

RESEARCH ON VARIETIES ON BEHALF OF THE REGISTRATION ¹⁾

F. E. NIJDAM

By registration of varieties in the sense used in the Plant Breeders' Decree of 1941, is meant the entry of varieties in the Central Register of Varieties. Such registration establishes the breeders' right.

New varieties are registered on application of the breeder or of his assign. A variety is considered as being new if it differs sufficiently from other varieties of which propagation material has been put on the market at the moment of application for registration and if it is sufficiently pure.

Registration, and with it the granting of breeders' rights, is effected by the Board for the Plant Breeders' Right.

RESEARCH ON IDENTITY AND AGRICULTURAL VALUE

The investigations to produce all requisite data regarding varieties are the responsibility of the I.V.R.O. (Government Institute for Research on Varieties of Field Crops), as far as field crops are concerned. A List of Varieties has been established for field crops, on which list, with some exceptions, only *registered* varieties may be placed. Since the List of Varieties is authoritative — which means that only varieties put on it may be marketed — registration becomes the basic condition for admission to the market.

Registration is a condition, but not the only condition. A registered variety is only placed on the List if it also satisfies a second demand: it must be considered to be of particular value to Netherlands agriculture, i.e., for cultivation on Netherlands soil.

As regards a new variety, the normal procedure is approximately as follows. The breeder submits his variety to the Board for the Plant Breeders' Right, and applies for it to be registered. The council instructs the I.V.R.O. to examine it on the grounds of newness.

Not until the novelty of the variety has been established and registration has taken place, with consequent award of Breeders' rights, does the moment come when attention must be given to the second condition, viz., the variety's especial value for cultivation on Netherlands soil.

The Board for the Plant Breeders' Right is not concerned with this problem; that is the business of the Government Committee for Compilation of the List of Varieties of Field Crops, which, however, like the Board, charges the I.V.R.O. with the investigation.

In actual fact, the investigation is carried out in such a way that a new variety passed to the I.V.R.O. by the Board for the Plant Breeders' right with instructions to examine its novelty is studied from the outset with regard to both questions, novelty *and* agricultural value. Investigation practice itself has led to this. It is of great importance to every breeder that the investigation

¹⁾ Offprint from *Landbouw*, No. 17 (1953), pp. 15–24 (published by the Netherlands Ministry of Agriculture, Fisheries and Food).

should take place as quickly as possible ; for him, the main thing is to get his variety put on the List at the earliest opportunity. Accordingly, it is all to the good if an idea of the variety's agricultural value can be gained during investigation of its identity. By adopting this course of procedure, it is often possible to give a positive verdict on the variety's agricultural value even before all the data have been collected which are required for examination of its identity.

For instance, the inquiry into the agricultural value of a certain variety of wheat proves it to be highly susceptible to yellow rust, which makes its chance of achieving a place on the List of Varieties very small. This, to begin with, makes further investigation of the variety's individuality a very unattractive proposition to the breeder. For every year of investigation costs him a certain amount of money, and if progress has reached such a point that the variety can be registered, registration, again, will cost him more money. And what good does it do him to acquire breeder's rights on a variety which will not be passed for admission to the market anyway? As a rule, the breeder will feel more inclined to withdraw the variety. That is the best solution, both for the breeder, who saves himself further trouble, time and expense, and for the I.V.R.O., which does not then need to waste its resources on fruitless labour. A further argument in favour of simultaneously carrying out investigation of identity and of agricultural value has arisen from the discovery that the inquiry into identity can be profitably carried out, in most cases, on the normally growing crop in a trial field for investigating yields. It is not necessary, and often even undesirable, as regards the investigation on identity, to sow or plant in very small plots, in which the seed is laid by hand, or in which special distances between the plants are chosen.

The ordinary trial field, which satisfies the demands that have to be made in respect of reliable yield determinations, is, as a rule, also admirably suitable for the investigation on identity. Accordingly, it is almost a matter of course that the two spheres of examination should have been combined.

VARIETY CHARACTERISTICS

The variety is an agronomic, not a botanical conception ; it is a "quantity" valued as a unit for practical considerations. Differences between varieties will, in general, be small by comparison with those which the botanist takes as his terms of reference in establishing his systematic classifications.

Leaving exceptions out of account, an assortment of varieties falls within the boundaries of a botanical species. Where this is not the case, for instance in the case of barley, it is obvious that, by way of preliminary subdivision, the assortment should be split into groups, each of which is located within a species. Accordingly, in the example of barley, the range should be split into a group belonging to the species *Hordeum vulgare*, with three fertile spikelets per node (four-rowed barleys in our range), and a group belonging to the species *Hordeum distichum*, with one fertile spikelet per node (the two-rowed barleys in our range).

The differences forming the basis of distinctions between varieties are of two kinds: *qualitative* differences, and *quantitative* differences.

In the first place, qualitative differences are looked for. These enable sharp

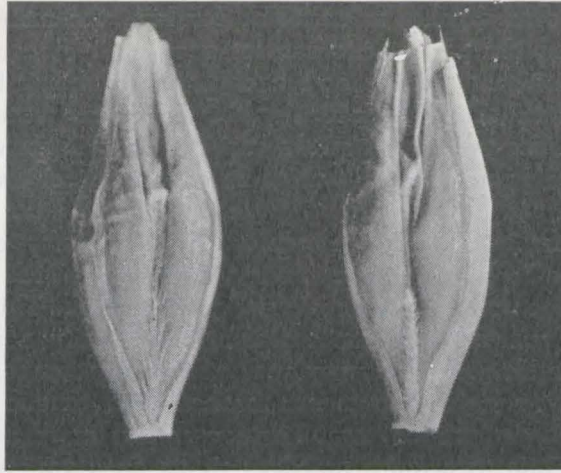


FIG. 1. VARIETAL DIFFERENCE IN SUMMER BARLEY.
Left: grain with long-haired rhachilla (Herta).
Right: grain with short-haired rhachilla (Pirolina).

distinctions to be made. Each qualitative difference splits the range completely. The greatest advantage is to be drawn from this if the dividing line splits the range into groups which are as nearly equal in size as possible. As an example, the colour of the glume in oats may be mentioned. Our range includes white, yellow and black oats. But of these, only one variety of *black* oats is present. The characteristic of possessing a *black* glume is enough to separate *one* variety from the whole of the rest of the range. Varieties with a *yellow* glume are likewise only few in number, and consequently we are left with a large group of varieties with a *white* glume. Now, if the number of *qualitative* characteristics happened to be very large, such a disproportionate division would be no obstacle. In general, however, it appears that there are not so very many of this type of characteristics. The groups of varieties which have not yet been distinguished must therefore be further subdivided by reference to characteristics of the other type, the *quantitative*.

Making use of quantitative characteristics means, that one has to decide on "more or less"; they do not draw sharp dividing lines through a range. For example, it is not possible to apply an absolute measure to length of straw. The straw of Marne oats cannot be said to be so many centimetres long; it is only longer or shorter than that of other varieties. Now there are a number of varieties which cannot be reliably distinguished from Marne by length of straw. The relative lengths cannot be ascertained with certainty from a single observation on one specific trial field. The modifiability of the quantitative characteristics greatly affects the utility of such results. If, by repeated observations, under varying conditions of soil and climate, a good understanding of the situation has been obtained, rendering it possible to risk presuming the existence of a difference in a certain direction, it is still often by no means certain that that difference will be demonstrable on the occasion of any subsequent observation.

In the case of varieties which have to be differentiated on the basis of such quantitative characteristics, it is often difficult to find an expressive way

of indicating their differences. The larger the group of varieties which have remained indistinguishable up to the point of quantitative difference, the greater the difficulty. For that reason, the variety investigator is thankful for any qualitative difference he may happen to find, and delighted if it also effects an advantageous division in his range.

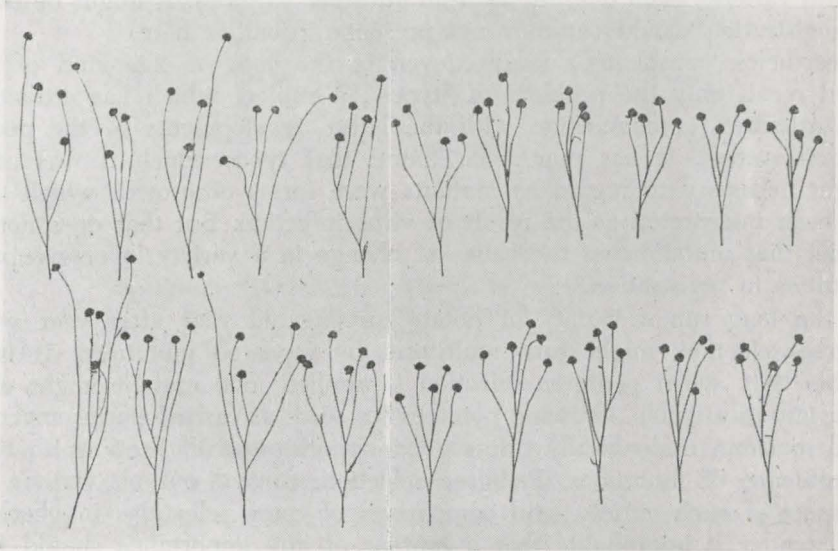


FIG. 2. VARIETAL DIFFERENCE IN FLAX.
Long secondary axes (Fivel).
Short secondary axes (Hollandia).

The Plant Breeders' Decree demands that a variety distinguishes itself sufficiently from other varieties if its novelty is to be recognized.

In distinguishing features, however, a variety has to show itself to be constant, even though the law does not claim this in so many words. For registration establishes the Breeder's right. This is a right to a concrete thing—to the variety concerned. Such a right can only be granted when the distinguishing properties of the variety are stable. If this condition were not satisfied, how would it be possible for a verdict to be given in the event of litigation?

Before granting rights, the Board for the Plant Breeder's right always has to ask itself the question: is it possible for this variety, with which legal rights are connected, to be recognized at all times? Are its characteristic properties stable, and do they reproduce themselves in subsequent generations?

It is of interest to examine the general question of the stability of such properties.

It appears possible to distinguish three main groups of crops, in the case of each of which the situation is different as regards stability of the varieties.

a Crops which reproduce themselves vegetatively

Here, each variety is a clone. All individuals possess the same hereditary characteristics, and these do not change from one generation to another. The

potato is a representative of this type. Stability, uniformity, and a habit of growth of its own characterize each variety. The variety presents the same appearance to us today that it presented last year. Any difference is only an expression of modifiability. Each variety exhibits an individual nature, according to the qualities of the tuber, the type of plant, mode of flowering and ripening. It is possible to form a clear idea of the whole essential nature of a potato variety; each one differs from all other varieties. It might be thought that registration would certainly not present difficulties here.

Nevertheless, problems do arise, even in the case of this kind of plant. I need recall only the problem of "types", a subject which has attracted so much attention in connection with the latest developments in the pedigree selection system. It has now been found that types which it was at first thought necessary to regard as mutants were forms of growth which should have been interpreted as the result of virus infection. But that does not alter the fact that mutation, as the cause of change in a variety, may give rise to difficulties in registration.

In the long run a variety of potato, propagated year after year without pedigree selection, might turn multiform by repeated mutations. It is conceivable that, when pedigree selection is applied, one mutant might change the variety as a whole. Growing potatoes for seed, as carried on in our country at the moment, undoubtedly offers good opportunities of keeping an eye on the influence of mutations. Pedigree selection, carried out on various farms in respect of each variety, and comparison of these selections in check trial fields, render it improbable that a mutant of any importance should fail to be recognized early.

Mutation in a variety may also lead to complications in the matter of legal rights; but this is not a problem that arises exclusively in connection with varieties which reproduce themselves vegetatively. Suppose, for instance, that somebody submits such a mutant as a new variety for registration. According to law, recognition of a variety as new is determined by the question of whether sufficient difference exists between it and established varieties. The Board for the Plant Breeder's right has to decide this point.

In certain cases, if the difference is considered sufficient, and the breeder's right is granted, the question arises as to whether this always entirely satisfies the demands of justice. The original variety might, perhaps, have been the creation of considerable talent, achieved with much trouble and expense; the mutant is, as it were, "treasure trove", obtained by chance, without cost or exertion. That mutant may, however, be a serious rival to the original variety, and the interests of the breeder may suffer if, alongside his variety, a product (the mutant) is marketed, the value of which is almost entirely due to him.

Arguments have been brought forward for the view that, if such a case should occur, the holder of the breeder's right to the mutant ought to hand over part of his revenue from it to the breeder of the original variety. Although, discovery of a mutant is generally esteemed as has been pointed out here, I think that such treatment as this would not be just, in every case, to the man who appears with such a mutant. In calling discovery of a mutant "chance", "luck", it should nevertheless be born in mind that such good fortune does not fall to the lot of everyone. The art of making the most of chance is given to very few people in this world. The words of Goethe are certainly appli-

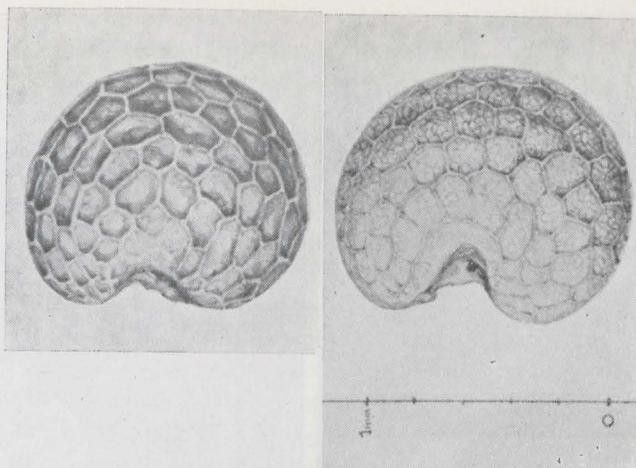


FIG. 3. VARIETAL DIFFERENCE IN OIL SEED POPPY.
 Network of low ridges (Noordster).
 Network of high ridges (Nobel).

cable here: "wie sich Verdienst und Glück verkettten, dass fällt dem Toren niemals ein." The merit associated with finding the mutant is essentially the same as that for which we praise the breeder. It is the gift of the sharp eye, of intuition, of talent, to be able to distinguish the singular from the ordinary.

b Self-pollinators

Self-pollination leads to homozygosis. A variety of a self-pollinating plant may possess the character of a "pure line". All individuals are then genetically like each other, and homozygous. This structure ensures uniformity and stability of properties. Provided such varieties are sufficiently differentiated, no difficulties arise in registering them. But in many cases the situation is not so simple. Sometimes a variety is not a "pure line" but a mixture of related "lines". Young varieties, in particular, may not be entirely free from a certain heterozygosis. In the majority of self-pollinating plants the possibility of cross-pollination is definitely present. Mutation can also be expected here. All these factors tend to lead to a variety of a self-pollinator becoming impure—it can degenerate, if it is not kept strictly in hand while being maintained; and even if serious maintenance work is done on it, it is not impossible that a variety may alter in the course of the years.

Accordingly, in the registration of varieties belonging to this category, it will always be necessary to watch vigilantly to see that the necessary purity is present, and a check must be kept to ensure that the properties which determine the character of the variety are preserved to a sufficient degree in succeeding generations. Uniformity and stability of character are uncertain properties at the best of times, as far as these varieties are concerned, and can only be maintained under the watchful eye of the breeder. One would be quite justified in hesitating before answering the question as to whether things so very much threatened by degeneration — which, in fact, frequently carry in themselves the germs of degeneration — can form a good foundation on which to base legal rights. It is probably considerations of this nature which,



FIG. 4. VARIETAL DIFFERENCE IN WHEAT.
 Steeply rising leaf (Carsten's Dikkop V).
 Hanging leaf (Elisabeth).

in America, have led to the possibility of acquiring patent coverage on varieties being limited to plants which reproduce themselves vegetatively.

The instability of self-pollinating varieties can be illustrated here by a few examples.

It is known that certain wheat varieties, unless they are kept strictly and unremittingly in hand, degenerate very rapidly. A case in point is the Juliana variety, which, on simple propagation, soon changes into an unrecognizable hotchpotch of diverse forms. It has been observed that hard winters, in particular, promote this degeneration.

The wheat variety Demeter is a selection from Mendel. Both varieties exhibit fairly radical differences at a number of points. The fact that it is possible, by simple selection, to produce such a widely deviating type is clear evidence of the essentially slight degree of uniformity inherent in such a variety as Mendel.

Certain abnormalities turn up over and over again. Examples which may be mentioned are the occurrence of bearded wheat plants in an unbearded variety, and the appearance of oat plants in which the awns are especially strongly developed. Sometimes the abnormality is simply to be found in the *quantity* of awns, which may occur in great abundance in a number of flowers in any variety; sometimes abruptly twisted, dark-coloured, bent awns, characteristic of wild oats, are seen to appear. Other abnormalities are: the occurrence of two-rowed barley in a four-rowed variety; the occurrence of bursting pods in the case of peas; the development of winding stems in haricot beans.

c *Cross-pollinators*

It is not so simple to characterize the cross-pollinating varieties according to their hereditary composition. It is conceivable that a variety of a cross-pollinating plant might be evolved on the basis of a single homozygous plant. The result would be a variety which, in genetic type, would not differ from

a variety of a self-pollinator. It would be a "pure line". But in fact, in the case of most varieties of cross-pollinators, we have to deal with quite different material. They are populations; some of the hereditary elements are present in an exclusively homozygous form, others occur in both homozygous and heterozygous forms. The "segregating factors" are responsible for a number of genotypes within the variety. There are as many genotypes as can be formed, according to the action of the known bastardization laws, from the given number or segregating factors; this number also determines the ratio of these types, it dominates the picture of hereditary variation of the variety.

If we take a fodder beet as representative of the type, we can assume that such a beet is stable as regards the factors which determine colour and main shape; hereditary variation, however, affects size, content, details of shape, form of leaf, size of leaf, form of rosette.

In the case of varieties belonging to the same type, differences in variety must be sought among those variable characteristics. The one variety of the greentop fodderbeet type differs from the other in that the totality of variable qualities is not the same in both varieties. If, now, these varieties were to be constant in their multiformity, if the boundaries within which each property can vary were to be established, and if, in this hard-and-fast range, the variation curve were to exhibit the same, immutable form, — then we should be concerned with varieties which are multiform, but which, nevertheless, are distinct from each other and constant in their differences.

In reality, however, many varieties of cross-pollinators show changes in appearance from year to year. The variability of the variety must be described slightly differently from one year to the next. If the relationship between two varieties is compared in different years, the difference between them will be found to be greater as regards one property, and smaller as regards another.

The way in which such varieties are bred makes this very understandable, if their hereditary structure is taken into consideration. If, seed of a given variety, with the population structure assumed for this type, were to be obtained by simple propagation without the application of any form of selection, and if, likewise, no selecting influence whatever, as a result of natural conditions or method of growing, were to be operative — then that variety would have to remain "true to itself".

But the breeder, who must produce a new harvest of seed every year, effects this not by simple growing but as the final result of breeding operations carried on according to a certain plan. Assuming that he has applied family breeding methods, the result will be that — whatever his precise mode of procedure may have been — he will have chosen from his variety a limited number of plants, which form the basis for the next generation. By doing so, he has exerted a certain influence on the variety's hereditary structure — an influence the consequences of which cannot be forecast in every detail, but which, in any case, can be said to have altered the variable properties of the variety.

We are forced to conclude that many cross-pollinators, which are varieties that might be called breeding-products of a certain, specific type, are not distinguished from each other by stable differences; they cannot be characterized differentially. For this reason they are not suitable objects for the granting of breeder's rights.

Accordingly, the breeder of this kind of variety is in a highly unfavourable position. For him, there is no breeder's right, to protect him from theft. But it is just in *his* sphere of operations that protection is to be desired. In cases in which a number of selections or varieties exist within a specific type, it is not difficult to enter the market with a product which has behind it no background of breeding work on the part of the producer – which is merely obtained by multiplication of material that has been endowed with its good

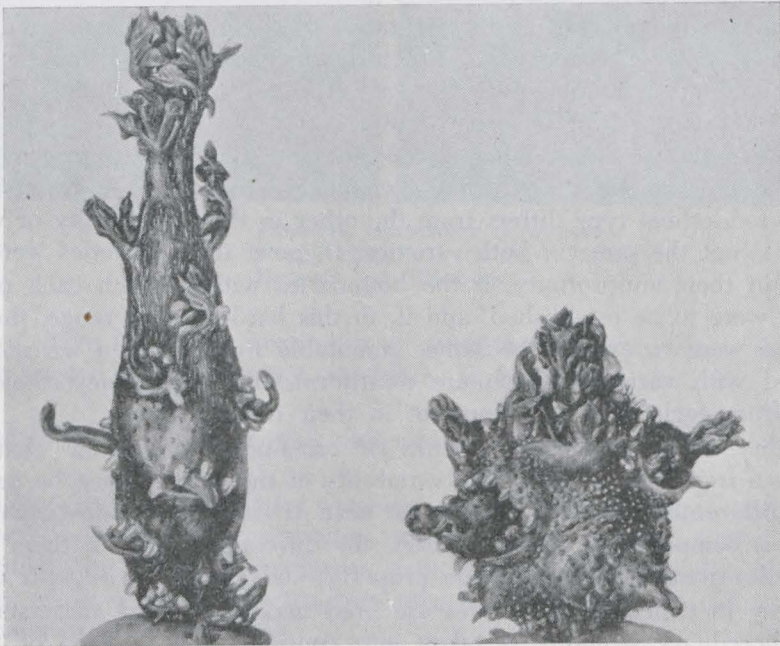


FIG. 5. VARIETAL DIFFERENCE IN POTATOES.
Light sprouts of varieties.
Saskia (elongated) and
Libertas (compact).

qualities by other people's sacrifice of time and money. If, nevertheless, it is desired to protect the breeder here, where the Plant Breeders' Decree cannot be applied, another way of doing so will have to be looked for. This may be found by introducing the breeder's labour as a factor in evaluating a variety.

Not all cross-pollinators can be condemned *a priori* as unsuitable for registration. In this connection I would compare the fodderbeets – with the selections occurring within one type – with the Swede-rape plant. The differences between Swede-rape varieties such as Mansholt's Hamburger, Lembke's and Janetzki's, are clear to everybody. It is easier to distinguish Mansholt's Hamburger and Lembke's from each other, than to distinguish, for instance, oats varieties such as Marne and Zonne II from each other. The Swede-rape varieties exhibit certain constant, striking differences. The fact that multiformity may be present with regard to certain other properties, and that no absolute congruence exists, perhaps, in that multiformity from year to year, is not the

point here, for differences between varieties just do not need to be measured in this fluctuating region.

In the above account, an endeavour has been made to give the reader an impression of the possibilities and problems associated with registration. Within the borders of material which is closely related, from the points of view of both system and inheritance, a search has to be made for the constant differences by means of which varieties may be characterized.

Living material has to be treated. Its physical appearance is influenced by its surroundings, and it hides its true nature behind modifications. It tends to change in course of propagation, which, again, is the only way in which it can remain in existence.

When the Plant Breeders' Decree came into effect in 1941, it was not realized that difficulties lay ahead as regards the registrability of varieties. That law had perhaps been formulated with the potato too much in mind; and at that time, in any case, none of the parties concerned had any experience whatever of examination of varieties for characteristics.



ERRATUM

"The Effect of Air-drying of Soil Samples upon some physical Soil Properties" by J. van Schuylenborgh.

On p. 52 line 6 from bottom should be read as follows:
soils are always nearly completely saturated with water as in our case, the