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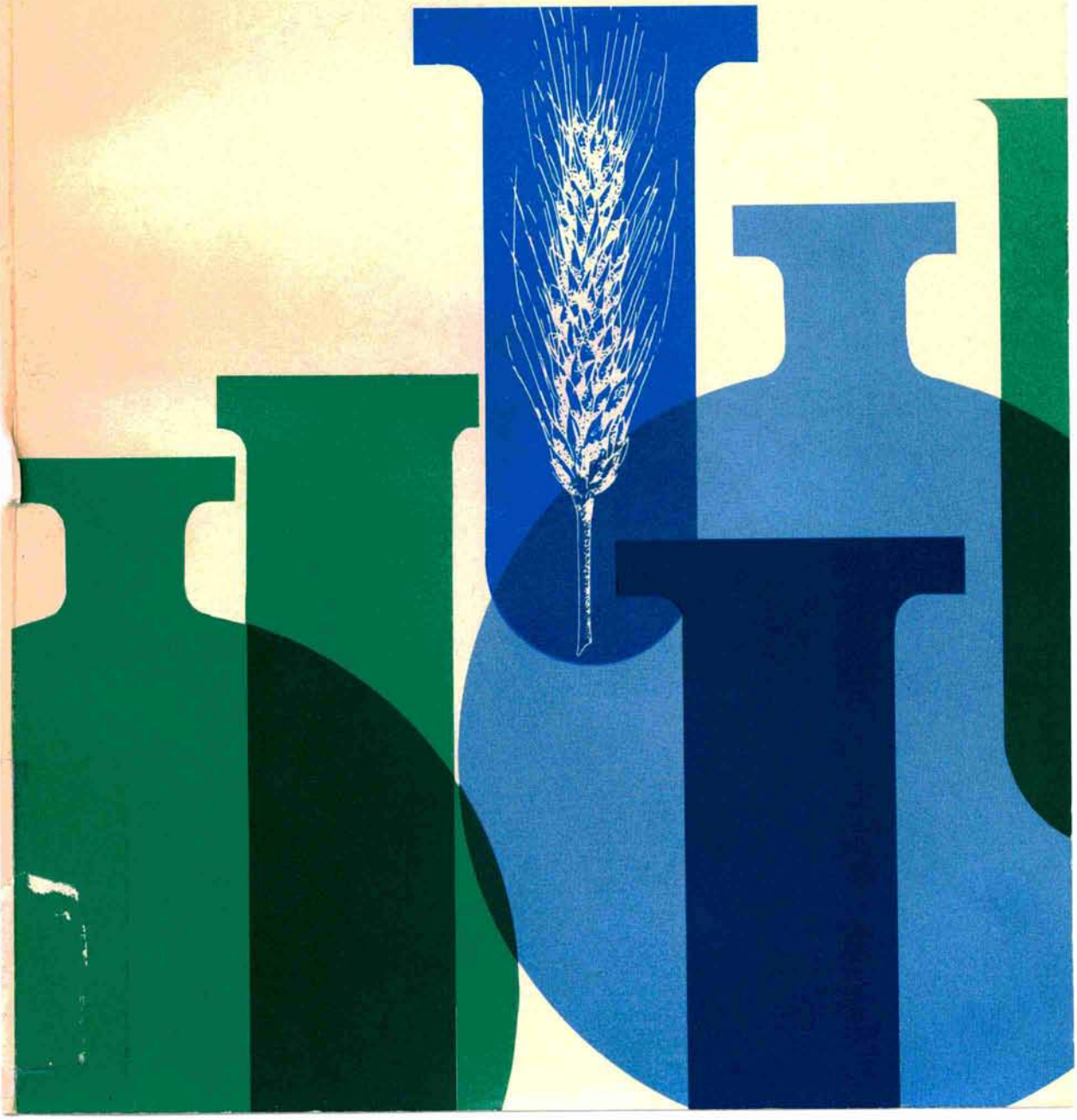
Editors: Reginald MacIntyre/Marilyn Campbell



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Contents

Triticale Breeding Experiments in Chile[1]

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Abstract Triticales are new in Chile. The first seeds, from CIMMYT's Fourth International Triticale Screening Nursery (irrigated), were planted in 1972 at the Pirque Experiment Station of the Catholic University of Chile. Results were limited but promising. The best triticales yielded about 80% of the wheat controls, but some lines showed excellent agronomic types; many were resistant to the prevalent races of *Puccinia striiformis*, *P. recondita*, and *P. graminis*. Their main advantage, however, proved to be the high protein content, which ranged from 9.2 to 18.5%.

A much larger and more complete set of triticale germ plasm was received from CIMMYT in 1973, and was planted under irrigated and dry-land conditions. This year's results may provide a sounder basis to determine the scope of the breeding program.

Résumé Le triticale est un nouveau venu au Chili. Les premières semences y furent mises en terre en 1972 à la Station Expérimentale de Pirque de l'Université Catholique du Chili; elles provenaient de la quatrième pépinière internationale de sélection du triticale (à l'irrigation) du CIMMYT. Les rèsultats obtenus furent limités mais prometteurs. Le rendement des meilleurs triticales atteignit environ 80% de celui des blés témoins, mais certaines lignées se révélèrent excellentes sur le plan agronomique; un grand nombre d'entre elles étaient résistantes aux *Puccinia* sévissant au Chili: *P. striiformis*, *P. recondita* et *P. graminis*. Leur principal avantage s'est cependant révélé être leur teneur élevée en protéines qui allait de 9.2 à 18.5%.

Un lot plus important et plus complet de matériel génétique est arrivé du CIMMYT en 1973, et ces triticales ont été semés en culture sèche et en culture irriguée. Les résultats de cette année pourront fournir une base plus solide de détermination de la portée du programme de sélection.

CEREALS have a significant importance in Chile's economy. Wheat represents 15% of the total agricultural production, and in 1970 was, along with beef cattle, the main component of the agricultural sector (ODEPA 1970).

The area planted with wheat up to 1970 was consistently over 700,000 ha, or approxi-

[1]This paper was prepared before the 11 September 1973 events in Chile. Some of its forecasts may be thus invalid. Nevertheless, the need for triticale development remains as urgent as indicated.

mately 55% of the land used for annual crops (Table 1). Wheat production decreased in 1971 and 1972, and the situation will not likely change in 1973. The reasons for this decrease are a combination of political, social, and economic factors that fall outside the scope of this paper.

The average daily diet of the Chilean population is 2720 calories (FAO 1970); of these, 1430 calories, or approximately 52%, are supplied by cereals, mainly wheat. Wheat contributes about 40% of the energy and 50% of the protein in the national diet, and is thus its most important constituent.

Wheat commercial cultivars have a comparatively low protein content (Table 2) and although the trend in recently produced cultivars is toward higher protein levels, the average remains inadequately low. This emphasizes the need to produce grains with a genetically higher protein content, so that the diet may be enriched with more and better protein, at no additional cost to the consumer.

In spite of the importance of wheat in the country's economy and in the dietary requirements of the population, Chile imports a considerable amount of this cereal (Table 3). Import estimates for 1973 range from 1,000,000 to 1,507,000 tons, or from 47 to 71% of the total needs. The outlook for the next few years is not too promising. In addition, the high price of wheat, coupled with the country's unfavourable balance of payments, dramatizes the requirement to locally produce more grains to feed the population.

TABLE 1. Area, production, and yield of wheat in Chile, 1948–72.

Year	Area (*'000 ha*)	Production (*'000 tons*)	Yield (*100 kg/ha*)
1948–52	777	928	11.9
1953–56	772	989	12.8
1964	852	1320	15.5
1965	849	1276	15.0
1966	784	1167	14.3
1967	719	1204	16.7
1968	700	1220	17.4
1969	740	1307	17.7
1970	776	1343	17.3
1971	724	1145	15.8
1972	540	810	15.0

TABLE 2. Protein percent of spring wheat cultivars released for the north-central region of Chile.[a]

Cultivar	% protein	Year released
Menflo	10.4	1954
Vilufén	10.0	1956
Orofén	10.8	1959
Rulofén	11.6	1960
Huelquén	10.7	1963
Platifén	14.1	1964
Centrifén	11.5	1965
Collafén	11.4	1967
Yafén	12.6	1967
Toquifén	12.6	1969
Mexifén	11.3	1970

[a]Source: INIA, Chile.

TABLE 3. Chile's wheat imports, amount and cost, 1970–72.[a]

	Year		
	1970	1971	1972
Amount (*tons*)	200,371	502,200	740,000
Cost (*US$*)	13,357,000	36,600,000	55,000,000

[a]Source: ODEPA (1970).

Because wheat is mostly used for human consumption, and production does not meet demand, other grains have to be grown for animal feed. Corn is undoubtedly the most important animal feed in Chile. The north-central region, located approximately between 28°30′ and 36°30′ lat S, possesses optimum environmental conditions for corn production. Yields have increased significantly since 1961 (Table 4) but the reduced area planted with corn has maintained an inadequate level of production, the deficit becoming acute after 1965, when the poultry and swine industries were expanded. After 1970, the variables affecting corn production were altered, as in wheat, and despite recent efforts, major

changes in the present trend may not be expected. The import situation for corn is shown in Table 5. Current estimates for the 1973–74 season range from 450,000 to 608,000 tons, or from 55 to 72% of the total needs.

The conditions of the 1971–73 period should be considered "abnormal" for wheat and corn production, as for agriculture in general. But even under "normal" conditions, Chile needs to produce more grain, and grain with better nutritional quality, since replacement with other sources of protein seems to be difficult and expensive.

The alternatives are not simple. It had been planned to concentrate on export commodities such as fruits, the returns for which might pay for wheat and corn imports. The instability of the world grain market makes this possibility rather dangerous. Sorghum has been tested on a limited basis, but it has to compete for land with corn, and as indicated, corn yields are difficult to surpass. Sorghum, however, does not represent a viable solution to supply grain for direct human needs. Research with soybeans was initiated a few years ago. Low yields are still a major problem, but we are certain that our scientists may overcome them. Still, there are years of work ahead before satisfactory results may be obtained, and even then, although soybean-enriched flour may be used for bread-making, the demand for bulk will still remain unsatisfied.

TABLE 4. Area, production, and yield of corn in Chile, 1960–72.

Year	Area *(000 ha)*	Production *(100 ton)*	Yield *(100 kg/ha)*
1960/61	83.3	162.8	19.5
1961/62	84.6	180.8	21.4
1962/63	84.4	176.0	20.9
1963/64	88.2	241.0	27.4
1964/65	87.6	259.9	29.7
1965/66	80.7	285.3	35.4
1966/67	92.2	362.2	39.3
1967/68	88.5	320.8	36.2
1968/69	58.4	153.8	26.3
1969/70	73.9	239.1	32.4
1970/71	77.0	258.3	33.5
1971/72	84.5	180.2	21.3

TABLE 5. Chile's corn imports, amount and cost, 1970–72.[a]

	Year		
	1970	1971	1972
Amount *(tons)*	163,579	270,300	465,000
Cost *(US$)*	10,826,000	20,600,000	31,620,000

[a]Source: ODEPA (1970).

Triticales are now in Chile. The first seeds, from CIMMYT's Fourth International Triticale Screening Nursery (irrigated), were planted in 1972 at the Pirque Experiment Station of the Catholic University of Chile. Results are limited but promising. The best triticales yielded about 80% of the wheat controls, but some lines showed excellent agronomic types; many were resistant to the prevalent races of *Puccinia striiformis*, *P. recondita*, and *P. graminis*. Their main advantage, however, proved to be the high protein content, which ranged from 9.2 to 18.5%.

A much larger and more complete set of triticale germ plasm was received from CIMMYT in 1973, and was planted under irrigated and dry-land conditions. This year's results may provide a sounder basis to determine the scope of the breeding program.

When initiating a triticale breeding program, several aspects must be considered. No matter how good the potential cultivars may be, if conditions conducive to high and efficient agricultural production are not restored, the cultivars will be of no use. If such conditions are restored, as we hope they will be during the second half of this decade, now is the best time possible to initiate such a breeding program, so as to be prepared with suitable cultivars when proper conditions are available.

A triticale breeding program in Chile should have the following goals:

(1) *Develop high-yielding spring triticale cultivars that will supplement grain production for human consumption.* Such cultivars

would be planted in the wheat-growing areas. Chances that new land may be opened for triticales, or diverted from other crops to triticales, are limited. Triticales would then compete with wheat for the same land; whether this is irrigated or dry land remains to be seen. Most of the area in the region, however, is irrigated, and the best soils and best yields are usually found under irrigation. Triticale cultivars must show yield advantages over wheat cultivars, or at least perform comparably under similar environmental conditions.

(2) *Develop triticale cultivars with adequate milling and baking characteristics.* If triticales are to compete with wheat for land, their flour must have the appropriate milling and baking quality, so that they may be used directly for bread-making, or in mixtures with wheat flour without lowering the quality level. Only in a secondary manner should triticales be considered as a source of cookie flour.

(3) *Develop triticale cultivars with high protein quality and quantity.* To compete with wheat, triticales must show advantages other than yield, since yield levels attained with one set of cultivars may be soon surpassed with the next set developed by the breeding programs. The importance of wheat as a source of food has been indicated. To emphasize it, it should be noted that the average Chilean incorporates in his diet 77.8 g of protein per day, of which 39.3 g are supplied by cereals, mainly wheat. Wheat consumption is obviously high, but its contribution to the diet, both as protein and as total calories, is inadequate. The chances that the proportion may be altered and replaced by animal protein are limited. Triticales may produce more protein per unit area even with lower yields, but if by using high-protein triticale flour, more nutritious bread and other flour derivatives may be supplied to the population, triticales would justify the effort and money invested in a breeding program.

(4) *Develop triticale cultivars for animal feed.* Triticales, or any other small grain, may at present compete for yield with corn in Chile's north-central region. High-yielding triticale cultivars, with poor milling and baking quality may be grown, however, in areas where topography or summer moisture, or both, preclude corn production. In addition, early maturing triticales could be introduced into a double-cropping system, followed by corn or other crop, increasing the output per unit area of land.

With these considerations in mind we have taken the first steps to initiate a triticale breeding program, based on CIMMYT's germ plasm. The magnitude of the program will depend on the funds available to finance it.

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