T. spelta)

Variety, BALILA (T. aestivum) from Duro di Puglia (T. durum) and Akagomughi (T. aestivum)

Variety, Sen. CENCELLI (T. durum) from Akagomughi (T. aestivum) and Giustalisa (T. durum)

Variety, CANTORE (T. aestivum) from Haynaldia villosum = (T. villosum) and Rieti (T. aestivum)

Variety, TERMINILLO (T. aestivum) from Segale (Secale) and Rieti (T. aestivum)

The above are only some of the intraspecific crosses from which varieties have been released, but many other crosses were also studied, including T. aestivum, T. durum, T. turcicum, T. dicoccum, T. monococcum, Haynaldia, Secali, Aegilops spp., etc.

Strampelli Bread Wheat Breeding Results (See Figure 1)

Strampelli had very great success with his first varieties such as: Carlota (Rieti x Massy), G. Mendel (P. Alberto x Rieti), Apulia (Rieti x Spelta), etc. However, the real impact was obtained from a cross between Rieti and W. Tarwe, from which two selections No. 21 and No. 67, became the corner stone of his breeding work, because of their high yield, resistance to lodging and because they combine well when crossed with such wheats, as Akagomughi, a Japanese wheat, very early and with a rather short stem.

Strampelli was very successful with this cross, thereby winning the "wheat battle". He was able to obtain very high-yielding varieties and through them to increase production in Italy as a whole, making the country self-sufficient.

Through this cross he obtained such varieties, which later became very important, as Ardito, Mentana, Villa Glori and Damiano.

Ardito and Mentana have been cultivated with success in various regions in many parts of the world, both varieties and their derivates being widely included in wheat breeding, not only in Italy but in many other countries, because of their high yielding capacity, resistance to lodging and rusts, and their earliness.

In Argentina, Chile, Uruguay and Brazil they were introduced and cultivated after the 1920s and were extensively used in breeding work. Today they constitute, together with Riccio, Apulia, a very high percentage of the varieties grown in these countries. In this way, among others, resistant factors to P. striiformis, P. recondita and P. graminis have been incorporated in the germplasm of the wheats cultivated in Latin America.

The Klein varieties H 31, H 32, H 30 and Acero, in which resistance to yellow rust has been introduced from Ardito, helped to solve a very crucial situation after the 1930 epidemic, when this rust suddenly appeared for the first time in Argentina.

Mentana was one of the first wheats in which resistance to P. graminis race 15B, was discovered (Vallega, 1940). On the other hand, from the Strampelli varieties it was possible to obtain factors for short culm, resistance to lodging earliness and for the increase of yielding capacity. Through some Argentinian varieties, the germ plasm of these wheats was spread to other regions, eventually returning to Europe and is even found in the pedigree of the famous and widely cultivated Russian variety Bezostaya I (Ardito x Klein 33). The Mentana characters, noted for their great adaptability, have been introduced directly, but mainly from such South American varieties as the Brazilian Frontana and Fronteira into important breeding programmes in the U.S.A., Canada and particularly Mexico, from whence, through the Rockefeller Foundation and CIMMYT Programmes they have been spread all over the world, overlapping the early dispersion of the Strampelli varieties.

Mentana has, without any doubt, played a very important role, perhaps one of the most important, in the international field of wheat breeding.

Among other varieties produced by Strampelli special credit must be given to San Pastore (See Figure 2) launched after the Second World War which, in spite of some early difficulties, very soon became a leading variety; it is still widely cultivated in Italy (See Figure 5) and other countries. San Pastore grows very well under quite different conditions, has great rusticity, high yielding capacity and some resistance to low temperature. Its introduction to Yugoslavia, about 10 years ago, contributed considerably to the increase in wheat production in that country.

Strampelli Durum Wheat Breeding Results

Strampelli made many selections from Italian and North African "land varieties" of durum wheat. He was able to select among others Aziziah, Cappelli which became the most widely cultivated variety in Italy and other countries. It has been widely used as a base material in genetic durum wheat improvement in Italy (See Figure 4) and elsewhere.

He also obtained "durum" varieties through crosses, like Garigliano, (Tripolino x Cappelli), but none of these was able to replace Cappelli, because of its wide adaptability, rusticity and excellent quality. Cappelli was selected in 1915, ultimately covering more than 60% of the total area of durum wheat in Italy and still is cultivated to some extent (See Figure 6).

Work carried out by other breeders (See Figures 3, 4, 5 and 6)

During and after Strampelli's period, many other breeders made important contributions to the improvement of the varieties cultivated in Italy.

Breeding was and is done by official and private breeders and many varieties have been released through the years, some of them with great success, mainly due to their high yielding capacity.

R. Forlani spent long years working on interspecific and intergeneric crosses. He was the leader in this field in Italy, and his excellent material is still used in several breeding programmes being carried out by different breeders. Maliani is using "Forlani" variety (Villa Glori x T. turcium) to improve "durum wheat" because of its high fertile head, and Rusmini is taking advantage of some intrageneric hybrids to introduce in T. aestivum and in T. durum resistance to low temperature, especially from Agropyrom.

U. De Cillis, for many years Director of the "Instituto Sperimentale per la Cerealicoltura N. Strampelli", working in Sicily, made some selections in local populations and obtained several varieties like Russello s.97 and Timilia s.G1, etc.

G. Conti, first in Bari and later in Catania, also introduced very interesting selections from "old cultivar" of "bread wheat" (Bianchetta 83, Majorica 47, Rossetta 55) and "durum wheats" (Aziziah 301-302 and Russello S.G. 329).

M. Bonvicini, working in a research institute in Bologna, bred a series of rather short and very high yielding varieties. Several of his wheat such as Fiorello, Fortunato, Funo, etc., had a great success in Italy and neighbouring countries.

C. Orlandi, working in a seed company in Bologna, obtained San Giorgio among others. Later U. De Beni following up his work, released such varieties as Productore, Glutinoso, Argelato, Inerio, etc. Argelato (Mara x Orlandi), is a very high yielding variety, rather short (65 cm.), very resistant to lodging. Inerio (Produttore x Manitoba) is also of good quality.

E. Avanzi, A. Oliva and M. Gasparini were mainly interested in breeding wheats for hill and high mountain conditions. They were successful with the varieties; Trento and Ancona, Est Mottin and Verna.

A. Dionigi, working first in Rieti and later in Bari, succeeded in breeding very interesting bread varieties for rather poor soil conditions with some resistance to rusts like Elia and Ovest; both of these have Est Mottin in their pedigree.

He also released some durum varieties; SAS 38, SAS 449 (Cappelli x Grifone).

C. Maliani, a private breeder, followed very closely the breeding work started by Strampelli. He bred several very high yielding bread wheat varieties like Gallini, Gemelli (Mara x Gallini), "N. Strampelli" (San Pastore x Jacometti), the last of quite good quality.

He also worked on "durum wheat" with great success, mostly with the varieties: Carlo Jucci, Montanari, Raineri, etc., which yield very well, and all of which come from crosses with the bread wheat "R. Forlani".

M. Michahelles is another private breeder, known through the release of a really outstanding series of varieties. He formerly worked in the private Frassineto Institute, but later started work on his own. During the former period he bred among others, Frassineto 405, Autonomia, Impeto and later Mara; the last was very extensively cultivated in Italy and other countries for its yield capacity, specially in fertile soils. Mara was followed by such other varieties as Rondine, Generoso, etc. Conte Marotto (Mara x Impeto) is one of the most recent and is a very well accepted wheat not only for its high productivity, but also for its good quality.

A. Trentin, working in a breeding institute at Lonigo also produced very high yielding varieties. Some of these such as Libelual, Leonardo, etc., had great success both in Italy and in Yugoslavia.

F. Cesale, at Catania Experimental Station, bred several outstanding "durum" varieties, Capeiti (Eiti x Cappelli) among them. Because of its good yield this variety is replacing Cappelli, even though its quality is not as good as Strampelli's wheat.

During recent years R. Barbieri in Sardinia, released several "durum" varieties, among them Maristeola, Icnusa, Ottava, as well as Ballatore, introduced into Sicily, as well as Himeria and Trinakria with a very high protein content: Some years earlier, at Foggia, P. Janelli launched Sincape 9.

Through a mutation breeding programme, started some years ago at the CNEN (La Cascacia) Scarascia, Bozzini and others obtained several "durum" varieties, such as Castelfusano, Casteldelmonte, etc. In the Instituto Sperimentale per la Cerealicoltura (Rome) new directions were taken by J. Vallega and G. Zitelli, who have obtained interesting results in "durum" wheats in relation to high yielding capacity, resistance to lodging and quality, with special emphasis on resistance to rusts, mildew. This work has led to the development of the Valgerardo, Valgiorgio, Valfiora, etc., varieties; they also bred the bread wheat Victor I and Oscar, very resistant to stem rust. Wheat genetic improvement in Italy was and still is being carried out by official and private breeders working in universities, seed companies, cooperatives and private institutions.

Generally speaking, there are no laws, regulations or any other means which directly or specifically support breeders, their work or the varieties they obtain. Moreover, it is only recently that recording and testing control of new varieties before release has been organized.

This situation must be considered as a heavy handicap to the efforts made by breeders. However, despite that, the increase in national production has been constantly due, without any doubt, to the contribution by able breeders, who have orientated their selection in accordance with the constant improvement of cultural techniques.

There is no question that Strampelli's clear and wide vision and the results of his breeding work, have produced the first significative increase in Italian wheat production. His varieties created this great opportunity because of their yield capacity, great adaptability to the most widely different ecological conditions, resistance to lodging and diseases, capability of benefitting from highly fertile soil and to the proper use of fertilizers. Their earliness also allowed them to avoid the effects of negative climatic factors, to escape late attacks of rusts, and to facilitate land utilization.

Strampelli's success in a battle that could be considered a real "Green Revolution" in Italy, with repercussion in many other countries, was followed by the efforts of many other breeders (mentioned above), who were able to gradually increase production through higher yielding varieties.

These breeders continued a gradual genetic improvement, not only selecting new varieties with higher yielding capacity, but also with more stable production in fertile as well as in rather poor soil and even on hills or in high mountain environment.

On the whole, with a few exceptions, wheat breeding in Italy has been carried out, genetically speaking, inside a very close circle, in which the Strampelli varieties were almost always involved (See Figures 3 and 4).

But one element was lacking in Italian bread wheats: good gluten quality. However, this weak point is gradually being overcome with the new varieties.

With respect to "durum" wheat, the replacement of the old Strampelli selection Sen. Capelli by varieties higher in yield created a serious quality problem. Indeed the "durum wheats" that are taking the place of Capelli are far from having the "pasta" quality of this famous wheat. It seems however, that the problem will be solved by means of several breeding programmes now under way.

From the quality point of view, it is necessary to consider Italy not only as a producing but also as an importing country. Production is not sufficient to cover total consumption and while the bread industry requires the strengthening of the flour blend with the Manitoba type (imported specially from Canada, U.S.A. and Argentina) the pasta producers ask for the Candeal-Taganrog type from Argentina to strengthen the simoline blend in order to improve the "macaroni" quality.

Figure 1 PEDIGREE OF SOME STRAMPELLI BREAD WHEAT

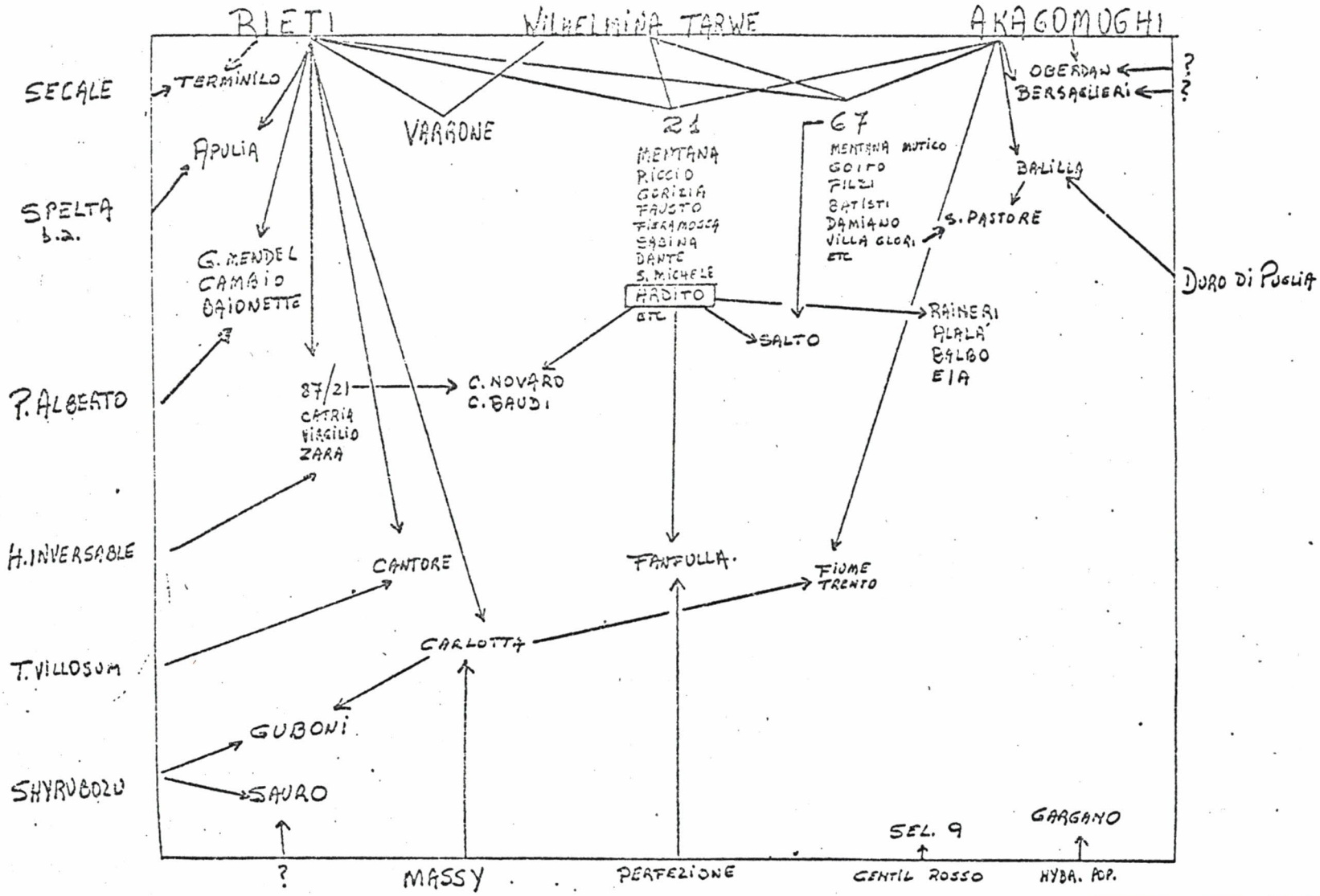

Figure 2

PEDIGREE OF SAN PASTORE

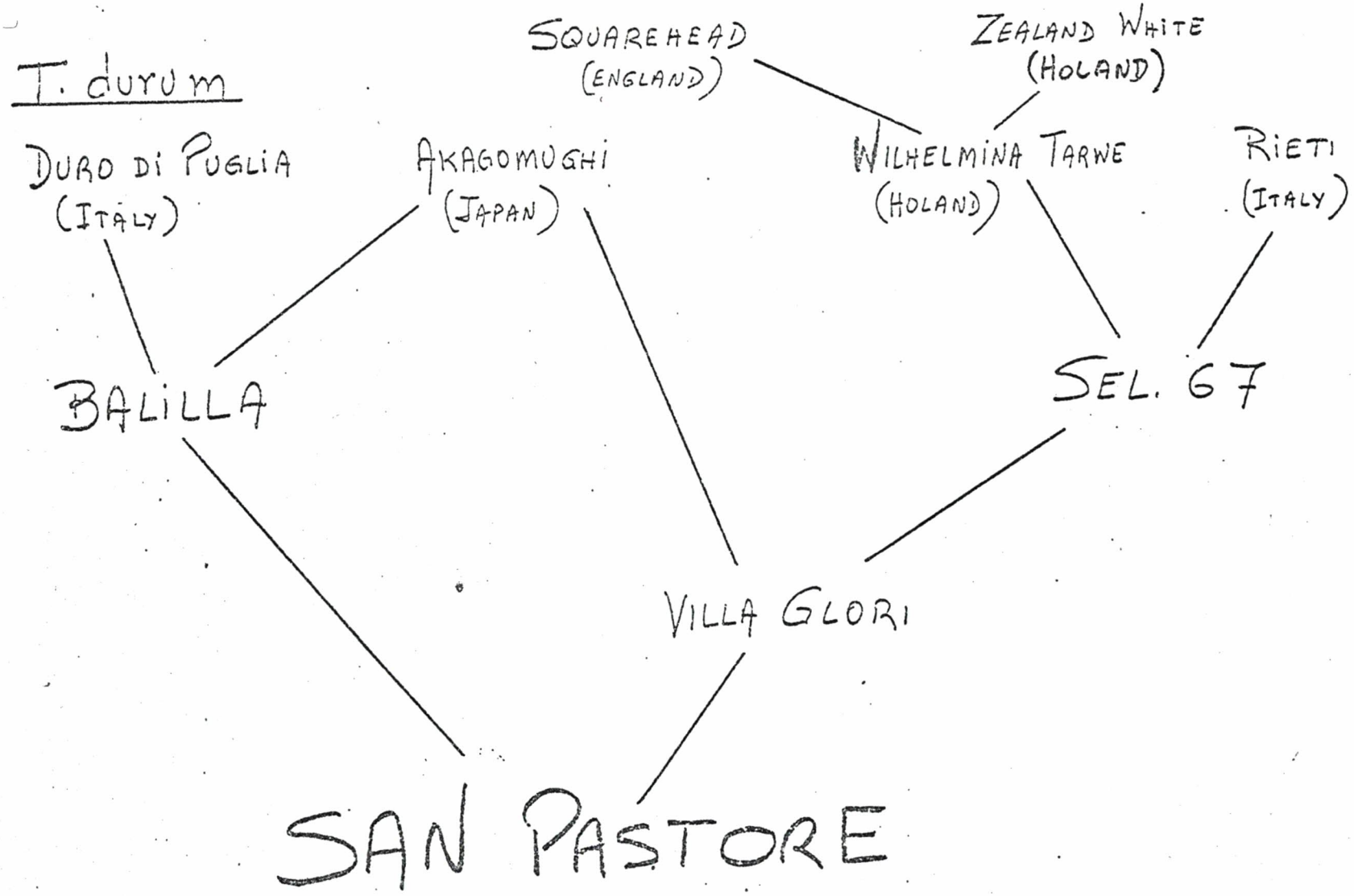

Figure 3 PEDIGREE OF SOME ITALIAN BREAD WHEAT VARIETIES

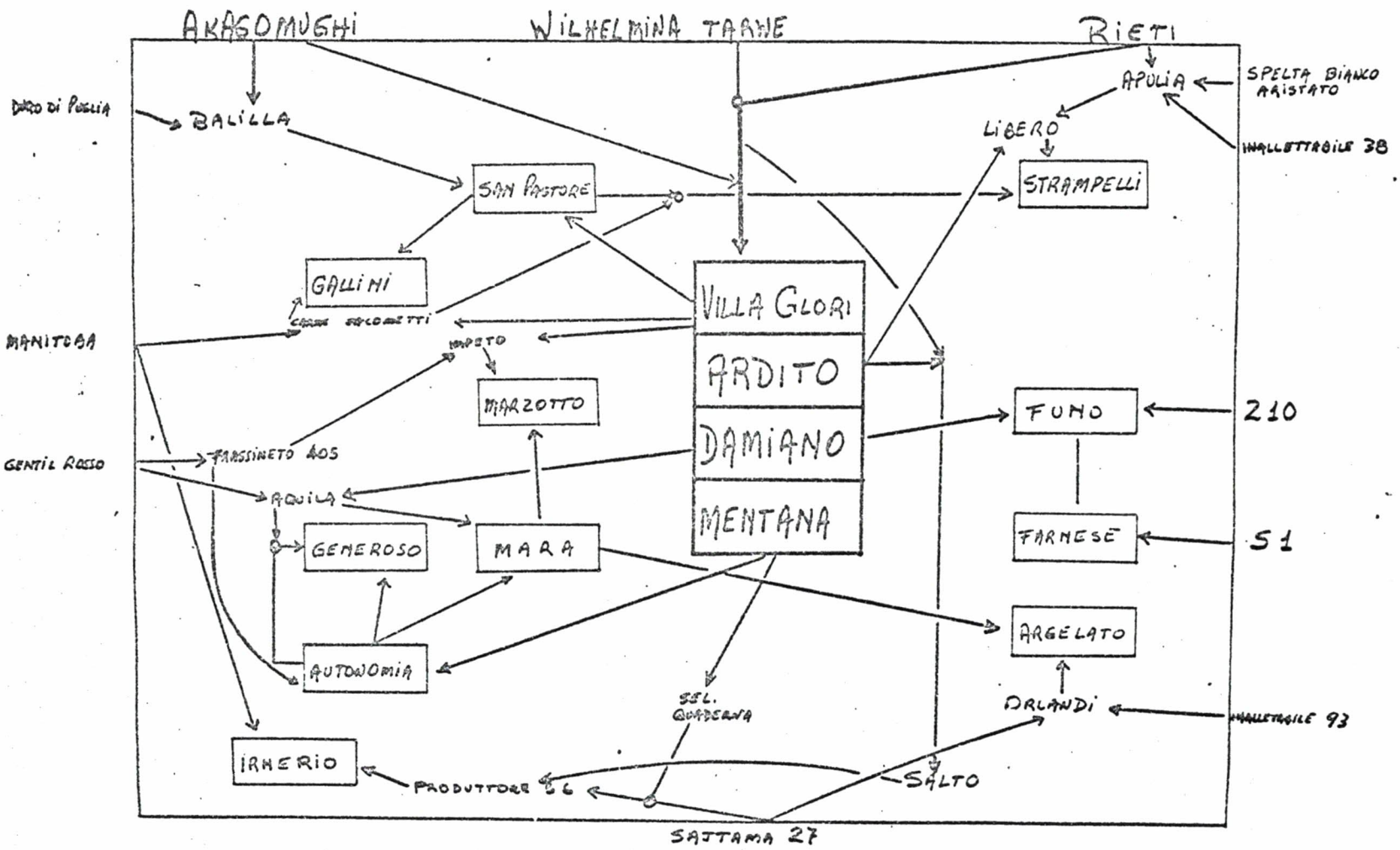

Figure 4. PEDIGREE OF SOME ITALIAN DURUM WHEATS

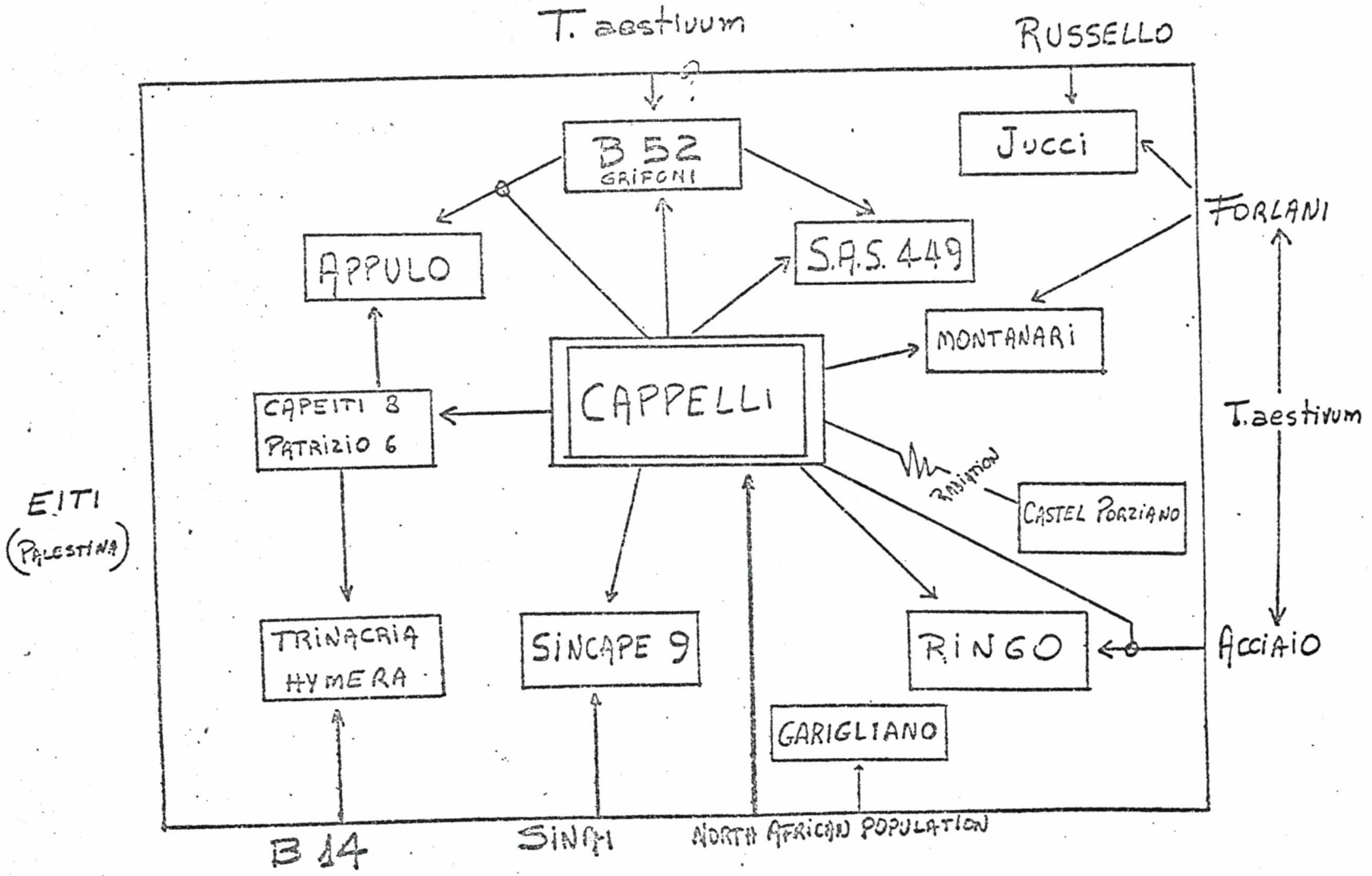

Figure 5

BREAD VARIETIES CULTIVATED IN ITALY IN 1971

Varieties	% of acreage	Yield qq/ha
S. Pastore	22	28
Marzotto	10	34
Generoso 7	8	29
Gallini	8	33
Autonomia	7	22
Mara	7	30
Argelato	6	40
Funo	4	26
Campodoro	2	34
Frassineto 405	2	21
Abbondanza	2	27
Maiorica 47	1	13
Others	7	18

Data from "Boll. Mensile di Statistica" No. 3, 1972

Figure 6

"DURUM" VARIETIES CULTIVATED IN ITALY IN 1971

Varieties	% of acreage	Yield qq/ha
Capeiti 8 . Patrizio 6	56	21
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" No. 3, 1972