Soft Wheat: View from France[1]

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At the outset it is important to note that in France wheat is *not* subdivided commercially into soft and hard kernel types. Because this distinction does not exist, my article deals with French wheats (*Triticale aestivum*) in general. Included are the subjects of production, import/export, usages, quality testing, and future trends.

Wheat Production

France ranks fifth in the world in wheat production, after the USSR, China, U.S., and India (Table I). It is the largest producer of wheat in Europe (with about 40% of all bread wheats) and a central trading member of the European Economic Community (EEC). France occupies a key position in the wheat economy of Western Europe due to its geographical conditions, adequate soils, and technology of its farmers.

The cereal sector is the backbone of French agriculture and forms the basis for its exporting status. France is now also the fourth exporter of wheat grain and the first exporter of wheat flour in the world.

The main wheat growing areas of France are indicated in Figure 1: Paris Basin, Beauce, Brie, Picardie, East Central, West Central, and Southwest. Although wheat is grown in every department of France, the 17 in the north supply 70% of the crop.

French areas sown in wheat, yields, and production for 1983–88 are shown in Table II. They are characterized as follows:

1) **Higher production in less area.** French wheat production has doubled in the last 60 years, and crop yields have increased 3.5 times, while the growing area has shrunk by 30–40% and now comprises only one tenth of France (about 5 million ha or 13 million acres).
2) **Very intensive cultivation** with an average yield of 60–62 q/ha (89–92 bu/acre), which is still on a continuous increase (Fig. 2). The Paris Basin and the northern areas produce extremely high wheat yields (higher than 100 q/ha or 148 bu/acre in many places). In the south, the yields are somewhat

Table I. World Wheat Production, 1986-1987[a]

Country	Areas (%)	Yield (q/ha)	Production (million tons) 1986	Production (million tons) 1987 (Predicted)
USSR	21.0	18.9	92.3	80.0
China	13.0	30.4	90.3	87.0
USA	10.0	23.1	56.9	57.3
India	10.0	20.3	46.9	46.0
EEC	7.0	45.6	72.0	71.7
France	2.1	55.0	25.5	27.0
Canada	6.0	22.4	31.4	26.3
Australia	5.0	14.8	16.1	12.8
Argentina	2.0	18.2	8.9	10.0
Others	26.0	...	120.6	116.6
Total	229[b]	23.4	535.4	508

[a]Source: Chamroux (1)
[b]millions ha

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lower owing to hotter, drier conditions, causing premature ripening. The average yields of the country could go above 80 q/ha (119 bu/acre) towards the end of the century.

3) **Large variations in quality between regions** (due to the relatively small size of productive areas, compared to North America, Australia, or Argentina), and a strong seasonal effect resulting in variable quality.
4) **No grading system equivalent to that of many other countries** that can market consistent and homogeneous wheats. Although excellent in concept, the grading system—attempted by ONIC (National Interprofessional Office of Cereals) to encourage the growing of high-quality wheats—has always found little commercial acceptance in France because of these variations in quality.
5) **French environmental conditions** make it difficult to produce very strong and high-protein varieties with competitive yields. A few areas (located in the south) are able to produce such varieties (Prinqual, Florence-Aurore, Aubaine). But shipping costs may make them more expensive in Paris than imported wheats. On the other hand, when grown in the north, these varieties are inferior to those grown in the south.
6) **Importance of variety in the domestic grain trade.** In the past, millers and other members of the wheat sector performed electrophoresis inspections of varieties (Fig. 3) on 50-kernel wheat samples taken from as many as several thousand deliveries per year.

However, both breeders' efforts and improved cultural techniques have made it possible to combine in a single variety several characteristics that looked incompatible a few years ago. For instance, the new cultivars Apollo and Créneau can reach the same yields as Monza, a hybrid-type wheat (5); even the good baking quality cultivars Récital and Camp Rémy do not yield significantly less than nonbaking wheats such as Arminda and Promentin.

Although French wheats are more difficult to export than homogeneous types from countries with an efficient grading system, French exports have increased considerably in the last years. In 1987, they represented 14 million tons, two thirds of the total wheat produced, divided as follows:

Table II. Area, Yield, and Production of Wheat in France, 1983-1987[a]

Year	1983	1984	1985	1986	1987
Area (millions ha)	4.7	5.0	4.7	4.7	4.8
Yield (q/ha)	52	66	61	55	56
Production (million tons)	24.4	32.7	28.5	25.5	27.0

[a]Source: O.N.I.C. Statistics (3)

To EEC countries (total ~ 6.3 million tons)

Italy	20.0%
Netherlands	5.4%
West Germany	5.1%
Belgium	5.0%
Others	9.4%

To non-EEC countries (total ~ 7.7 million tons)

USSR	27.8%
China	4.1%
Poland	2.3%
Egypt	1.2%
Others	19.7%

About 4 million tons are shipped to third world countries. As a consequence, France tends to import much smaller amounts of strong wheats than in the past—only 100,000 tons (i.e., 0.3% of total production, or 1.1% of domestic usages).

Traditional Uses of Wheat in France

Of every 100 tons of wheat produced in France, on the average 55–60 are

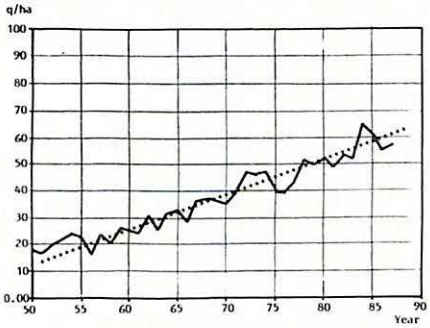

Fig. 2. Bread wheat yield in France, 1950–1990. Average increase, + 1.3 quintal/hectare/year. Source: Feyt (4).

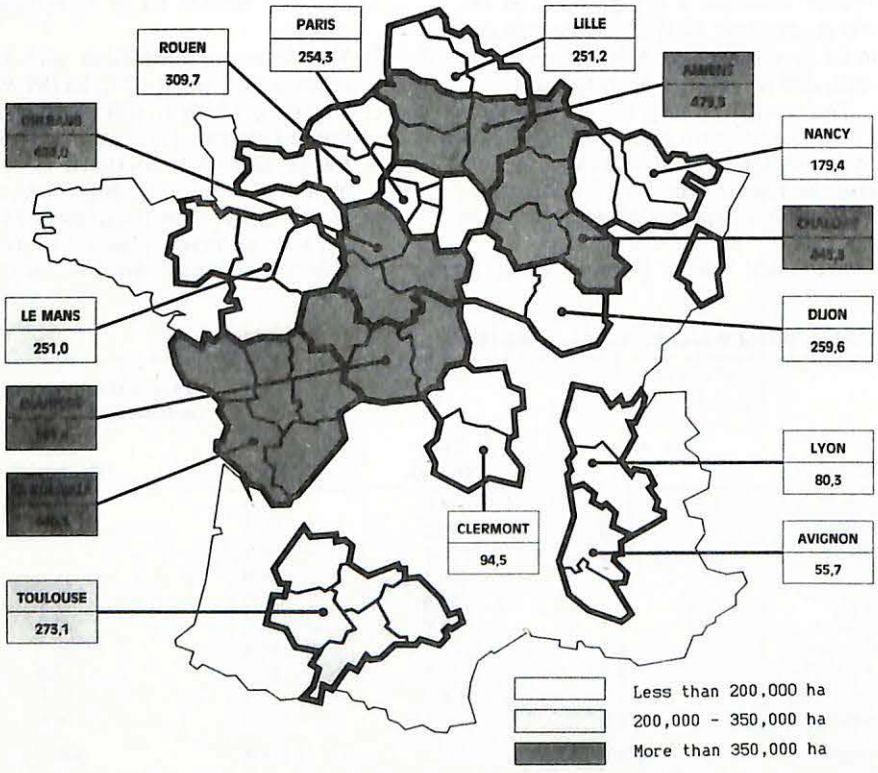

Fig. 1. Wheat production in French regions (Areas in thousands of hectares). Source: ITCF-ONIC (2).

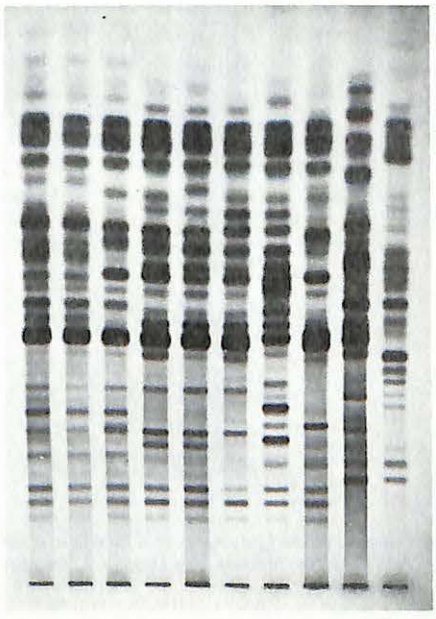

Fig. 3. Varietal identification of French wheats by electrophoresis

exported as grain and 10 as flour. Of the one third that is used domestically, 9% is fed to animals, and 21% is sold as flour to home consumers, with much of the remainder going to bakeries.

Because the largest use of domestic flours is for bread production, bread-baking potential is the prime quality consideration (Fig. 4). In 1987, 72% of French flour was used to make bread, the rest going into ready mixes (1.7%), *biscottes* (rusks) and *pain grillé* (toast) (3.6%), cookies and crackers (7%), pastry (1.3%), and wheat starch and gluten (7%).

In France, as in all other Western nations, per capita daily bread consumption has declined in the recent decades—from 350 to 165 g (from over 12 to less than 6 oz)—and no longer occupies as preeminent a place in the diet as it once did. Nevertheless, it is well known that in France bread continues to play an important socioeconomic role and that most consumers would not like to do without it (7). Most French consumers make daily purchases of fresh bread from small bakeries. More than 80% of all bread is still produced by skilled workers (Fig. 5) in 38,000 small bakeries, while only about 10% is produced in large wholesale bakeries (9,10).

Typical French breads differ from the conventional American loaf in three essential respects:

1) They are made of essentially four ingredients—flour, water, yeast, and salt—with small amounts of fava bean flour and ascorbic acid, but little or no shortening, sugar, dry milk, or potassium bromate. A formula representative of the typical French breads (*baguette, pain parisien, gros pain*) is given below (11):

Ingredients:	
Flour	100
Water	60
Yeast	2.5
Salt	2.0
Fava bean flour	2.0
Ascorbic acid	0.005
And sometimes the following:	
Malt	0.3
Lecithin	0.3

2) They are normally baked on the oven hearth rather than in a pan.
3) The dough is cut with a blade immediately before baking.

French bread is characterized by a crisp eggshell crust (3–4 mm or about 1/8 in. thick), open grain, full-bodied flavor, and high crust:crumb ratio, especially in the long types such as the *baguette* (Fig. 6), which represents more than 50% of all bread produced in France (10).

All these facts have governed for many years the major requirements of wheat quality in France. For instance, traditional breadmaking required wheats with a protein of 10.5–12%. Unlike in English or American breadmaking, very high protein contents were detrimental to French baking score or loaf volume (12) (Fig. 7). For a long time, the protein content of the wheat produced in the major growing areas of France has been consistent with the requirements of bakers. Recently protein contents have been increasing slightly, to 11–12.5%.

Baking quality specifications also have been extensively based on the W, P, and G characteristics shown by the Chopin Alveograph (Fig. 8). Especially impor-

Fig. 5. Bread-baking in France is done almost entirely by bakery craftsmen. Source: CIFAP (8).

Fig. 6. Baguettes. Source: CIFAP (8).

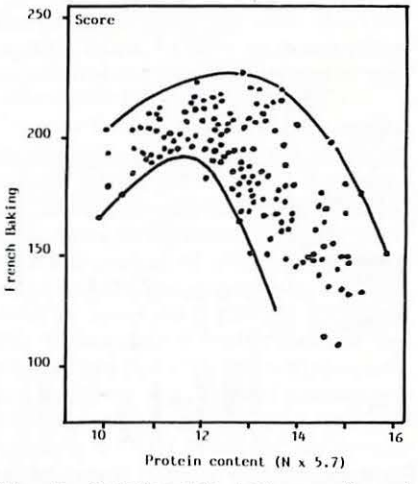

Fig. 7. Relationship between French baking score and protein content. Source: Martin (12).

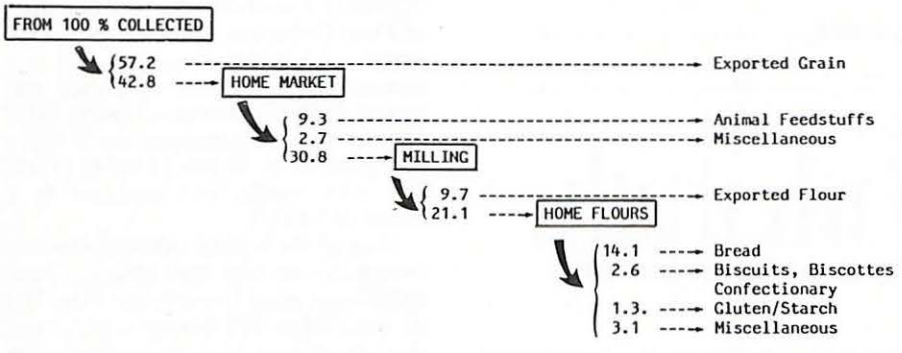

Fig. 4. Soft wheat uses in France in 1987. Sources: ONIC (3) and Lacroze (6).

Table III. Wheat Quality Required for Registration in France[a]

W Alveograph[b]	Baking score	Protein content[b]	Class	Threshold of Yield[b]
190%	special baking	...	A	no
90–190%	Capitole	...	B1	98
	Capitole	...	B2	100
90%	Talent	...	C1	105
	Talent	...	C2	108
...	unsuitable for baking	≥110	D1	105
		<110	D2	108

[a] Source: C.T.P.S. (16)
[b] as % of the standard cutivar Capitole

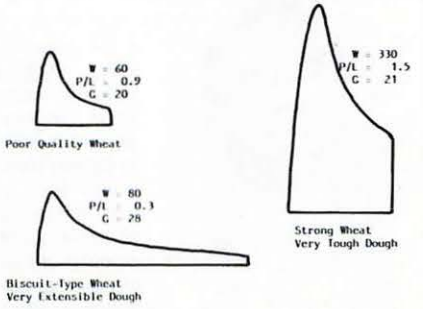

Fig. 8. Alveograph curves of different wheat types. Source: Branlard and Autran (13).

Table IV. Baking Strength Doubling over a 30-Year Period[a]

Registration Year	Major Cultivar	W Alveograph
1933	Vilmorin 27	90–100
1946	Cappelle	120–130
1950	Etoile de Choisy	60–70
1959	Champlein	80–90
1964	Capitole	140–150
1969	Hardi	160
1973	Talent	130
1973	Maris Huntsman	70
1977	Arminda	120
1978	Fidel	140
1980	Camp Rémy	180–200
1981	Festival	170–180
1984	Moulin	180
1986	Thésée	180
1986	Récital	220–240

[a]Data from Beaux (17) and Feyt (4)

tant is a satisfactory balance between the two main parameters: P (resistance to dough deformation) and G (dough extensibility), the latter being perhaps more critical and sometimes a better indicator of French bread-making ability than the W index itself.

Recent Trends in French Breadmaking and their Consequences for Wheat Quality Requirements

Several important changes in French bread technology occurred over the last decades. For instance, early in the 1950s the development of intensified kneading techniques began to bring new quality specifications demanding stronger flours.

More recently, several other changes have occurred that are worthy of mention:

1) The decrease of manual handling of the dough and the mechanization of dough dividing.
2) The introduction of mechanical refrigeration in a majority of bakeries—either for dough refrigeration in order to control fermentation and to limit the night work of the bakers, or freezing, which is increasingly used by supermarket bakeries. For instance, as measured by the alveograph W index, the strength needed for baking has evolved from 100 in the 1950s, then to 200 in the 70s, to at least 250 today, even for ordinary (*baguette*) breadmaking (14).
3) Moreover, the rapid development of new products such as rolls and fast food breads and buns now requires W indexes as high as 300 or 350 (15).
4) On the other hand, new specifications for higher protein contents (up to 14%) are resulting from increased export trade.

So the question arises—are the French wheats of today satisfactory for these new uses? The answer is yes, to a certain extent. This is due to 1) considerable research effort involving INRA (National Institute of Agricultural Research), IRTAC (Institute of Technological Cereal Foods Research), and ITCF (Technical Institute of Cereals and Feeds); and 2) effective communication initiated among the different members of the wheat sector: breeders, farmers, storagers, millers, and bakers, in the framework of the CTPS (Permanent Technical Committee for the Selection of Plant Cultivars). It has resulted in the success of a policy of quality, and in a continuous increase in both yield and quality of the registered cultivars (Table III). As for baking strength, the W index has doubled in 30 years (13,14) (Table IV), while yields have increased by a factor of 3.5 (17).

Most of the leading cultivars of today (which are all very high yielding) have either *very good* (registration class B1) or *good* (class B2) baking quality, and five out of nine are ones recommended by the milling industry (18) (Table V). The nonbaking wheats that increased at the end of the 1970s (e.g., Maris Huntsman, Clement, Corin) are no longer of major concern in France.

Another example is grain hardness (Fig. 9). For a long time, the majority of French wheats had opaque kernels and were starchy, and lesser quantities of vitreous wheat were grown (20). However, several newly developed cultivars (Thésée, Pernel, Castan) can be now classified as medium hard (19).

Another illustration of the French policy of quality is, as shown by the following list of bread wheat prices in

Table V. Leading Bread Wheat Cultivars in France in 1987[a]

Cultivar	Quality Class	W Score (1–9)	Baking Score (1–9)	Area (million ha)	%
Festival[b]	B2	6.5	5.5	0.81	17.3
Camp Rémy[b]	B1	6.5	6.5	0.54	11.4
Fidel	B2	5	6	0.50	10.6
Arminda	C1	5	...	0.27	5.8
Beauchamp	B2	4.5	5	0.27	5.8
Pernel[b]	B1	6	6.5	0.25	5.4
Talent	B2	4.5	5	0.18	3.8
Hardi[b]	B1	7.5	7	0.14	2.9
Moulin[b]	B1	6.5	6	0.13	2.8

[a]Data from Glémas (18)
[b]Recommended by the milling industry

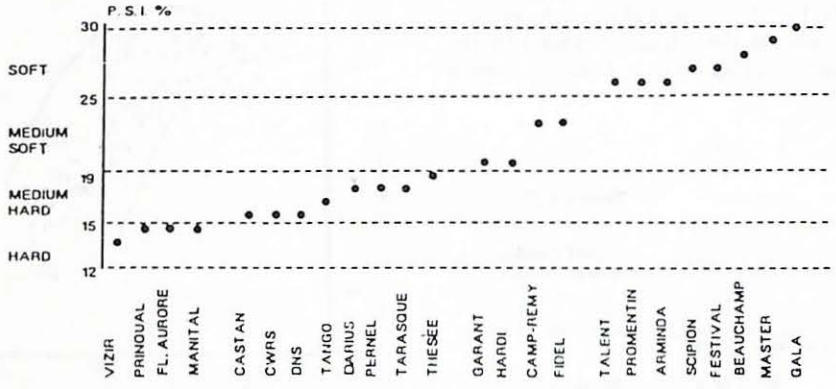

Fig. 9. Particle size index of French wheats. Source: Le Brun and Mahaut (19).

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France in September 1988 (21), the fact that some cultivars recommended by millers can command higher prices.

Standard prices	
For breadmaking	126.1 F/q
For animal feed	119.8 F/q
Recommended cultivars	
Capitole, Camp Rémy, or Castan	133 F/q
Strong wheat cultivars	
Darius (Rhone Valley)	142 F/q
Aubaine (Southwest)	150 F/q
Prinqual (Rhone Valley)	180 F/q
Florence-Aurore (Rhone Valley)	210 F/q
Imported wheats	
Dark Northern Spring	251 F/q
Canadian Western Red Spring	256 F/q

However, this is not enough to meet all flour quality requirements of today. Besides genetic improvement of the cultivars, technology is extensively used by the millers. According to the relative price level, they can use any of the following: imported wheats or strong wheats from southern France, air-classified flours or specific mill streams, or vital gluten. Today, vital gluten is the most often used of these to improve both gluten content and baking strength in domestic and exported flours.

A considerable increase in wheat starch production has occurred in the last 10 years (22,23) (Table VI). This did not result from a substitution of wheat starch for corn, but essentially from specific developments in the wheat starch and gluten industry without any significant decrease in corn utilization (Table VII).

As is true in many countries, other industrial uses of wheat are being studied in France: in the production of ethanol, in the paper industry, and in degradable detergents or plastics—both from starch/gluten separation and from whole wheat (25–27). However, their profitability depends on the prices of raw materials and on the relative price levels of starch and gluten. (For instance, in 1988 gluten prices fell substantially, to 5.70 F/kg (about $0.40/lb at F6.5=$1.00). This situation could call some uses into question again. In general, it makes the agricultural impact of new industrial uses still difficult to predict today.

A specific situation in France results from the wheat yields that are very high and still rapidly increasing. In the future any further rise will be obtained not from using more fertilizer but through more scientific control of wheat-growing by farmers and technical institutes. This will result in lower costs per ton produced (28). It also should further decrease the prices of raw materials and stimulate new uses for wheat (e.g., ethanol production, for which the cost of raw material is especially critical). However, besides the price decrease (at least in the framework of the wheat world market, as it is shared today between Europe and North

Table VI. Gluten Production in Europe, 1981-1986[a]

Year	1981	1982	1983	1984	1985	1986
France	6.6	7.2	9.4	11.1	12.5	15.9
West Germany	8.1	8.9	10.0	13.8	16.5	
U.K.	4.0	4.7	11.9	15.3	17.1	
Others	10.5	10.7	12.6	15.3	24.3	
Total	29.2	31.5	43.9	55.5	70.4	130.0

[a] Data from Feillet (24), in thousands of tons

Table VII. Wheat and Maize Uses for European Starch Industry, 1976–1986[a]

Year	Wheat	Maize
1976/77	207	2,880
1977/78	309	3,820
1978/79	351	4,120
1979/80	344	4,010
1980/81	372	4,120
1981/82	384	3,890
1982/83	564	4,200
1983/84	794	4,180
1984/85	952	4,240
1985/86 (a)	1,294	4,357
1986/87 (b)	1,100	4,260

[a] Data from Feillet (24), in thousands of tons

America), another negative consequence of this situation for the farmers might be the necessity of idling a significant part of the area previously sown in wheat.

Conclusions

The main characteristics and future trends of soft wheats in France can be stated as follows:

1) Intensive wheat growing, very high yields, large regional variations in quality;
2) Importance of the variety concept for the millers (electrophoretic inspections);
3) Specificity of the French bread-making process and extensive use of the alveograph curve for quality specifications;
4) New bread-making technologies (refrigerated and frozen doughs);
5) Continued increase in the level of baking strength required for standard French breadmaking;
6) Considerable increase in gluten production and uses; and
7) Agricultural impacts of other industrial uses (ethanol), which are still difficult to predict.

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