

RESEARCH ON VARIETIES IN CONNECTION WITH THE NETHERLANDS LIST OF VARIETIES ¹⁾

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1 INTRODUCTION

Since the *Plant Breeder's Decree* of 1941 came into force, it has been permissible only to put on the market seed and seed potatoes of varieties entered on the official List of Varieties and approved by the General Netherlands Inspection Service for Seeds of Field Crops and for Seed Potatoes (known for short as the N.A.K.).

Varieties are placed on the list by the Government Committee for the Compilation of the List of Varieties of Field Crops, which is made up of the directors of the Institute of Agricultural Plant Breeding (I.V.L.), the Central Institute of Agricultural Research (C.I.L.O.), and the Government Institute for Research on Varieties of Field Crops (I.V.R.O.).

In order to be eligible for entry on the List a variety must satisfy two conditions :

- a It must be sufficiently differentiated from other varieties, and be sufficiently "varietally pure".
- b It must be judged to be of especial value to agriculture in the Netherlands.

Accordingly, only certified seed and seed potatoes of good, independent varieties are allowed to circulate.

There are some exceptions to this general rule. For instance, sale and exchange of the seed of the following crops is not bound either by the List of Varieties, or by official inspection : Jerusalem artichoke, buckwheat, turnip like rape, fodder radish, millet, lucerne, parsnip, phacelia, serradella, spurry, fodder mallow, vetch and sunflower. The same applies to seed potatoes of the varieties "Opperdoese Ronde", "Paarsput" and "Schoolmeester".

The seed may also be marketed of varieties of various grasses, clovers and lupins which have not been placed on the List of Varieties. Unlike the crops named above, however, these varieties are subject to inspection by the N.A.K.

The investigations required for the List of Varieties, like those for the Central Register of Varieties, are the responsibility of the I.V.R.O., which carries out the investigations in cooperation with institutions and official services concerned with agricultural research.

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2 VARIETY INVESTIGATION

Crops can be divided into three groups :

- a Cereals, pulses and commercial crops,
- b Potatoes,
- c Forage crops, grasses and green manure legumes.

a Cereals, pulses and commercial crops

When a breeder has evolved a new variety of, for instance, wheat, which he considers promising, he reports it to the Board for the plant breeder's right. The Board then instructs the I.V.R.O. to conduct an investigation into the *individuality* of the new variety, which, for that purpose, is compared in trial fields with the old varieties and, on occasion, with other new varieties. The I.V.R.O. has as its disposal an experimental farm on moisture-bearing sandy soil, situated north of Wageningen (Eastern Netherlands), as well as trial fields on other types of soil.

Since the task of the I.V.R.O. involves carrying out investigations not only on behalf of the Board for the breeder's right, but also for the List of Varieties authorities, the trial fields serve at the same time as a means of obtaining an idea of *the agricultural value* of the new variety.

If, after a season's observation, the investigators are convinced that the variety under examination is a definitely new and independent one, and if it has made a good impression from the point of view of practical value, a proposal is made to the Contact Committee for Interprovincial Research that the variety should be tested in the Netherlands' "trial farms series". If it gives satisfactory results there as well, it is further tested for another year in the "interprovincial series". At this stage, as a rule, consideration is given to the eligibility of the variety for entry on the List of Varieties.

The trial fields mentioned here are under the direction of official Government agricultural advisers.

In 1952, the number and distribution of trial fields for cereals, pulses, and commercial crops were as follows :

Cereals	58 trial fields in the trial farm series, and 187 in the interprovincial series ;
Pulses	65 trial fields in the interprovincial series ;
Commercial Crops	11 trial fields in the trial farm series, and 41 in the interprovincial series.

These trial fields are distributed throughout the entire country, and on as many types of soil as possible. Those of the interprovincial series are generally laid down on ordinary farms ; examples of this series are, however, also frequently encountered on the trial farms proper, and in the central trial fields. Fields of the trial farm series are found, as the name indicates, in the first place on the trial farms, but also in the central trial fields, and occasionally on ordinary farms.

Variety trial fields are laid down regularly on the following trial farms.

- a On marine clay : Jacob Sijpkensheerd, Nieuw-Beerta ; the Dir. Wieringermeer Trial Farm in the Northeast Polder ; the Prof. Dr. J. M. van Bemmelen Farm and the Ir. S. Smeding Farm, both in the Wieringermeer Polder ; Mariënhof Trial Farm, Westmaas ; Scheldemonden Trial Farm, Bruinisse ; Zeeland Trial Farm, Wilhelminadorp ; and the trial farm of the Bedrijfsorganisatie, Klundert.
- b On sandy soil : Kooyenburg, Rolde ; Heino Trial Farm, Heino ; and Hoosterhof, Beesel.

c On sandy peat soils : the testing establishments of the Society for the Exploitation of Trial Farms in the Fen Colonies, at Borgercompagnie and Emmercompascuum.

The following table gives a picture of the number of new varieties under investigation in 1952. For purposes of comparison the number of varieties placed on the 1952 List of Varieties is also stated.

Crop	Number of new varieties under investigation in 1952		Number of varieties placed on Varieties List for 1952
	In I.V.R.O. trial fields	In the inter-provincial and trial farm series	
<i>Cereals</i>	86	25	44
Wheat	40	14	16
Barley	21	4	10
Rye	8	2	4
Oats	17	5	14
<i>Maize</i>	17	16	5
<i>Pulses</i>	33	10	38
Peas	17	5	18
Field beans	2	—	9
Haricot beans	14	5	11
<i>Commercial Crops</i>	24	15	26
Fibre flax	7	4	10
Linseed	11	8	4
Winter colza	4	2	3
(swede-like rape)			
Oil seed poppy	2	1	4
Caraway	—	—	3
Mustard	—	—	1
Canary seed	—	—	1

From this summary it will be seen that the number of new varieties under investigation exceeds the number entered in the List of Varieties. New varieties are added every year, and it may be expected that this number is more likely to increase than decrease. There are also plans to speed up the process of investigation. The result of both factors will be to raise the number of varieties requiring testing.

b Potatoes

In the case of potatoes, organized variety investigation takes place at a much earlier stage than in the case of the crops just described, under the auspices of the Committee for the Advancement of Potato Breeding and Investigation of New Potato Varieties. This Committee gives the breeders advice and information on breeding procedure, provides them with seed, and helps them in making a choice from the seedlings.

As regards the latter, the normal course of events is as follows.

- 1st year. From seed the breeders produce new potato varieties in the form of seedlings.
- 2nd year. In the autumn, the breeders send some tubers from the second year seedlings to the Plant Protection Service at Wageningen, to be examined for wart disease.

For one of the permanent aims of the authorities is to render the Dutch range of potato varieties free from this scourge. The examination by the Plant Protection Service takes place in the laboratory. A round three thousand seedlings are examined every year to ascertain their resistance to wart disease.

- 3rd year. The seedlings which have remained free from wart disease are checked in the field for resistance to it on the Potato Trial Farm belonging to Mr. A. H. MUNTINGA at Oostwold (Oldambt), the former establishment of Dr. OORTWIJN BOTJES. About 400 seedlings are tested annually in this way.
- 4th year. The seedlings which have been found free from wart disease in both laboratory and field investigation, and which have made a good impression on the breeders, may undergo, as fourth-year seedlings, a simple preliminary test on a type of soil different from that on which their original breeder works. For this purpose, three trial farms have lent their assistance. On the trial farm at Borgercompagnie, on sandy peat soil, special attention is paid to the suitability of the seedlings for industrial processing. Their consumption value when grown on clay soil is investigated at the Prof. van Bemmelen Farm, in the Wieringermeer Polder. On the Hoosterhof trial farm at Beesel, the seedlings are tested for fitness for growing on sandy soil as a ware potato, and as a fodder potato. At the same time, an idea can often be obtained on this farm regarding the potatoes' resistance to drought. These investigations concern a good two hundred seedlings.
- 5th year. The potatoes are examined again on the Potato Trial Farm at Oostwold. Now, in the first place, for agricultural value. Furthermore, the seedlings are examined once again for resistance to wart disease, while, in addition, disease-free multiplication takes place. The number of seedlings is now about 100.
- 6th year. At Oostwold the investigation of agricultural value is continued with healthy seed potatoes produced there. Use of this seed material of equal value enhances the reliability of the trial field results. Investigations into the potatoes' susceptibility to virus disease are also carried out at Oostwold. There are now about eighty seedlings left.



FIG. 1. PRELIMINARY TEST OF A LARGE NUMBER OF NEW VARIETIES OF POTATO ON A TRIAL FARM.

7th year. On the propagation farm of Mr. J. T. KAPENGA, at Zijldijk (Groningen), healthy seed material is produced for various trial fields from about fifteen varieties which have steadily continued to make a good impression. Investigations are continued at Oostwold.

The above number of varieties presents itself afresh each year, demanding further sifting, which takes place, to begin with, in the *observation trial fields*. The latter, numbering about 120, lie scattered over the whole country, on ordinary farms, breeding establishments, agricultural schools and trial farms. The experiments carried out in these trial fields are entirely voluntary; no payments are made for them — a fact which does not prevent them from providing very valuable data.

In addition various special trial fields have been laid down, viz., to ascertain susceptibility to scab (four fields), spraing (four) and eelworm (two). Furthermore, on three trial fields investigations are carried out to find out how quickly subsequent crops from the varieties degenerate. And lastly, in Limburg and East Brabant six trial fields have been laid down on dry soils, to investigate sensitivity to drought. Numerous tests of the taste of potatoes are carried out at the Central Institute of Agricultural Research (C.I.L.O.).

After an examination lasting two years in the observation trial fields, those varieties which have passed the test are further investigated in the *interprovincial* trial fields. In 1952, there were 102 of these fields, subdivided into trial fields for early and medium-early varieties, for ware potatoes, for fodder potatoes, and for potatoes for industrial use.

In 1952 twenty-six new potato varieties were investigated in the observation



FIG. 2. IMPROVED LABORATORY IN A VAULTED STABLE, ON THE VERY OLD FARM BELONGING to Mr. N. J. HUYTS, at Voerendaal (Limburg).

trial fields, and eight in the interprovincial trial fields. A successful variety is generally placed on the Varieties List after from one to three years of interprovincial investigation. The number of potato varieties shown on the List of Varieties for 1952 is fifty.

The system we have described here is not always strictly adhered to. In the case of highly promising seedlings investigations take less time.

Every breeder is also at liberty to submit a variety to the Board for the Breeder's Right at any time he likes, in which case investigation takes place along lines more like those on which cereals, etc., are dealt with.

c Forage crops, grasses and green manure legumes

We shall deal with the mangolds as an example of the forage crops group. When, at the beginning of World War II, regulations for growing mangold seed were introduced, the Netherlands Arable Farming Centre found that the number of mangold varieties was, in reality, several times as great as the number of 25, then shown on the List of Varieties. Some authorities at Wageningen, however, did not consider it desirable to restrict seed growing permits to varieties on the List, because valuable material might possibly exist among the other varieties, and because some breeders of renown had, for commercial reasons, chosen not to take part in the selection competition for the List of Varieties, which was only a free and recommended list in those days. Moreover, the number of varieties which a breeder could enter for the competition was limited. As a result of all these considerations, the Netherlands Arable Farming Centre (N.A.C.) decided to have the value of all varieties investigated.

A committee was formed to supervise the investigations, the Commission for Research on Varieties on behalf of the N.A.C., a name which was later changed into the Commission for Research on Varieties on behalf of the Corporation for Seeds and Planting Material of Agricultural Crops and Meadows. In order to meet expenses a tax was levied on the seed of forage crops.

When the mangold varieties came to be listed, it was found that they numbered no less than 210, the products of 57 breeders and growers/seed merchants.

The reader may wonder why at that time the range of varieties of cereals, potatoes, etc., had been limited, and why practically no varieties of these crops were grown which did not appear on the List of Varieties, whereas, on the other hand, the number of varieties of forage crops was very great, and only a few of them appeared on the List.

The main reason for this, in my opinion, is that growing and trading mangold seed, entirely for his own account, is not a very attractive proposition for the ordinary farmer, not only because separate drying and cleaning installations are necessary for it, but, above all, because the mangold seed, if it cannot be disposed of for sowing purposes, is worthless.

Accordingly, growing mangolds for seed has traditionally been in the hands of a limited number of firms which, as a rule were at the same time, growers and merchants of horticultural seeds. These firms often tried to make sure of their market by employing agents. They delivered their own strains, or at any rate their own brands, of all desired types. This was a result of the fact that it was not customary to offer progeny seed. There was a reason for this, too: mangolds belong to the cross-pollinating plants, which can be gradually improved by selection, but which, if this is not done, frequently decrease in value. In the last few decades, beside those houses of seedmerchants-breeders the breeding stations of our agricultural cooperative societies have occupied themselves with improving mangolds.

Simultaneously with investigation of the round 200 known mangold varieties, the houses of the breeders and grower/seedmerchants were visited to

ascertain the extent to which breeding and selection work was being carried out. On the basis of the results, it was possible for 19 of the 57 establishments to be recognized as breeding firms or stations by the N.A.K., 12 of them provisionally. The material from the firms or stations which were not recognized was gradually eliminated from circulation, while, after consultation with the recognized breeding firms or stations, further restrictions were placed on the range of varieties. In this way, the number of strains available for the home market was reduced to 66. Later on, the provisional recognition of one or two firms was withdrawn, while less prominent strains were removed from the List of Varieties. Some new varieties could be entered, with the result that, on the List of Varieties for 1952, 45 mangold varieties were eligible for growing in the Netherlands. A reasonable standard has already been reached in respect of some types; this is not yet the case, however, with others.

At present, 70 mangold varieties are under investigation, in 10 large trial fields distributed throughout the country. Here, everything is directed from a central point, in contrast to the situation as regards cereals, potatoes, etc. A travelling laboratory is available, and so dry matter contents can be estimated on the spot. Yield and analysis figures are partially ascertained at once, thus rendering possible correction of any errors, which is of great importance.

As a rule also most other forage crops — the number of strains available and the level of investigations of which vary considerably — are tested centrally. In the case of grasses, there exists a cooperation with the C.I.L.O., whereby the variety and mixture tests are combined.



FIG. 3. ONE-EGG CATTLE TWINS IN A TRIAL PASTURE.

Of recent years, more and more tests have been carried out with cattle in investigating varieties of forage crops.

For the sake of completeness, we should like to draw attention to the following.

Investigation of the agricultural value of *sugar beet varieties* is mainly

carried out by the Institute for Rationalized Sugar Production at Bergen op Zoom. In 1952, 25 varieties were on trial, in 13 trial fields. As regards the testing of *chicory selections*, there exists co-operation with the Chicory Study Committee, which examined eleven strains, in 5 trial fields, in 1952.

The National Committee for Malting Barley has always been very active in testing new *varieties of malting barley*.

The *susceptibility* of the varieties to various diseases is investigated at the Institute for Phytopathological Research.

Furthermore, the Foundations for the Propagation of Dutch seed potatoes and field crop seeds abroad have also laid down many *variety trial fields outside the frontiers of the Netherlands*. In 1952 the number of such fields for potatoes abroad amounted to 121, distributed over 33 countries, all over the world. The number of trial fields for other crops was 98, scattered throughout 28 lands over the entire world. These trial fields must be looked upon as of the greatest importance to a seed potato and seed exporting country such as the Netherlands. Especially, too, because the countries around us strive more and more to become self-supporting, so that we have to look for marketing areas farther from home. In this connection, the question as to which are the most suitable varieties plays a very important part.

Summing up, the above account shows that various organizations are concerned in the investigation of varieties as a whole. The very close degree of cooperation which exists with the I.V.R.O. often makes it possible to utilize the results from these various trial fields both for the List of Varieties and the Central Register, and also for other purposes.

3 THE COMPOSITION OF THE LIST OF VARIETIES AND THE INCLUSION OF NEW VARIETIES

The following elements form the foundation of the List of Varieties :

- 1 The results of extensive trial field examination at home and abroad, together with the results of scientific investigations.
- 2 The practical experience of very many agriculturists. Every year, more than 5,000 farmers are asked to give their verdict on a specific variety. It is generally new varieties which are concerned here, but older ones may also be considered. This inquiry produces very valuable information.
- 3 The opinion is asked of all other people who, in one way or another, have to do with plant varieties, or with seed and seed potatoes. This is often done by means of the Draft List of Varieties, up to 2,000 copies of which are circulated annually with a request for comments.
- 4 The field observations of those closely concerned in the compilation of the List of Varieties. It is only possible to form a synthesis of trial fields results and the findings of practical experience — two factors which often apparently contradict each other — when the varieties have been observed personally during growth and ripening and under varying circumstances.

What standards are applied when a variety is entered on the List of Varieties ?

The only principle the Government Committee goes by is, that the varieties must be considered to be of particular value to agriculture in the Nether-

lands. The difficulty here is that it is not easy to weigh or measure this particular value in simple fashion. To illustrate the Committee's method of working, I shall explain some aspects of it, but without making any attempt at a complete account.

A new variety is always judged against the background of the existing range. In general, it is demanded of a variety, when considered for the List, that its inclusion will, in all probability, benefit the assortment of varieties.

In the case of cereals, the yield factor weighs very heavily. It is, however, no hard-and-fast stipulation in the case of a new variety that it must yield more than the most productive of the established ones. A new variety of oats with very strong straw is judged by comparison, not with the most productive variety, but with a strong, current variety which is very likely not among the most productive. This is also the case with early varieties, whose outstanding characteristic is their earliness, which may be important for distribution of labour and for the stubble crop. A new, winter-hardy variety of wheat will be compared with the varieties in the winter-hardy group, and not with those varieties which do not stand the winter very well but are often highly productive. A variety of spring barley of very good malting quality starts with an advantage. In the case of a variety of rye which is resistant to eelworm disease, allowances are willingly made as regards its other properties. The same can also be said of a pea variety immune from *Fusarium oxysporum*, a flax variety resistant to smut, or a potato variety that can stand drought well. Certainty of a future supply of seed is another factor which must sometimes be taken into account, especially where the forage crops are concerned.

The national interest is kept constantly in mind in deciding whether or not a variety is to be placed on the List of Varieties. Furthermore, an effort is made to satisfy, as far as possible, the breeders' sense of justice. For, whatever the decision may be, somebody is sure to be hurt by it. Acceptance of a variety generally causes harm to the possessors of the varieties grown at that moment; but if it is not accepted, the breeder concerned will suffer. This means that both inclusion and rejection of a variety must be capable of being defended in the eyes of everyone. If we add to this the fact that it is no simple matter to determine the value of a variety, it will be easy to see what difficult decisions regularly confront the Government Committee. It is therefore desirable that the trial field data should be published, as far as is possible. The stencilled "Results — Variety Trial Fields", which show the yields of the varieties in each of the trial fields, have, on the one hand, the aim of notifying the Government agricultural advisers of the results achieved in their colleagues' fields, but serve on the other hand to inform the breeders of the yields obtained with their varieties. In the "Reports on Choice of Variety", in which the trial field results are summarized, the I.V.R.O. gives its public verdict on the new varieties under investigation.

No regulations exist as to the time necessary for investigation before a variety is placed on the List. On an average, good varieties are entered on it after three years of examination, one in the I.V.R.O. trial fields and two on the trial farm and/or in the interprovincial series. In some cases, entry takes place after two years, in others after four years. In doubtful cases the inquiry may last longer; sometimes a delay is due to too late submission of seed, or to the delivery of seed with insufficient germinating power.

Inclusion of varieties takes place as much as possible in consultation and agreement with the breeders. If no agreement is reached, and the List authorities consider that the expense does not justify testing an unpromising variety

again on an extensive scale, it is often suggested to the breeder that he should himself lay down a few trial fields under the conditions in which he considers the variety would thrive best. The same action is also taken in the case of a difference of opinion with an official agricultural adviser.

An additional "safety-valve" is provided by the permission given to breeders to put on the market certain quantities of seed or seed potatoes for trial purposes. As regards varieties under investigation for entry on the List of Varieties, this quantity amounts to 5,000 kg in the case of, for instance, cereals, pulses and flax, and 20,000 kg in the case of potatoes, per variety, per year. In this way, practical experience can be obtained; and, at the same time, the possibility of good varieties being rejected is still further reduced.

Nor does deletion from the List take place, as a rule, without caution. If an old variety is abolished somewhat prematurely, a demand for it usually remains. And newly entered varieties are given ample opportunity to show what they are worth.

Evaluation of varieties is carried out according to purely practical standards. But this does not exclude the necessity of enlisting the help of the most advanced scientific methods, especially in the sphere of mathematics. A very large number of figures have to be worked up; and the strange thing about figures is that they are, on the one hand, highly convincing, but that it is also possible to juggle with them.

Let us quote a simple example devised by Mr. HAMMING, which has almost become classic. Suppose that two varieties, P and Q, are compared on two trial fields of equal size, a and b. The yields from the varieties are shown under I. It is required that the results from both trial fields should be summarized.

	I Yields in kg		II Relative value P = 100		III Relative value Q = 100	
Variety	P	Q	P	Q	P	Q
Trial field a	20	25	100	125	80	100
Trial field b	25	20	100	80	125	100
Total	45	45	200	205	205	200
Average	22½	22½	100	102½	102½	100

From column I it may be concluded that varieties P and Q have produced equal yields. Now, in summarizing results from variety trial fields, it is often customary to take the yield of a particular variety as a standard, and give it a notional value of 100. Under II this has been done in respect of variety P, and under III in respect of Q. We see that in case II Q yields 2½% more than P, and in case III exactly the opposite, i.e., P yields 2½% more than Q.

The case quoted here is easy to see through. In column II, a valuation of 5 has been ascribed to trial field a, and a valuation of 4 to trial field b, while in III exactly the opposite has taken place. This sphere, however, contains far more difficult problems, which can only be solved by very talented mathematicians, in cooperation with agriculturists.

4 THE IMPORTANCE OF THE LIST OF VARIETIES

a The executive instrument of the Plant Breeder's Decree; basis for inspections

The present List of Varieties, as executive instrument of the Breeder's Decree, is binding — which means that, apart from a few exceptions, only

seed and seed potatoes of varieties entered on the List may be put on the market. This automatically makes the List of Varieties the basis for official inspections.

b A guide for the farmer

The List contains a description of all varieties, from a practical angle and, as a rule, supplemented by tables regarding yield and the requisite quantity of seed, and by summaries of the other most important qualities. The name of the breeder is always given, and also the name of the person, firm, etc., marketing the original seed or seed potatoes. In the case of the grasses, details are included of mixtures for permanent pastures and leys. The various forage crops are briefly described. In addition, the List of Varieties also contains statistical data regarding distribution of the varieties of almost all crops.

Many farmers make direct use of the List of Varieties. And it is certain that the information contained in it reaches many more interested parties via the Agricultural Advisory Service, the press and the trade.

c Breeders, growers of seed and seed potatoes, trade and industry, all make use of the List of Varieties

From the descriptions the breeder can deduce the shortcomings of the present range, and the good points of particular varieties. Such factors can be taken into consideration in breeding and selecting new varieties and strains.

Growers of seed and seed potatoes prefer to propagate those varieties for which a demand is expected. Trustworthy seedsmen will also try to cover themselves by investing in such varieties.

From the variety statistics the malting and brewing industry is able to ascertain the approximate size of the area sown with malting barleys.

d Promotion of exports

For the benefit of the export trade in seed and seed potatoes, certain sections of the List have been translated into English, French, German, Italian, Portuguese and Spanish. In addition, a short explanatory account of the List of Varieties as a whole is given in the English, French and German languages.

e Use in education

Good use is made of the List of Varieties in giving instruction in the growing of field crops. For teaching it is an advantage that the List of Varieties is revised each year, whereas the particulars regarding varieties in the textbooks are soon out of date.

f Miscellaneous

By means of the yield tables from the statistics on the distribution of varieties, it is possible to calculate the increase in yield achieved by plant improvement and changes in choice of variety. It is also possible to calculate the areas grown with Dutch varieties and foreign varieties, respectively, and what the situation has been in this respect throughout a series of years. It goes without saying that correct knowledge of such matters is of great importance.

5 FINANCIAL RESULTS FROM THE USE OF BETTER VARIETIES

Since 1931, thanks to the variety statistics, we have been fairly accurately informed as to the area covered by certain varieties and the fluctuations which

have taken place in the range. The relative yields of the varieties are also fairly well known, from the yield tables found in the List. By means of these data, it is possible to calculate the increase in yield obtained by using more productive varieties.

In 1939 the writer made such calculations in respect of the self-pollinating cereals (wheat, barley and oats), for the period 1931–1938. Throughout these seven years the increase in yield owing to the use of more productive varieties amounted to 3.5%, or 0.5% per year (*Landbouwkundig Tijdschrift*, November 1939).

Mr. G. VEENSTRA dealt with the same problem in the *Plattelands-Post* of 12th February, 1949. Mr. VEENSTRA compared the rise in yield of a group of crops, which had been the object of a great deal of breeding work, with the rise in yield in a group in respect of which little or no breeding work had been done. The result was represented in the form of graphs. Until about 1900–1910, the yield graphs for these two groups were practically the same; there-after, the yield from the group on which the breeders had worked hard rose more quickly than that from the other group. Mr. VEENSTRA then concludes that "if this 0.5% (the percentage found by GROENEWOLT is meant) is compared with the figure of 19.5 kg of wheat per ha per annum calculated in quite another way, it must be admitted that a close degree of agreement is apparent here."

In the *Landbouwkundig Tijdschrift* of May, 1952, we find an article on the same subject by Mr. G. AMELUNG, who, again, has made use of the statistics and yield data in the List of Varieties. Mr. AMELUNG comes to the conclusion that the rise in productivity obtained by using new varieties may be estimated at about 7%, or, on the average, 0.3% per annum, for the period 1932–1955. These figures relate to all crops.

Mr. AMELUNG has, however, assumed that no success has been achieved in breeding rye in the last few decades. In 1932, Petkuser rye was almost the only variety cultivated, and that is still the case. But rye is a cross-pollinating plant, in respect of which constant endeavours are made to effect improvements by selection. The name has remained the same, but the *intrinsic value* of the variety may have changed. In any case, the breeder of Petkuser was successful to such an extent that, up till a few years ago, nobody had succeeded in surpassing this variety as far as yield was concerned. Comparison of the old land varieties, still sporadically grown, with Petkuser, gives a picture of the results achieved by breeding even in the case of this variety. Mr. AMELUNG would have done better to have omitted rye from these calculations. The same applies to sugar beet and mangolds; and objections can also be made to the inclusion of field beans.

Mr. W. SCHEIJGROND gave the following information on mangolds in a lecture to the "Breeders Union" on 25th June, 1951:

"The question, 'what has been achieved by the use of better mangold varieties?' is naturally difficult to answer. Sundry records show that, about 30–40 years ago, mainly French seed was imported into the Netherlands, while, furthermore, the seed of land varieties was in local use. If it is realized that the French mangolds whose seed was imported in 1947 have remained more or less on the same level as those of 30–40 years ago, we have something to go by. The value of those varieties was 82–91% of the average value of the varieties on the Netherlands List. The land varieties examined by us are sometimes

rather better, but only by a few per cent. Moreover, both the French seed and that of the land varieties generally showed a strong tendency to shoot, while the good varieties of the present day have been improved by selection to such an extent that they can be sown earlier. I estimate the increase in yield thus obtained at 5–10%. Summarizing, we come to the conclusion that the average yield of the varieties on the List is now about 20% higher than that of the varieties used 30–40 years ago. This figure is of the same order of magnitude as the calculated progress of $\frac{1}{2}\%$ per annum which is often quoted. This result is surely to be termed favourable for a plant in respect of which great attention has not always been paid to choice of variety."

Mr. R. WASSENAAR has made calculations regarding the self-pollinating cereals (wheat, barley and oats), which give, from year to year, a picture of the increase in yield owing to an alteration in choice of variety throughout the period 1931–1951. The following graph shows the result. (Fig. 4). The time has been plotted on the horizontal axis, and the increase in yield due to a change in choice of variety on the vertical axis, production capacity in 1931 being taken as a basis for calculations and reckoned as 100.

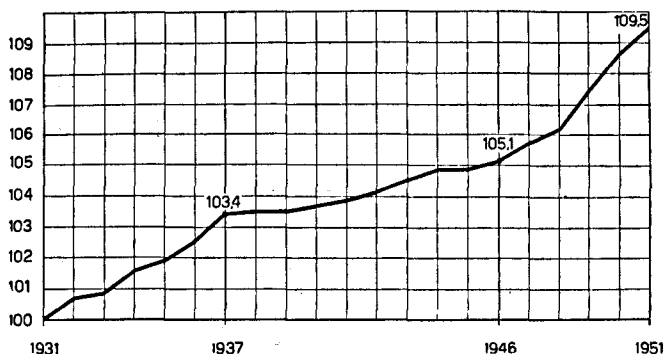


FIG. 4. INCREASED YIELD, AS A RESULT OF CHANGE IN CHOICE OF VARIETY, IN THE SELF-POLLINATING CEREALS THROUGHOUT THE PERIOD 1931–1951 (0.475% per year; production capacity 1931 = 100).

In the first place, it can be seen that the increase in yield of the self-pollinating cereals, through use of more productive varieties, has been 9.5% over the last 20 years, or 0.475% per year, viz., almost $\frac{1}{2}\%$. Furthermore, three periods, in particular, strike the attention. The first is 1931–1937, in which the increase in yield was 0.57% per year; the second, 1937–1946, with a much smaller increase, i.e., 0.19% per year; and the third, 1946–1951, with the very considerable increase of as much as 0.88% per year. We shall be on the safe side if we assume the average increase in yield from 1946 onwards, for all crops, as a result of a change in choice of variety, to be $\frac{1}{2}\%$ per year. In doing so, account has been taken of the fact that progress in the case of some crops has been less than in that of the cereals.

WHAT DOES $\frac{1}{2}\%$ INCREASE IN YIELD MEAN?

Let us suppose that the arable land of the Netherlands – taking into consideration the area under stubble crops and occupied by leys – is 1,000,000 ha in extent, and that the proceeds from 1 ha amounts to the round sum of 1,000 guilders (rather more than £ 100). $\frac{1}{2}\%$ of 1,000 guilders is 5 guilders; at first sight this seems a small amount, but if we multiply this additional yield for 1 ha by 1,000,000, the changed choice of variety means, for the whole

country, an increase in financial receipts of 5,000,000 guilders per year. If, at this moment, we were to grow the same varieties we were growing five years ago, and in the same proportion, the value of the harvest would be smaller by $5 \times 5,000,000 = 25,000,000$ guilders per annum. On good grounds it is to be expected that a change in the choice of variety will increase financial receipts throughout five years by another 25,000,000 guilders. Accordingly, over a period of 10 years this means an increase of 50,000,000 guilders per annum — certainly a by no means negligible amount; and, in considering it, it must also be borne in mind that it was obtained at very little cost to the farmer.

The reasons for the rapid rise in yields in recent years through the use of better varieties are, besides the intrinsic value of the new varieties, the effect of the Plant Breeder's Decree, increasing research on varieties, and more intensive dissemination of advice and information in the post-war period. The system of inspection of crops also plays a part; nor should the influence of the trade be forgotten, both as regards private enterprise and cooperative circles. And finally — or perhaps in the first place — thanks especially to agricultural education, the increase is due to the well-informed, progressive farmer, who, with the help of trial-field results and advisory service, and on the basis of his own experience and the discoveries of his colleagues, puts the improvements into effect extraordinarily quickly.

Through this totality of factors, very important results have been achieved. We may consider the better variety as one of the most important means of raising the productivity of our arable land. And, as yet, there are no signs whatever that the limit has been reached.

