RECENT PLANT BREEDING RESEARCH

Edited by

E. ÅKERBERG and A. HAGBERG

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SVALÖF 1946—1961

EDITORIAL COMMITTEE

E. Åkerberg · A. Hagberg · G. Olsson · O. Tedin

ENGLISH TECHNICAL EDITOR

W. M. Myers

St. Paul, Minnesota, U.S.A.

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PREFACE

When the Swedish Seed Association at Svalöf celebrated its 60th anniversary in 1946 it was considered appropriate to publish in English a book which should "present a survey of experiences, ideas and work from the institution". This book was also intended to demonstrate, from the side of Swedish plant breeders, the wish for increased and intensified international collaboration in the field of plant breeding when, after World War II, the borders were again opened for technical and personal contacts.

The book was given the title "Svalöf 1886–1946" and appeared in 1948. It has been a pleasure to find that this book has attracted considerable interest among plant breeders in various countries and has also been used as a text book by many colleges, *i.a.* in the USA. It has been distributed by the Swedish Seed Association and is now practically out of print.

In 1961 the Swedish Seed Association celebrated 75 years of work. On this occasion a memorial volume in Swedish was published as an ordinary issue of the Journal of the Association, which besides some general surveys presented developments and results from the different divisions of the Association, mainly referring to the years from 1946 to 1961. From several sources in other countries it has been pointed out that an international publication would be of interest, presenting recent experiences in plant breeding methods gained in the work of the Seed Association. In agreement with this opinion and in order to present to our colleagues in other countries and to our numerous visitors from these countries a survey of recent developments it has been considered proper to publish a continuance volume to "Svalöf 1886–1946".

In the present volume a number of the scientists working at Svalöf report on some of the scientific investigations made since 1946 which may be considered as of more general interest. These investigations have been made in closest connection with the practical breeding work carried out at Svalöf and at the branch stations of the Association. The intention has not been to publish a "manual of plant breeding" but to present a comprehensive report on research work, the details of which have in many cases been published in several papers in different technical journals. The close connection between plant breeding methods and theoretical genetics and its development has

been given cognizance especially in the contributions by professors A. Müntzing and Å. Gustafsson.

All articles in this book have been closely scrutinized by professor W. M. Myers and several of his colleagues at the University of Minnesota, St. Paul, Minn., USA. The editorial committee wishes to express its deep gratitude for this very valuable aid which has not only included linguistic corrections but also many valuable suggestions concerning the content, conclusions, *etc.*

In the publication of the book it was considered of value to have the aid of a professional publishing house. The editorial committee made contact with representatives of the publishing houses Almqvist & Wiksell AB and John Wiley & Sons Inc. and was met with great interest in the publishing and full understanding of the special character of the book. It is therefore a pleasure to thank the publishers for valuable aid in preparing and issuing this volume.

In all scientific research work close collaboration is necessary between colleagues in all countries if the results are to be of as great value as possible for humanity. This is very true also of plant breeding which has been and will be of the greatest importance for the development of food production in the world. It is the sincere hope of the editors that this book on Swedish plant breeding research may be of some value for plant breeders and plant breeding in other countries.

The editorial committee

THE SWEDISH SEED ASSOCIATION

ITS HISTORY AND ORGANIZATION

By G. Andersson

THE ORIGIN OF THE SEED ASSOCIATION

The Swedish Seed Association is an organization for plant breeding: its main task is the development of new and improved varieties of all agricultural crops grown in Sweden, the practical work to be carried out with methods based on scientific research. The Association was founded in 1886 and in 1961 celebrated its 75th anniversary. In 1946 a survey of 60 years work was published in English in the book "Svalöf 1886–1946". In this book, E. W. Ljung, the then secretary and economic director of the Association, gave an account of its foundation, and of the organization and development that had taken place during 60 years. Reference to this survey is made for those interested in details. Here the background of the Association was given in a brief history of the development of Swedish agriculture during the first three quarters of the nineteenth century.

The first steps towards a modern system of agriculture were taken in the first half of the century when each farm was consolidated as a continuous piece of land around the farm buildings instead of being split up into scores and even hundreds of small plots, intermingled with those of the neighbouring farms belonging to the same old village. This consolidation was necessary to make further development possible, including modern drainage, improved machinery and the use of artificial fertilizers.

As one means of increasing the production of Swedish agriculture, foreign varieties were imported, beginning around 1870, especially from Germany and Great Britain. In favourable conditions these varieties yielded much more than the old Swedish ones but usually they were not sufficiently winter-hardy or else poorly adapted to Swedish conditions. The "adaptation" of these varieties to Swedish conditions was the first main task of the Association and the necessity for such adaptation was the immediate cause of the foundation of the Association.

The formal organization was that of a society of private persons, the members being Swedish farmers, and this organization is still retained. The

practical aim of the work of the Association was clear from the very first and direct practical service to Swedish farming is still the lode-star of its endeavours. At the same time the initiator and the founders were well aware of the necessity of using strictly scientific methods in the work and of following the development of the fundamental sciences. The understanding of this fundamental principle was expressed already in the membership of the first board, one half of whose members were practical farmers while the other half were scientists, representing botany and agronomy. From the very first the directly practical breeding work has been complemented with scientific research concerning variation and inheritance and the development of new methods in plant breeding.

The Association founded in 1886 was local, comprising only southern Sweden but in 1894 it was merged with another Society, founded in 1889 and located in central Sweden. At the same time the name "Sveriges Utsädesförening" (The Swedish Seed Association) was adopted.

From the outset the new Association obtained support from the Swedish Government, support that has gradually increased. Although the formal organization as a private society has been retained, the Government influence upon the Association has grown, and at present the Association is considered to be the state plant breeding institution of Sweden.

TRENDS IN THE DEVELOPMENT OF SWEDISH AGRICULTURE AND THE TASK OF THE SEED ASSOCIATION

In the first bylaws of the Association its task was stated thus: "to work for the cultivation and development of improved varieties of agricultural plants and the utilization of this cultivation in Sweden and abroad". The necessity for adapting the imported varieties of cereals to Swedish conditions was, as already stated, the immediate cause of the foundation of the Association, and at first work with small grains dominated its program. Successively, however, pulses, herbage crops, root crops and potatoes were included and later on—during World War I—oil and fibre plants. At first, increased yield was the main aim of the breeding but reliability of yield was considered as a main component of high yield as such. Increased winter hardiness, for instance, of the winter wheat varieties was one of the first main tasks and has remained such until the present day. From the first decades of the present century the quality of the product has gained increased importance. Among quality problems included in the program may be mentioned baking quality of bread grains, dry matter and sugar content in fodder and sugar beets,

protein content in herbage and other fodder crops, oil content in oil crops, malting quality of barley, table quality of potatoes, *etc.*

In the planning of its work the Association has always tried to adapt itself to changing conditions in Swedish agriculture. Not least during the fifteen years after World War II, a period covered by the present book, has Swedish agriculture passed through a period of deep-going changes. The outstanding feature is the increased mechanization but also a large number of farms on the plains have abandoned animal production with a decrease in herbage acreage and more one-sided plant husbandry as a consequence. These changes have offered the plant breeders new and important problems. The replacement of binders by combiners has enhanced the need for varieties with extreme resistance to lodging and shedding and also requires increased diversification in regard to earliness. The trend towards more one-sided plant husbandry has increased the risks of damage by pests and diseases and thus brought resistance breeding increasingly to the fore.

The introduction of new agricultural crops, suitable as raw material for different industries, is one way of counteracting the prevalent one-sidedness; and the search for such crops is one of the important tasks which have been added during the last 15 years. At the same time the quality of the products is becoming more and more important as the refining industries and the consumers increase their demand for high quality food stuffs while at the same time—for reasons of national economy and preparedness—it is desirable to use as much as possible of home-produced agricultural products in the country.

FORMAL ORGANIZATION OF THE ASSOCIATION

In the formal organization of the Association no important changes have taken place since Ljung published his survey in "Svalöf 1886–1946". The present statutes were promulgated by the Government in 1913 with some amendments in 1935. According to these statutes the board of the Association has eight ordinary members and three deputies, the Government appointing five of the ordinary members, among them the chairman, and the others being elected by the annual meeting of the Association. There are three auditors, two appointed by the Government and one elected by the members.

The plan of works and the budget of the Association are annually submitted to the Ministry of Agriculture, after routine scrutiny by the board of the Royal Agricultural College of Sweden.

The total personnel of the Association varies between 250 and 350 per-

sons, according to the season. Among these the permanent staff comprises about 25 scientifically trained people and about 60 technicians for laboratory and field work, employed on conditions similar to those in effect at similar State institutions while the remainder are engaged in accordance with agreements obtaining in the free labour market.

Since 1907 the heads of departments are organized in a special committee which has to advise the board of directors concerning technical problems and certain matters connected with organization. For general discussions concerning such problems this committee holds meetings open to all scientifically trained members of the staff. For discussion of certain problems of interest to all employees a special committee is formed including members elected by all the different categories of employees.

The Association has no formal training program, but students in different branches of biology and agronomy are employed during vacation for training by practice and such—at first temporary—students constitute the main source for recruiting the scientific staff. Even students from other countries are received on similar conditions and, furthermore, the Association has the pleasure every year of receiving more advanced students and scientists from all over the world who want to follow in greater detail its work on one problem or other.

INTERIOR ORGANIZATION. WORK AT THE MAIN STATION

At the outset the main station of the Swedish Seed Association was located at Svalöf. At the turn of the century the work had developed to such an extent that it was divided into several departments, each head of department being responsible for work carried out with the plants delegated to him. Gradually, though fairly slowly, the staff of each department was augmented by one or two scientific assistants.

At the beginning of the 15-year period dealt with in this book there were six breeding departments at Svalöf, viz.,

1) Wheat and oats;
2) Rye, potatoes, sweet lupine, tobacco, also seed control;
3) Barley, fibre plants;
4) Herbage crops;
5) Root crops and Kokzaghys;
6) Oil plants.

There were also two general departments, not specialized in crops:

7) Cytogenetic department and
8) Chemical department.

Two departments were located at branch stations (cf. chapter E), *viz.*, one for pulses at the Ultuna branch and one for herbage plants for northern Sweden at the Västernorrland branch.

The distribution of plants among different departments is partly caused by biological or agronomical reasons, partly as a result of historical development: new plants introduced being given to the department which for different reasons had the best possibilities of taking over.

On the whole the same organization is still in effect in 1961 with a couple of changes. In 1959 the breeding of potatoes was intensified and this species was taken from department 2 and given over to a new specialized department. The work with Kokzaghys has been practically abandoned and department 5 has taken over work with fodder rape, other cruciferous fodder plants and maize, which formerly belonged to department 6.

Gradually the work at the cytogenetic department has widened in scope and besides the work financed by the general budget several special investigations are being carried out with the aid of grants from different research councils and other funds. During recent years physiological research has been included in the program and for this reason the department is sometimes referred to as the department of general biology.

The increased importance of quality problems in Swedish agriculture and, consequently, in the work of the Association has resulted in a rapid increase in the amount of work carried out by the chemical department. This growth was made possible, at first mainly by income from routine analyses carried out on demand from farmers' organizations, industries and governmental institutions; in later years economic support for research has been granted, especially by government institutions and farmers' organizations. The necessity for intensified research has resulted in a subdivision of the department into four divisions: starch and related enzymes, fat, etc., protein, etc. and a general division, mainly to deal with routine analyses. The organization into these four divisions is just under way.

The breeding work at the main station has not only widened its scope by gradually including more species—at present practically all those used in Swedish agriculture and some others—but at the same time the work with each of these crops has been very much intensified. The degree of intensity may be measured in different ways: one method is to count the number of plots grown in the experimental fields at Svalöf. Table 1 shows the number of plots from 1886 to the present time for some of the important groups of plants. As seen from column 7 in the table, the total number of plots has shown, with a few exceptions, a steady increase from 150 at the start to 110.000. The numbers of plots of different crops show that in later years

TABLE 1. *The number of plots at the main station of the Swedish Seed Association.*
1886–1961.

Year	Number of plots with					
	Grain crops	Forage plants	Root crops	Potatoes	Other crops	Total
1886	129		21			150
1889	816					816
1892	2,344	(156)				2,500
1895	1,889	326				2,215
1898	2,321					2,321
1901	3,087					3,087
1904	3,039			940		3,979
1907	2,938	445	(200)	1342		4,925
1910	2,592	1,420	1250	1205		6,467
1913	3,359	1,812	2363	1245		8,779
1916	3,816	3,413	2627	758		10,614
1919	5,184	2,624	2511	1280	1,451	13,014
1922	4,956	2,038	2796	1037	2,719	13,546
1925	9,707	4,624	2646	1083	2,926	20,986
1928	10,731	6,459	2591	1139	68	20,988
1931	14,831	7,432	2401	1490	50	26,204
1934	13,499	11,040	2379	1113	1,045	29,076
1937	17,135	13,144	2794	2644	535	36,252
1940	11,642	9,741	2167	2612	10,874	37,036
1943	17,086	8,243	1839	2643	9,185	39,054
1946	15,646	9,225	2176	2898	17,640	47,585
1949	20,172	11,326	1723	2526	15,797	51,544
1952	31,616	11,760	1605	1848	12,794	59,623
1955	40,872	14,867	1692	2042	10,017	69,490
1958	71,308	17,412	1977	3617	16,411	110,725
1961	67,874	11,848	2624	2362	18,869	103,577

especially small grains and oil crops have increased, a sign that the work of the Association has followed the modern trend in Swedish agriculture.

The field material of the Association has during its whole period of existence been sown partly on a small farm of about 10 hectares (25 acres) belonging to the Association and for the most part on land belonging to the General Swedish Seed Company (cf. chapter F). In 1958 this company purchased a neighbouring farm from Per Bondessons Lantbruks AB and from this year a considerable part of the field material of the Association has been located on this farm. The soil here is more rich in humus than that

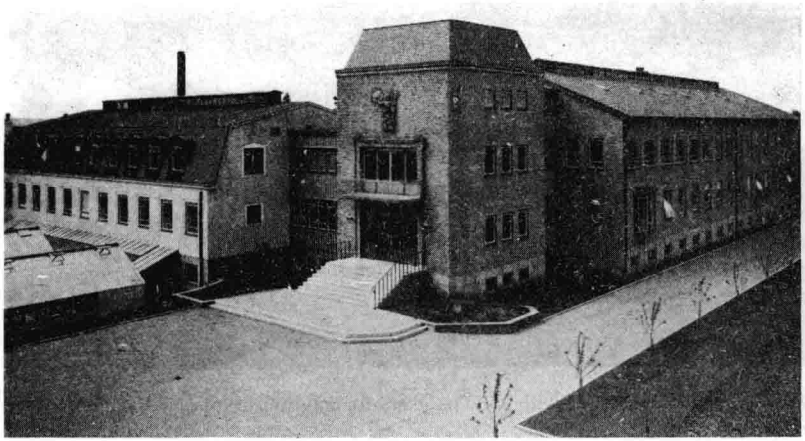

FIG. 1. The new laboratory building

of the former farms of the company and also in other respects better suited for field trials; in this way the resources of the Association have been considerably improved.

It was found advisable that certain series of breeding material should be grown under optimal conditions available in South Sweden and for that reason a special substation was established in 1955 in the vicinity of the city of Lund on soil of the very best quality. This substation is in the first place used for material of barley, summer wheat, rape and root crops.

Already in 1943 a substation on light sandy soil and in very dry climate was established at Ugerup near the city of Kristianstad in north-eastern Scania, on a farm which was first let to and then purchased by the Association. This substation is used for part of the rye material and for all material of sweet lupine and tobacco. From the start and until 1958, inclusive, potatoes were also bred at this station but the conditions gradually became less suited to this crop, especially since the whole area was infested by nematodes blown by wind. Since then different localities have been tried for the potato material which is at present located at a farm about 10 kilometers south of Svalöf on sandy soil.

The main station has a third substation, located at Tagel near the town of Växjö in the South Swedish hill region. Here some of the potato material is tested and grown for seed and also trials have been carried out with herbage plants and cereals.

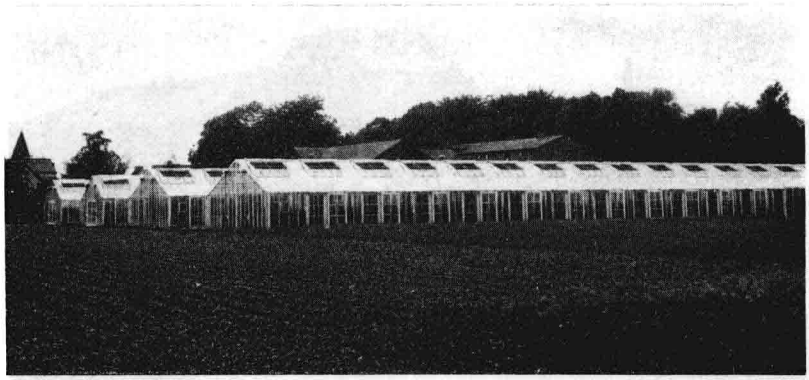

FIG. 2. Four greenhouses with 150 chambers for multiplication of breeding material of cross fertilizers.

Besides these substations belonging to the main station the Association has 8 branch stations in different parts of the country. These are dealt with in some detail in chapter E.

The need of office and laboratory localities has obviously increased with the increased scope and intensity of the breeding work. In *Svalöf 1886–1946* the first (1891), second (1892) and third (1908) office and laboratory buildings of the Association were presented. The last one of these was at the time of erection considered to be extravagantly large but during the 1940's it became overcrowded, and during 1949–1951 a new building (Fig. 1) was erected with modern and well equipped laboratories for the chemical and cytogenetical departments. At the same time the older third building was internally partly rebuilt and refurnished, the former laboratory localities being changed into offices for the breeding departments. The new building and the restoration of the old, including equipment and furniture cost about $2\ ^1/_4$ million Sw. crowns and was made possible mainly by grants from funds, organizations and private persons, and by a governmental loan of 450,000 Sw. crowns on mortgage but free from rent and repayment as long as the buildings are used for the purpose intended.

For use in breeding cross fertilizers, especially oil plants, green-houses (Fig. 2) were erected in 1949–1952. There are four houses in all with 150 chambers. The costs were 200,000 Sw. crowns, the money being granted by the Swedish Oil-growers Association.

Thanks to grants from the Rockefeller Foundation, the semi-governmental Swedish organization for trade in small grains and the Norwegian Hydro,