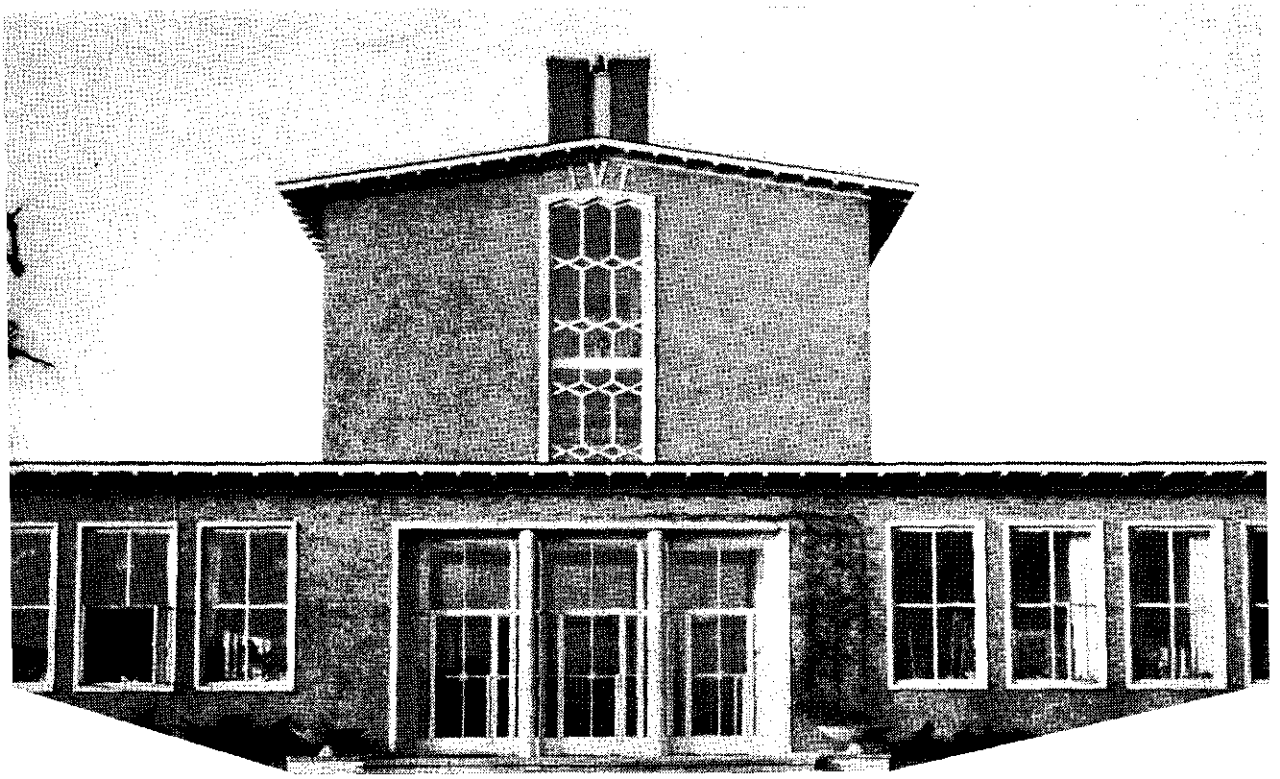
# THE INSTITUTE OF HORTICULTURAL PLANT BREEDING

BY

O. BANGA
*(director)*

The Main Building at Wageningen.



INSTITUTE OF HORTICULTURAL PLANT BREEDING
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Wageningen-The Netherlands

The institute is supervised by the Ministry of Agriculture and works under the following board of plant breeders and growers

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**Staff**

Director: *Dr. O. Banga*
Assistant director: *Ir. J. Groenendijk*
Breeding methods and special crops (including bulb and root crops): *Dr. O. Banga*
Ornamentals: *Ir. J. Groenendijk* (temporary)
„Boskoop" crops: *Ir. F. Schneider* stationed at Boskoop Research Station for Arboriculture
Tomatoes, cucumbers etc.: *Ir. J. M. Andeweg* and *Ir. K. Szteyn*
Herbs and tobacco: *Ir. G. Elzenga, Ir. L. F. J. M. van der Ven* (guest associate)
Leafy vegetables: *Ir. J. A. Huyskes*
Pulses: *Ir. E. Kooistra*
Cabbage crops: *Ir. M. Nieuwhof*
Tree fruits: *Ir. A. S. de Bruyne*
Small fruits: *Miss Ir. H. G. Kronenberg*
Floral biology: *Drs. J. P. Braak, Ir. Y. O. Kho* and *A. E. Zeilinga*
Physiology: *Ir. L. Smeets*
Mathematical statistics and climate ecology: *Ir. J. H. A. Ferguson*
Phytochemistry: *Drs. J. W. de Bruyn*
Taxonomy of ornamental plants and street trees: *Dr. B. K. Boom*
Taxonomy of fruit crops: *Drs. E. T. Nannenga*
Disease resistance tests: *A. C. v. d. Giessen*
Secretary: *R. Vos*
Publications: *W. Koopmans*
Visitors: *G. Komen*
Matters concerning Plant Breeder's Right and Plant Introduction: *W. E. G. de Bruin*
Accountant: *J. W. van Eyndhoven*

## INTRODUCTION*)

As long as man has cultivated the earth he has retained the good plants and discarded the bad ones. The varieties we use in agriculture and horticulture are the results of centuries-old selection dating back to he remotest ages. This work has made extremely slow progress. In fact one could but wait and see what Nature happened to create, for hardly anything was known yet about the processes affecting plant life. Not until comparatively recent times, when biology was fully developed, did this, in principle, change. It is true that our knowledge is still far from complete, but we know in what direction we should try to extend that knowledge in order to be able to guide the natural processes in plants in such a way that our ends may be achieved. In this respect we are still on the threshold of a new era full of hopeful possibilities.

The modern science of plant breeding is in the first place based on genetics and cytology, but other scientific fields, too, will more and more supply indispensable links in plant breeding techniques. Certain branches of mathematics, physics, chemistry and physiology will be useful in giving plant breeding, which genetics has already helped forward so much, new and undreamed-of prospects.

## GENERAL PLANNING

All this has also been the guiding principle in designing the laboratories of the Institute of Horticultural Plant Breeding at Wageningen, in the Netherlands, officially inaugurated on October 29, 1954.

Two contradictory objectives had to be combined. The first question was how to be continually in touch with practical experience and how to enlist the active cooperation of the possessors of this experience, the various kinds of professional men.

The second question was how to make the fullest use of modern science.

With a view to solving this problem the research workers have been drawn up in two battle arrays as it were. A number of crop specialists are lined up on the first front. On the second front we find the specialists in mathematical, chemical, cytological, physiological, and taxonomic research.

The crop specialists are horticulturists especially trained in variety research and plant breeding. Each of them is in charge of a group of crops of which he has to know all the theoretical and practical particulars and perspectives. He keeps in touch with the professional men. He organizes variety trials, which are carried out in different growing centres and judged by juries of professional people (growers, seed producers or nurserymen, merchants, processors, etc.) and scientifically trained

*) The present paper is a revised edition of the article by Dr. O. Banga, published in Euphytica 4 (1955): 7-14.

experts. He has to find out what problems are of vital importance. For their solution he conducts field trials and breeding work, or when necessary or useful, he calls in the help of the second front research workers.
In this way team-work develops between crop specialist and mathematician, between crop specialist, chemist and mathematician, between physiologist and mathematician, or any other combination of two or more research workers.
The mathematician has a „computing section" at his disposal with a number of computers, who make use of modern calculation machines.
The chemist has a chemical laboratory employing a number of analysts.
The physiological section has at its disposal a phytotron in which growth and development of plants can be studied under controlled conditions of light intensity and day length, day and night temperature, and of air humidity. Several processes connected with sexual reproduction have also found to be influenced by environmental factors. Hence, in addition to plant physiologists, specialists on floral biology and on cytology are working in the same building. Moreover the phytotron contains a glasshouse specially equipped for the study of the asexual reproduction of plants.
It is unneccessary to mention every detail. It may suffice to say that it has been endeavoured to give every specialist the tools he needs most. By making use of the two factors: practical experience and modern science, it is possible both to aim research in a practical direction and to imbue it with a strongly penetrative power.
All this work is being done in an experimental garden covering 18 ha (45 acres) at the Dr. S. L. Mansholtlaan, Wageningen, and at a breeding establishment covering 40 ha (100 acres) at Elst in the Betuwe area. The main building with laboratories, phytotron and isolation cages have been set up among the trial fields at Wageningen. The breeding establishment at Elst houses an experimental farm and a number of aphid-proof isolation cages. Here a small field laboratory was finished in 1958. The staff of the Institute consists of 17 scientific officers, some dozens of technicians, furthermore of garden and clerical staff, totalling about 150 people.

## Variety trials

Since 1936 the Institute has been acquiring experience with variety trials of horticultural plants. At first the main object in the trial design was to work out statistically and to test mathematically any differences that could be detected. As the years went by, however, it became evident that this was insufficient. In the value of horticultural produce several irrational viewpoints (certain preferences for colours, shapes or tastes which are in themselves immaterial) interact with more material properties which can be directly expressed in figures.

*Jury judging variety trial with cichory.*

*Selection in carrots.*

Also thanks to the nature of horticulture, growers can exert a much greater and more diversified influence on environment than is possible in agriculture. The consequence of this situation is that the evaluation of varieties of horticultural crops is made more difficult by the necessity to ask oneself how a given variety should be treated in order to obtain the best results. Those horticultural varieties which, under a wide range of growing conditions, have averaged e.g. the highest yield, the earliest harvests, are mostly of too poor a quality, or in some other respect unfit for definite horticultural purposes.

The methodology of varietal research has changed. We now distinguish three phases:

a. Judgement by eye of simply designed variety trials in different growing centres by juries of various professional and scientific experts. The varieties and selections to be inspected are indicated by number only.

b. Physiological investigations of interactions between varieties and growing conditions. A distinction can be made between simple field-physiological and sharply aimed laboratory-physiological research, but both kinds of investigations are based on the same principles.

c. Statistical analysis of trial results. This method is no longer the principal one, but as we now aim at analysing only the more sharply defined characters of the plant, the method is becoming more effective. So it remains indispensable.

As it is impossible to investigate all the vegetable crops every year, variety

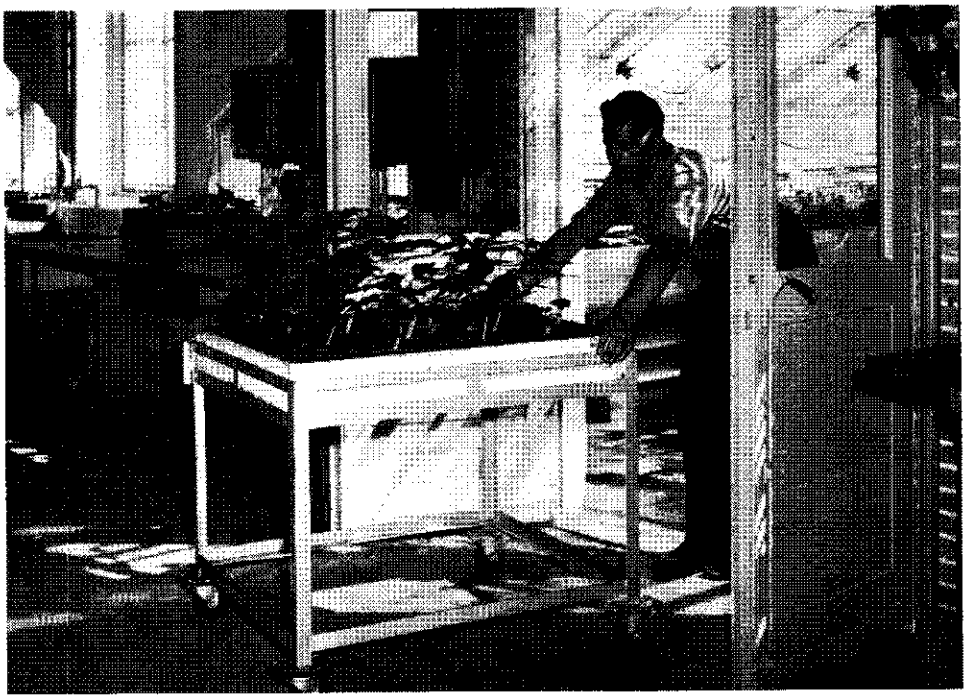
*Central corridor inside the phytotron, on the left doors of the air-conditioned rooms, on the right working tables and doors of the glasshouses (not visible in the photograph).*

trials with the most important crops of this section are carried out every six years. With fruit crops the procedure is as follows. During the first two years the varieties are grown in the nursery beds of the Institute. At this stage special attention is paid to healthy growth and disease resistance. Those varieties which pass the preliminary examination are transferred to selection field A, where they are kept for 10 years at most. Worthless material is discarded. Promising varieties are propagated and distributed for further trial among a number of fruit growers throughout the country, and on selection field B. For strawberries about the same procedure as with vegetables is followed.

Physiological and statistical research on varieties partly coincide with the variety trials (in as far as specific tests have already been developed); partly it is of a more incidental nature.

## Mathematical section

The task of the mathematical section is to design the experiments and to analyse the results. The design includes advice on the numbers of plants and replications to be used. The bulk of the investigational results passes through the mathematical section.

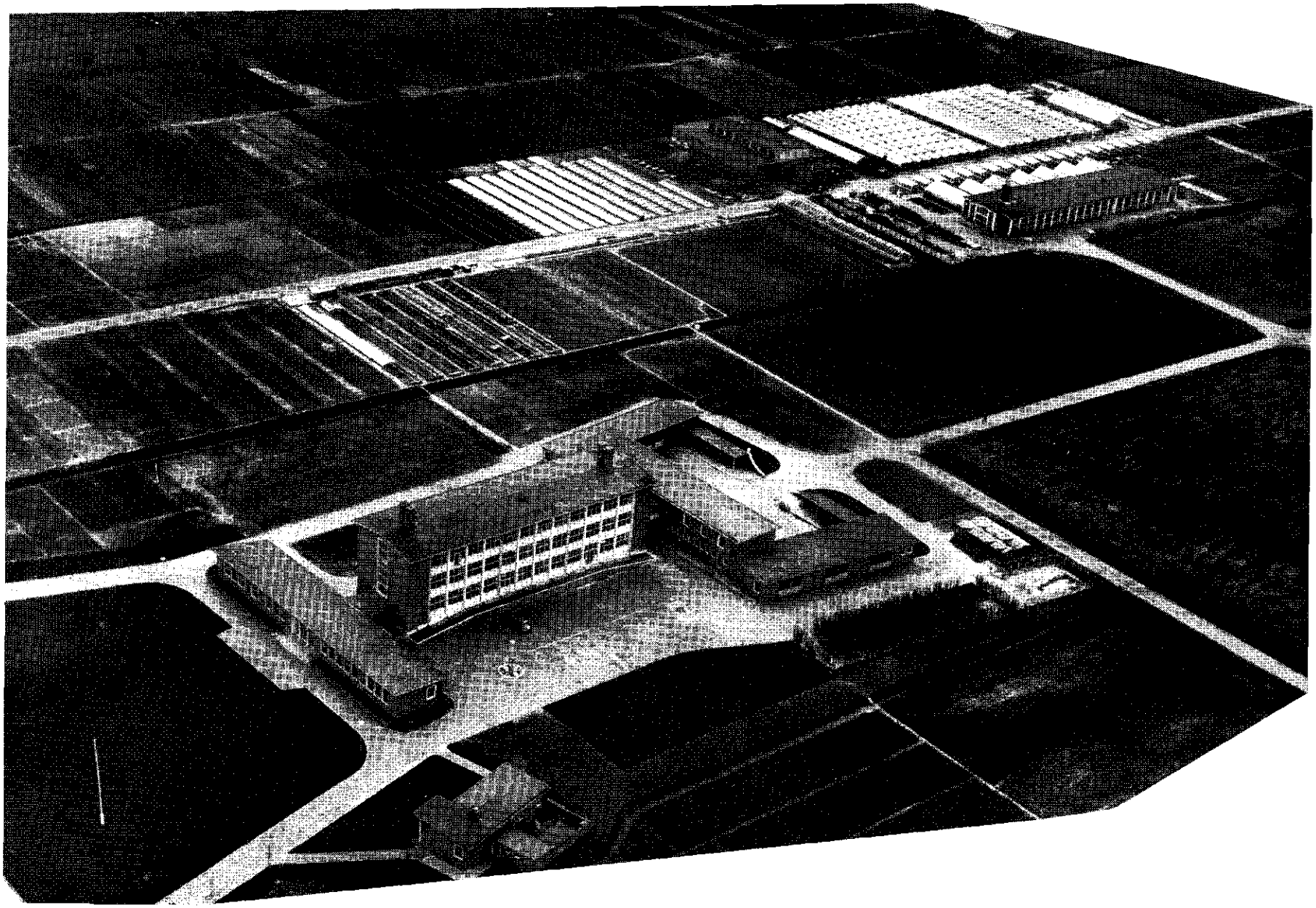


*Transferring plants on a trolley from one of the glasshouses to an air-conditioned room.*

Special studies are carried out on the correlations between climatical factors and the development, growth and quality of plants, also in connection with the export of vegetable seeds (J. H. A. FERGUSON).
Miss F. GARRETSEN of this section is studying the use of statistics in examining quantitative inheritance.

PHYTOCHEMICAL SECTION

This section carries out many determinations for breeding purposes, e.g. the determination of carotene in carrots, of vitamin C, of sugars and acids in small fruit, and the colour measurements of garden beets.
The breeding work on medicinal and aromatic herbs includes the determination of many alkaloids, volatile oils and glycosides.
One of the tasks of Mr. J. W. DE BRUYN, phytochemist, is to develop rapid methods for testing large quantities of plants for breeding purposes. Recently he succeeded in developing a rapid chemical method for demonstrating bitter principles in young cucumber seedlings.



PHYSIOLOGICAL SECTION

The activities of this section cover the following fields:

a) Effect of temperature and light and their interaction on plant growth and development. ( L. SMEETS).

b) Sexual propagation of plants (J. P. BRAAK, Y. O. KHO and A. E. ZEILINGA).

However, these two fields frequently overlap.

So far Mr. L. SMEETS has been studying the effect of temperature, day length and light intensity on the growth of fruit tree seedlings and strawberries from different geographical regions.

Mr. Y. O. KHO is examining the possibilities of improving the seed production after selfing in self-incompatible plants by means of temperature treatment.

Together with Mr. A. E. ZEILINGA and Mr. KHO, Mr. BRAAK is studying the technique of species crossings and generic crossings, the main problems being removal of barriers interfering with normal pollination and fertilisation, the prevention of embryo abortion and the restoration of fertility in sterile hybrids.

The effect of environmental factors on embryo and fruit development in fruit crops is being investigated by Mr. BRAAK with the object of improving the low seed viability occurring in early-ripening varieties.

Since 1950 Mr. ZEILINGA has devoted himself to colchicine research. He developed a rapid staining method for squash preparations by which large numbers of colchicine-treated plants can be checked cytologically in a relatively short time.

TAXONOMIC SECTION

Dr. B. K. BOOM studies taxonomic and nomenclature problems, mainly of ornamentals. He writes books and articles, corrects the nomenclature in the catalogues of nurserymen when so requested, collects plants and tries to find new plants fit for cultivation. He also advises on material for species crosses of vegetables and fruits.

Mr. E. T. NANNENGA and Mr. J. A. LEEMANS study the characters of fruit varieties and rose rootstocks for identification purposes. This is of vital importance as in the past there was much confusion over the naming of varieties used in experiments.

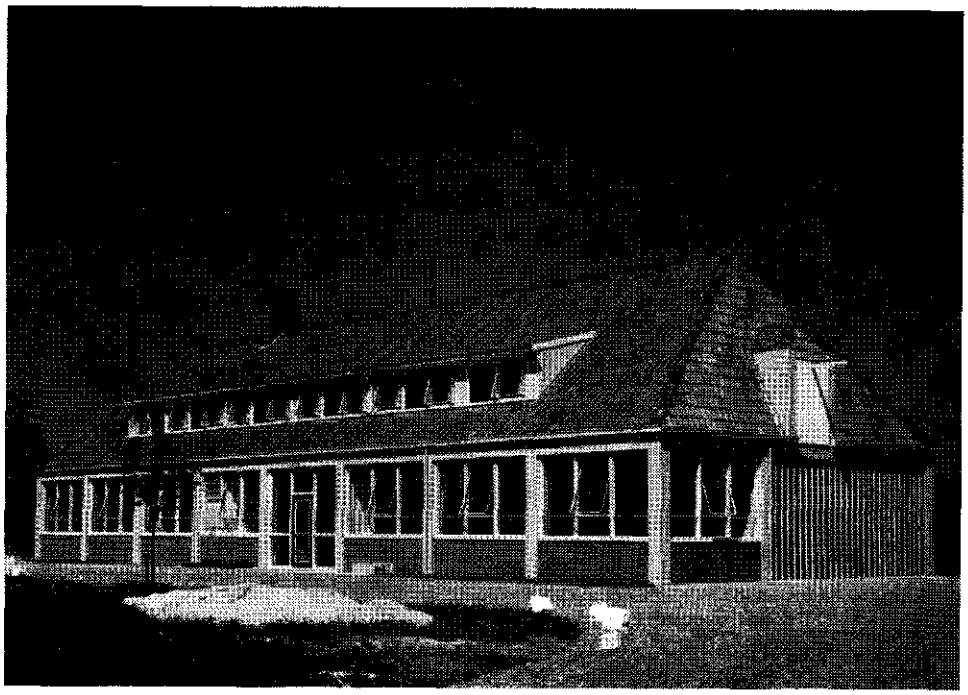
Summaries of the studies are published; recently a book on raspberries appeared. A book on morphological descriptions of 80 apple varieties is due to appear.

Mr. W. E. G. DE BRUIN is in charge of plant introduction. He either draws up or checks reports on new varieties before they are sent to the Board for the Plant Breeder's Right at The Hague.



*The buildings at Wageningen,*
*in the background the phytotron,*
*glasshouses and Dutch lights.*

Aero-photo Nederland.



*The field laboratory at Elst.*

The workers of this section also carry out the investigations on the identity of new varieties, frequently in co-operation with crop specialists, sometimes with committees of nurserymen, as in the case of roses and other ornamentals.

### Phytopathological section

This section carries out tests of varieties and breeding material for resistance against different diseases, as part of the breeding work.
As the number of plants used is very large it is important to develop simple inoculation methods. Thus a method was developed to test in one operation a large number of beans for resistance to anthracnose (Colletotrichum lindemuthianum).

### Breeding work

Where private plant breeding companies can and are willing to do the actual breeding work we restrict ourselves as much as possible to the investigation of breeding problems and to the development of populations which are ripe for selection.
In general, the testing for cultural value of plants of newly bred populations com-

prises the same elements as the testing for cultural value of varieties mentioned above.

Difficulties in the field of selfing, crossing, propagation and periodicity control of the plants can be studied in the physiologic section.

It is impossible to describe all the breeding projects under way. Therefore I will only mention the name of each of the crop specialists in alphabetical order and say a few words on some of their projects.

Mr. J. M. ANDEWEG is breeding new cucumbers which are free of bitter principles, not only in the fruits but also the young seedlings. He also investigates the possibilities of breeding tomato varieties that produce normal yields under less favourable light conditions.

Mr. K. SZTEYN is concerned with breeding for disease-resistant tomato varieties, particularly varieties that are resistant to corky root, and also carries out interspecific crosses with tomatoes.

Dr. O. BANGA tries to breed a red Delphinium, radishes with better threshable siliques, better transportable onions, carrots with a higher carotene content and monogerm red beets of improved quality.

Mr. A. S. DE BRUYNE has made much progress in breeding a scab-resistant apple variety and tries to breed a peach variety that can be grown outdoors under Dutch conditions. He works on the selection of a dwarfing cherry rootstock and a dwarfing pear rootstock. He is also building up a stock of virus-free basic material of all Dutch-grown apple rootstocks and of the more important apple varieties. By applying mist propagation at the right development stage an effective propagations method for bleuberries could be developed for use under Dutch conditions. Attention is paid to the development of rapid propagation methods for rootstocks.

Mr. G. ELZENGA has a large programme of investigating and improving the culture of medicinal and flavouring herbs. He carries out breeding work on Angelica, Artemisia, Atropa, Digitalis, Lobelia, Rheum and Valeriana.

Selections of Angelica and Digitalis were obtained which were appreciably higher in active principles. By mechanizations it was found to be possible to grow herbs on large and fairly large holdings.

Mr. J. HUYSKES. Important items on his working programma are the breeding of homozygous male asparagus plants, and of new lettuce varieties adopted to summer use with resistance to mosaic virus or to short days in winter.

In co-operation with experts in England, France and Germany a monograph on lettuce varieties is being prepared.

The ornamental plants department is breeding a self-fertile Lilium x hollandicum „Orange Triumph". It started a project for obtaining carnations resistant to Phyalophora cinerescens and self-fertile Freesias.

In addition the value of different Rosa canina selections as rootstocks in the Netherlands is being assessed. Mr. J. GROENENDIJK, assistant director, is temporarily leading this department.

Since 1957 Mr. E. KOOISTRA has been in charge of the pulses. One of his objectives is to breed varieties that are more consistent in yield (disease resistance and resistance to unfavourable weather conditions). In the breeding of garden pea varieties quality is a point of first importance.

Miss H. G. KRONENBERG'S main work is variety research on strawberries, red and black currants and raspberries. She tries to breed a good capping strawberry variety for processing and a raspberry variety resistant to Amphorophora rubi.

Mr. M. NIEUWHOF specialises in cauliflower and Brussels sprouts problems. He tries to breed cauliflower varieties with more resistance to drought and others that can be grown in rather cold, dark weather. He studies the possibilities of breeding, $F_1$-varieties of Brussels sprouts. He is also breeding for resistance to clubroot in cabbage and cauliflower.

Mr. L. F. J. M. VAN DER VEN, advisory officer for tobacco, cooperates with the institute in all tobacco investigations, and is also working on a project of improving the culture and the variety material of Mentha.

In this respect he is mainly concerned with the control of rust and the chemical control of weeds in Mentha.

## SAMENVATTING

### HET INSTITUUT VOOR DE VEREDELING VAN TUINBOUWGEWASSEN

Een overzicht wordt gegeven van de algemene opzet, de taakverdeling en de taakbezetting van het I.V.T. Bij de organisatie van het werk wordt er naar gestreefd enerzijds de vinger op de pols van de praktijk te houden en anderzijds zoveel mogelijk gebruik te maken van de moderne wetenschap. Vandaar enerzijds de praktijkproeven en anderzijds scherp gespecialiseerde laboratoria en onderzoekapparatuur.


*The lists of fruit and vegetable varieties in which the Durch grower can find a wealth of information.*