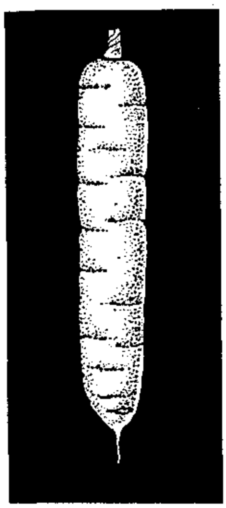
CARROT YIELD ANALYSIS

BY

O. BANGA



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INTRODUCTION

The yields of the same carrot varieties may differ widely, in fact so much so that in determining the differences in yield between varieties one often doubts whether the data are of any use. For this reason a series of trials was carried out to get a better insight into the factors governing yield.

These trials were primarily meant to determine the yield (in kgs) of usable carrots per plot, but in order to be able to observe changes in the structure of the yield the following figures were also determined:

Average number of plants per pot

Average number of usable carrots per plot (mostly expressed as a percentage of the total number)

Average root weight of the usable carrots.

Sometimes these numbers or weights as observed are given. In other cases some of them are expressed by means of index figures.

In converting the real numbers into index figures, the average of a whole trial has been fixed at 100, the real numbers having been converted to a percentage of 100. For instance, if the real average is 54, this is regarded as 100. If the real number for a variety or treatment in the same trial is 64, then this variety is given the index figure $64/54 \times 100 = 118.5$ or rounded off to a whole number 119.

TOTAL NUMBER OF PLANTS PER PLOT

To a limited extent it is possible to determine, by varying the planting distances and by thinning out afterwards, the number of plants that can be grown on a plot. Some of the young plants, however, will damp off so that the spaces between the plants in the row become larger than the planting distance originally chosen. Moreover, all the seed does not come up. This depends on the germinability of the seed and on the condition of the soil at the moment of sowing and afterwards.

How far the real plant number can deviate from the numbers which, theoretically, should be present according to the planting distance originally chosen, is shown in Table 1. The numbers given in this Table relate to the trials 53 B, 53 C and 53 D, which were block trials that had been replicated four times.

TABLE 1. PLANTING DISTANCE AND TOTAL NUMBER OF PLANTS PER PLOT

Variety	Planting distance in cm	Total number of plants per plot of 3 m^2 (row length 2 m; plot breadth 1.50 m)			
		Theoretical	Observed		
			De Goor	Wag. Berg	Elst
Flakkeese Improved	15 × 2½	800	397	306	230
	18¾ × 5	320	258	195	167
	25 × 10	120	114	106	114
Nantes	12½ × 1½	1920	831	–	467
	15 × 2½	800	565	–	412
	18¾ × 5	320	313	–	232
Amsterdam Forcing	12½ × 1½	1920	623	550	296
			690	544	–
	15 × 2½	800	498	420	392
			571	388	–

Amsterdam Forcing was sown twice on the same plots. It was first sown in spring, together with *Flakkeese Improved* and *Nantes*. Of the latter two varieties only one crop per season could be grown. Of *Amsterdam Forcing*, however, a second crop could be grown after the harvest in July. The second sowing was carried out in July. Therefore, in the case of *Amsterdam Forcing* grown at "De Goor" and "De Wageningse Berg", two figures are given for each planting distance, for the first and the second crop respectively.

At Elst, growth was so much slower that even of *Amsterdam Forcing* only one crop could be grown.

Table 1 shows that as the planting distances decrease the real plant numbers lag behind the theoretical ones. This Table also shows that the location has had an effect on these numbers.

At "De Goor" (low sand of good structure with always sufficient moisture) the real number of plants was highest. Then followed the "Wageningse Berg" (high sandy soil, without upward conduction of water, but in the spring of 1953 sufficiently moistened with rain-water).

Elst (heavy clay) came last.

Consequently the suitability of the soil for the germination of the seed is also of importance.

Furthermore the germinability of the seed has some influence. In 1950 and 1951, 32 selections of types of Flakkeese were tested in 6 trials. Prior to sowing them, the germination capacity of the 32 seed samples had been determined. That was in 1950. In the 6 trials the total number of plants, averaged per plot, was determined. For each test these numbers were converted into index numbers. Then the six index numbers of each selection were averaged.

In Table 2 the 32 selections are grouped into 4 classes of germinability and 4 classes of index numbers for the total number of plants per plot.

TABLE 2. GERMINABILITY AND TOTAL NUMBER OF PLANTS PER PLOT

Germinability in 16 days in %	Index numbers for total number of plants per plot averaged over six trials			
	102	102–98	97–93	93
82–78	4	5	0	0
75–63	2	8	2	0
55–48	1	2	3	1
42–38	0	0	2	2

It is clearly shown that the number of plants per plot tended to be lower as the germination capacity of the seed decreased. To sum up it may be concluded

a. that reducing the planting distance increases the real number of plants, but that this number lags all the more behind the theoretical number as the planting distance becomes less;

b. that the real number of plants per plot lags all the more behind the theoretical one as the germinability of the seed decreases and the soil becomes less favourable for the germination of the seed.

INFLUENCE OF THE TOTAL NUMBER OF PLANTS PER PLOT ON THE YIELD

In the trials already mentioned (53 B, 53 C and 53 D) a number of varieties were tested in three localities, at different planting distances. These trials provided the data shown in Table 3 (see p. 000). In addition to the figures mentioned previously, some data on the causes of carrots being unusable are also included.

In Table 3 it is shown that within the present limits the yield per plot always rose with the increase in the total number of plants per plot. As a rule, however, yield does not increase in proportion to the total number of plants, because when the total number of plants per plot increases the average root weight decreases. In addition, the percentage of usable carrots often (not always) drops. An increase in the total number of plants per plot is generally associated with an increase in the percentage of excessively small roots, but this mostly causes the percentages of ramified or cracked roots to decrease.

Consequently the factor "total number of plants per plot" directly affects the kg yield per plot by virtue of its number and indirectly by its effect on the average root weight and the percentage of usable carrots. It may be imagined that this indirect influence becomes less as the number of plants on the plot decreases, and ceases entirely as soon as a certain planting distance has been reached. It is safe to say that this distance will be different under different growing conditions.

THE PERCENTAGE OF USABLE CARROTS

In the preceding section it has been stated that the total number of plants per plot may effect the usable percentage. With increasing numbers of plants per plot the

TABLE 3. TOTAL NUMBER OF PLANTS PER PLOT AND YIELD

Variety	Locality	Total number of plants per plot of 3 m²	Usable carrots: Number in % of total	Number	Average root weight (g)	Yield in kg per plot of 3 m²	Causes of rejection Numbers in % of the total: Excessively small roots	Ramified roots	Cracked roots
Flakkeese Improved	De Goor	397	71	281	163	45.1	24.7	2.8	0.5
		258	80	207	216	44.7	14.6	3.3	1.5
		114	82	93	378	35.1	7.3	5.3	4.5
	Elst	230	65	149	208	30.8	25.4	6.1	3.6
		167	60	100	254	25.4	25.9	6.3	7.2
		114	64	90	282	20.6	19.6	7.5	7.6
	Wag. Berg	306	60	184	142	25.9	38.8	0.8	0.2
		195	73	143	182	25.6	22.1	2.5	0.2
		106	80	85	279	23.6	15.4	2.4	0.2
Nantes	De Goor	831	85	707	44	30.4	13.1	1.0	0.7
		565	84	477	59	27.7	11.9	1.7	1.3
		313	84	263	83	21.7	8.6	1.6	5.4
	Elst	467	65	301	58	17.3	28.6	2.1	6.8
		412	61	253	62	15.7	28.2	3.1	7.2
		232	67	156	81	12.6	15.3	3.6	14.1
Amsterdam Forcing	De Goor	623	88	546	33	17.8	9.7	1.0	1.7
		498	85	422	38	15.8	12.1	1.1	1.9
	Elst	392	55	214	43	9.2	29.2	3.0	12.6
		296	60	176	42	7.4	27.0	2.6	10.3
	Wag. Berg	550	78	427	30	12.6	20.7	1.1	0.7
		420	79	333	34	11.1	18.1	1.7	0.6

percentage of excessively small roots generally increases, whereas the percentages of ramified or cracked roots generally decrease (Table 3).

The type of soil is another important factor. At Elst, on heavy clay, the percentage of usable carrots was lower than on low sandy soil, and mostly also lower than on high sandy soil. On heavy clay and on high, relatively dry sandy soil the percentage of excessively small roots was high. In addition, the percentages of ramified roots and cracked roots were higher on heavy clay than on the two sandy soils, as can be seen from Table 3. Table 4 gives a number of cases in which one and the same variety with about the same total number of plants was grown in two or three different localities. Here the influence of the soil, apart from the total number of plants per plot, is even more clearly shown.

TABLE 4. INFLUENCE OF THE LOCALITY ON THE PERCENTAGE OF USABLE CARROTS

Variety	Locality	Total number of plants per plot of 3 m²	Usable roots				Causes of rejection Number in % of total		
			Number in % of total	Number	Average root weight in g	Yield in kg per plot of 3 m²	Excessively small roots	Ramified roots	Cracked roots
L. St. Wi.	De Goor	204	81	165	255	41.3	14.4	3.6	0.0
,,	Elst	209	63	132	230	30.4	29.1	6.3	0.7
L. St. Wi.	Elst	146	68	99	297	29.4	20.4	10.4	1.1
,,	Wag. Berg	149	75	112	206	22.3	21.1	2.8	0.0
Fl. Impr.	De Goor	114	82	93	378	35.1	7.3	5.3	4.5
	Wag. Berg	106	80	85	279	23.6	15.4	2.4	0.2
	Elst	114	64	73	282	20.6	19.6	7.5	7.6
A'dam. Forc.	Wag. Berg	388	72	280	34	9.6	26.3	0.6	0.6
,, ,,	Elst	392	55	214	43	9.2	29.2	3.0	12.6

Unusable carrots may also result from premature bolting, or off-colour roots and impurities in varieties. These causes, however, were of minor importance.

AVERAGE ROOT WEIGHT

The weight that can be attained by a carrot greatly depends not only on its genetic constitution but also on its environment and "growing period".

That this is so appears from the results obtained in trials which were carried out in 1952. Harvesting was done weekly or fortnightly. The trials were carried out on a number of different varieties, and replicated 5 times per variety-harvesting period, except for the winter carrots grown at the "Wageningse Berg". Here the number of replications was 3.

The results are shown in fig. 1. The average root weight is plotted on the vertical axis; the numbers of days between sowing and harvest are set off horizontally. The earlier varieties were harvested sooner than the later ones, so the curves partially follow each other.

Growing period. As the number of days between sowing and harvest increases the curves for the average root weight tend to rise. The curves for *Nantes* and *Flakkeese* rise more sharply than those for *Imperator* and *Berlikumer B.* This may indicate that at the moment of harvesting each of the former two varieties was not quite so mature as the latter. Consequently, for each variety to reach a relatively high root weight the time available for development must harmonize with the time needed for full development.

Total number of plants per plot. The influence of this factor on the average root weight has already been mentioned in discussing the data of Table 3. The average root weight tends to decrease as the number of plants per plot increases. This should be borne in mind when investigating the influence of the growing period and of the locality.

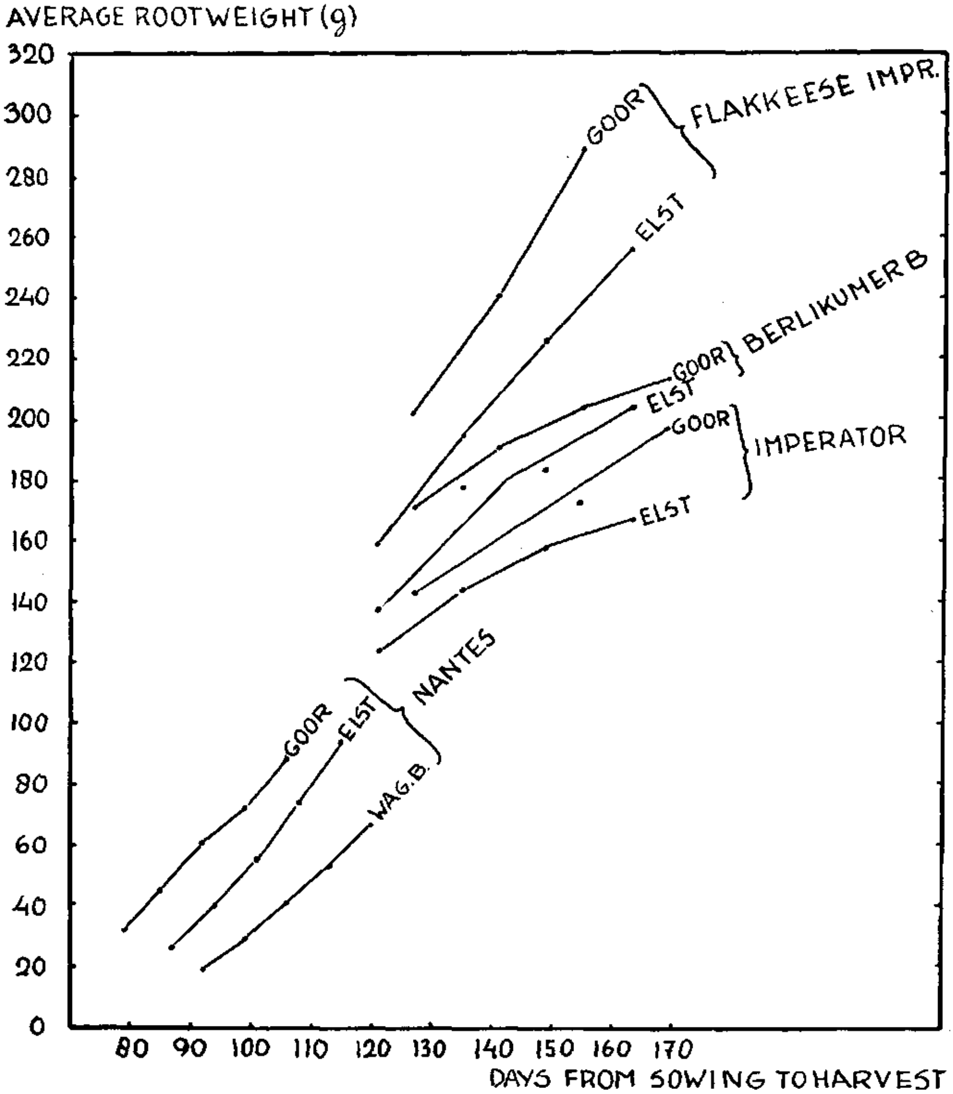

FIG. 1. INFLUENCE OF LENGTH OF GROWING PERIOD (DAYS FROM SOWING TO HARVEST), LOCALITY, AND VARIETY ON AVERAGE ROOT WEIGHT OF CARROTS.

GOOR: LOW SANDY SOIL OF GOOD STRUCTURE AND WITH SUFFICIENT MOISTURE.
ELST: HEAVY CLAY.
WAG. BERG: HIGH SANDY SOIL.

Locality. The average root weight of all the varieties grown at "De Goor" for an equal period of time was always greater than that of carrots grown at Elst. Carrots grown at the "Wageningse Berg", in 1952, had a still lower average root weight than those grown at Elst (only a curve for *Nantes*). Consequently the rate of growth was as follows: De Goor > Elst > Wageningse Berg.

Differences in varieties. The average root weight of *Flakkeese Improved* was highest. Next came *Berlikumer B*, followed by *Imperator*. Then came *Nantes*. As will be seen from Table 3 the average root weight of *Amsterdam Forcing* is still lower.

Influence of the average root weight on the yield

If the factors "total number of plants per plot" and "percentage of usable carrots" are the same, it may be expected that the yield greatly depends on the average root weight. This is clearly shown from the results of several trials each sufficiently large to include a fair number of selections with about the same total number of plants per plot and about the same percentages of usable carrots. In trial 50 PE with 62 strains of *Amsterdam Forcing* this number was 20; in trial 50 PQ with 25 strains of the *Nantes* type it was 7, while in trial 49 PK with 21 strains of *Berlikumer* the number was 12. These selections are represented as dots in Fig. 2. On the vertical axis the yields are plotted in kg per 10 m². The average root weights are set off horizontally as index numbers. These index numbers apply to each separate trial.

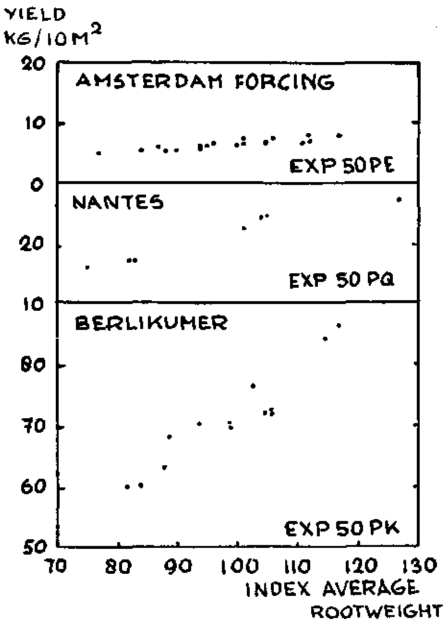

FIG. 2. RELATION BETWEEN AVERAGE ROOT WEIGHT AND YIELD OF THREE CARROT VARIETIES WHEN THE FACTORS 'TOTAL NUMBER OF PLANTS PER PLOT' AND 'PERCENTAGE OF USABLE CARROTS' WERE THE SAME.

THE AVERAGE ROOT WEIGHT IS EXPRESSED IN INDEX FIGURES. THE REAL ROOT WEIGHTS OF AMSTERDAM FORCING ARE SMALLER THAN THOSE OF NANTES AND THESE ARE SMALLER THAN THOSE OF BERLIKUMER. CONSEQUENTLY, IN THE HORIZONTAL DIRECTION, THE DOTS OF NANTES ARE RELATIVELY MORE COMPRESSED THAN THOSE OF AMSTERDAM FORCING, AND THOSE OF BERLIKUMER MORE THAN THOSE OF NANTES.

It will be seen that the yield increases in proportion to the increase in the average root weight.

As the total number of plants per plot and the percentage of usable carrots are respectively not and slightly dependent on the genotype of the plant, one might say that the simpliest way of judging the productivity of a variety or strain is by determining the average root weight which can be attained in a certain time.

Of course, the growing period of a variety is also of importance. It is possible to grow two successive crops of *Amsterdam Forcing* in the same time in which one crop can be grown of a winter carrot. In two successive cultures carried out with *Amsterdam Forcing* at "De Goor" in 1953, this variety yielded over 100 kg per 10 m^2 against 148 kg of *Flakkeese Improved.* At "De Wageningse Berg", where the soil was only friable at a shallower depth, the yields were 75 and 85 kg respectively. Here the roots of *Flakkeese* had a less decided advantage over those of *Amsterdam Forcing*, as they could not develop their entire length.

INFLUENCE OF THE ROOT DIMENSIONS ON THE YIELD

If it is possible to use the average root weight that can be attained in a certain time as an indicator for productivity, the selection for productivity can be carried out at a lower cost and more easily than by weighing the plot yields in extensive field trials.

The conclusion may be drawn, however, that the root length is a still better indicator than the average root weight.

Supposing that the specific gravities of the roots are about the same, then it is possible to take the contents of the root instead of its average weight. Now the shape of the root may approach that of a cylinder or that of a cone, but the contents are always dependent on two quantities, viz. the length and the area of the cross section. If, for simplicity, the cylindrical shape is taken as a starting-point, then the contents equal the length of the root $\times$ πr^2 (r = radius of the cross section of the root). It can now be proved that it does not matter whether one and the same field is planted with wide carrots or thin ones, for the sum of all the cross sections is always the same, provided the distances between the carrots are always in proportion to the radius (r) or diameter (2r) of each individual root. This can be proved as follows:

Let us suppose that the radius of the section of a root = r cm, and that each root is surrounded by an open space of xr cm. If the carrots have been planted in squares, each carrot requires a soil surface of $(2r + 2xr)^2 = (2 + 2x)^2 \times r^2$ cm^2. The surface area of the cross section of one carrot is πr^2.

Supposing that the available field is y cm^2, then it can contain

$$\frac{y}{(2 + 2x)^2 \times r^2} \text{ carrots.}$$

The total surface of the cross sections of all the carrots on the field equals the number of roots $\times$ the cross section of 1 root, or

$$\frac{y}{(2 + 2x)^2 \times r^2} \times \pi r^2 = \frac{y\pi}{(2 + 2x)^2} \text{ cm}^2.$$

The factor r does not figure in this formula. In other words: the total surface area of the sections of all the carrots on the plot is independent of the radius or diameter of the root, provided the planting distances are in proportion to the diameters of the roots.

It follows that in a properly cared-for culture the total contents of all the carrots on the plot are entirely dependent on their length and not on their thickness.

Discussion

It is possible to imagine the yield of a plot of carrots as the result of the interaction of the three factors "total number of plants per plot", "percentage of usable carrots" and "average root weight".

The "total number of plants" depends on the planting distance used, the germinability of the seed (better: germination energy) and the germination milieu; also on the numbers of young plants damping off. These influences are almost entirely of a non genetic nature, so the breeder can do very little about it. But the grower can do all the more. As the culture becomes more intensive and the grower more capable the possibilities of controlling the factor "total number of plants per plot" increase.

If the germinability is low, the total number of plants is likely to remain too small. From a number of trials it was shown that in that case the chance of producing heavy crops is also small. If the germinating milieu is unfavourable, even seed of good germination capacity may not come up well. In that case too, the result is a reduction in yield. The trials have shown that heavy clay can be a much less suitable germination milieu than sufficiently moist sandy soil. We know from experience, however, that even on a good sandy soil the seed may not come up well if sowing is followed by a spell with cold, drying winds. The influence of the germination milieu is also known to vegetable growers. They use to sow more seed as the germination conditions become less favourable. In addition, much can be achieved by tillage, by maintaining a proper moisture degree of the soil and by providing some kind of shelter, if necessary.

As already stated the "percentage of usable carrots" is in the first place affected by the total number of plants per plot. If the total number of plants per plot increases the percentage of excessively small roots increases too, but the percentages of ramified and cracked roots decrease. Another factor is the type of soil. The percentages of excessively small roots, ramified roots or cracked roots were higher on heavy clay than on good sandy soils. Presumably this is a matter of soil structure rather than of the type of the soil. It is our experience that, if the heavy clay is of good structure at a sufficiently great depth, it is possible to grow a high percentage of fine first-grade carrots on it, while on a sandy soil, if it contains layers that can only be penetrated with difficulty or if it is too moist or too dry, the percentage of usable carrots may be low. A crop of carrots on heavy clay soil is only more risky in that the good structure of clay is more readily lost through unfavourable weather conditions or injudicious treatment than that of sandy soils.

It has been stated that there were three causes of the reduction in the percentage of usable carrots. As far as our present knowledge goes only one of them (cracking) is also affected by genetic factors. At any rate in the varieties investigated by us, no genetic influences on the percentage of ramified roots were observed. The percentage of excessively small roots is not a genetic characteristic either, provided the specific requirements of a variety regarding planting distance and growing period can be fulfilled. Of course, diseases may also reduce the percentage of usable carrots. The most important affection is caused by the carrot fly, but effective control of this pest is possible. The problem of the unusable carrots mainly concerns the vegetable grower.

Now we come to the "average root weight", which is a real genetic characteristic. However, the root weight that can be attained greatly depends on the growing period, the total number of plants per plot and the environment. In the ecological behaviour of the plant genetic factors play again a part.

If the differences in the specific gravities of the roots are not too great, it is convenient to consider the length and width of the root and its shape instead of its average root weight. It has been shown that the width of a root does not affect the yield, so its length and shape are decisive.

It is self-evident that the length becomes all the more effective as the root shape approaches that of a cylinder. But in general we may say that for any particular type of carrot the productive capacity of a root is proportionate to its length. Of course, productive capacity is one thing and production another, for the development of the roots is also dependent on the depth and structure of the soil. If a vegetable grower asks what the most productive carrot is, it is in the first instance only possible to answer his question by asking another. He would be asked how deep is his soil and what is its structure, for there is no sense in growing a long carrot on shallow soils or on soils that are bad in structure. On such soils a carrot that is short by nature will be more satisfactory.

It should be noted, however, that even on the best soils the longest carrots are not always the best. As a matter of fact, long carrots are difficult to lift. In addition, they are bad travellers as they break easily. Therefore the breeder will have to find the best compromise between productivity and other requirements.

From the above the conclusion may be drawn that the length of the root is the simpliest indicator for its productivity, and that this indicator is only reliable if the carrots are grown on soils that are sufficiently deep and of good structure.

SUMMARY

1. Judging carrots on genotypical differences in yield is made difficult by many non-genetic factors affecting yield.
2. The yield of a plot of carrots may be imagined as the result of the interaction of the total number of plants per plot, the percentage of usable carrots out of this total number of plants and the average root weight of the usable carrots.
3. The total number of plants per plot depends on the planting distances originally chosen, the germinability (germination energy) of the seed, the germination milieu (type and structure of the soil, temperature, rainfall etc.), and the extent to which the young plants damp off.
4. The percentage of usable carrots is the number of usable carrots expressed as a percentage of the total number of plants per plot. It is primarily determined by the number of excessively small roots, ramified roots or cracked roots. This number is dependent mainly on the total number of plants per plot and the growth conditions. As far as our experience goes the genotype has a marked effect only on the susceptibility to cracking and presumably also on the resistance to certain unfavourable growth conditions.
5. The average root weight depends on the genetic constitution, the growing period, the total number of plants per plot and the environment. The most suitable growing period and the reaction to the environment are also dependent on genetic factors.

6. In so far as no important differences occur in the specific gravities, then the length and width dimensions and also the shape of the root may be considered instead of the average root weight. The interaction of the width of the root and the possible number of roots per plot does not affect the productive capacity.
   Therefore, the length and shape of the root may be considered as the simpliest and most reliable indicators of productive capacity.

SAMENVATTING

Opbrengstanalyse van wortels

1. Beoordeling van wortels op genotypische opbrengstverschillen wordt bemoeilijkt door vele niet-genetische factoren, die de opbrengst beïnvloeden.
2. De opbrengst van een perceel wortels kan worden gezien als het resultaat van de interactie van het totaal aantal planten per perceel, het bruikbaarheidspercentage van dit totale aantal planten en het gemiddeld wortelgewicht van de bruikbare wortels.
3. Het totaal aantal planten per perceel is afhankelijk van de gekozen plantafstanden, de kiemkracht (kiemenergie) van het zaad, het kiemmillieu (grondsoort, bodemstructuur, temperatuur, neerslag, enz.), en de mate waarin smeel in de jonge zaailingplantjes optreedt.
4. Het bruikbaarheidspercentage is het aantal bruikbare wortels, uitgedrukt in procenten van het totaal aantal planten per perceel. Het wordt vooral bepaald door de vraag of er al of niet veel te kleine, vertakte of gebarsten wortels worden geoogst. Dit is in het bijzonder afhankelijk van het totaal aantal planten per perceel en de groeiomstandigheden. Voor zover onze ervaring gaat, speelt alleen bij de gevoeligheid voor barsten en vermoedelijk ook bij de resistentie tegenover enkele ongunstige milieufactoren het genotype duidelijk een rol.
5. Het gemiddeld wortelgewicht is afhankelijk van de betreffende genetische aanleg, de groeiduur, het totaal aantal planten per perceel en de groeiomstandigheden. In de meest geschikte groeiduur en de reactie op de groeiomstandigheden doen genetische factoren mee.
6. Voor zover geen belangrijke verschillen in soortelijk gewicht voorkomen, kunnen de lengte- en dikte-afmetingen worden genomen in de plaats van het gemiddeld wortelgewicht. De interactie van de dikte van de wortel en het mogelijk aantal wortels per perceel is zo, dat het opbrengstvermogen hierdoor niet wordt beïnvloed. Daarom kan voor een bepaald type wortel de lengte van de wortel worden beschouwd als de eenvoudigste en tevens meest juiste indicator voor zijn productievermogen.

DRUK: H. VEENMAN EN ZONEN, WAGENINGEN

MEDEDELINGEN [1])
VAN HET INSTITUUT VOOR DE VEREDELING VAN TUINBOUWGEWASSEN

8. Algemene Veredelingsdagen 1947. Verslag van voordrachten en discussies. Juli 1948 . . . . f 1,15
9. **Banga, O.** De veredeling van tuinbouwgewassen in de V.S. van Amerika. Juli 1948 . . . . Uitverkocht
10. **Banga, O.** Krotenstudies. November 1948 . . . . f 0,25
    III. Vernalisatie en devernalisatie van bieten.
    IV. Verschillen in schiet-neiging bij verschillende rassen en selecties van platte of ronde kroten.
11. Algemene Veredelingsdagen 1948. Verslag van voordrachten en discussies. December 1948 . . . . f 1,05
12. **Banga, O.** Het kweken van nieuwe vruchtboomonderstammen in Engeland. Maart 1949 . . . . f 0,20
13. **Banga, O.** en **Hester G. Kronenberg.** Teelt en veredeling van aardbeien in België. Juni 1949 . . . . . . f 0,20
14. **Banga, O.** Krotenstudies. Juli 1949 . . . . f 0,50
    V. De inwendige vleeskleur van kroten. Haar beoordeling bij rassenvergelijking en selectiewerk.
15. **Andeweg, J. M.** Veredelingsdoeleinden en -resultaten bij de tomaat. September 1949 . . . . f 0,20
16. **Hubbeling, N.** Veredelingsdoeleinden bij slabonen. September 1949 . . . . f 0,20
17. Algemene Veredelingsdagen 1949. Verslag van voordrachten en discussies. Mei 1950 . . . . f 1,40
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19. **Banga, O.** Krotenstudies. September 1950 . . . f 1,50
    VI. De invloed van het loof op de groeisnelheid van de knol.
    VII. Classificatie van platte en ronde kroten naar knolindex, niveau van loofprestatie en groeisnelheid.
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21. **Banga, O.** Krotenstudies. November 1950. VIII. Veredelingsmethodiek bij de rode biet . . . . f 0,25
22. **Kronenberg, H. G.** Teelt en veredeling van fruitgewassen in Zwitserland. December 1950 . . . . . . f 0,25
23. **Banga, O. en J. Sneep.** Veredeling van tuinbouwgewassen in Denemarken. December 1950 . . . . f 0,25
24. **Floor, J.** Het enten van noten. Januari 1951 . . . f 0,35
25. **Floor, J.** De vermeerdering van onderstammen voor fruitgewassen. Augustus 1951 . . . . f 0,75
26. **Banga, O.** Bescherming van de kwekerseigendom. September 1951 . . . . f 0,40
27. **Sneep, J.** Selectie op het juiste tijdstip. Sept. 1951 f 0,35
28. **Floor, J.** Onderstammenonderzoek. Sept. 1951 f 0,40
29. **Gerritsen, C. J.** Walnotenteelt. September 1951 f 0,35
30. **Kronenberg, H. G.** (I.V.T.) en **H. J. de Fluiter** (I.P.O.). Resistentie van frambozen tegen de grote frambozenluis Amphorophora rubi Kalt. October 1951 f 0,40
31. **Sneep, J.** De betekenis van de andromonoecische planten voor de veredeling van Asparagus officinalis L. November 1951 . . . . f 0,35
32. Algemene Veredelingsdagen 1951. Verslag van voordrachten en discussies. Maart 1952 . . . . Uitverkocht
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34. **Sonnaville, P. de.** De mirabellenteelt. April 1952. f 0,40
35. **Kronenberg, Hester G.** Nieuwe aardbeirassen in West-Europa. Juni 1952 . . . . Uitverkocht
36. **Hofstra, R.** en **M. Keuls.** Onderzoek naar de opbrengst van nicotine van Nicotiana rustica (L.) over de jaren 1949–1950. Juli 1952 . . . . Uitverkocht
37. **Banga, O.** en **M. Keuls.** Practijkproeven wortelen Amsterdamse Bak 1949–1950. Juli 1952 . . . Uitverkocht
38. **Banga, O.** en **M. Keuls.** Practijkproeven zomerwortelen 1949–1950. Juli 1952 . . . . Uitverkocht
39. **Kronenberg, H. G.** Veredelingswerk met de aardbei op het I.V.T. October 1952 . . . . Uitverkocht
40. **Floor, J.** Proeven met vermeerdering door entstekken. October 1952 . . . . Uitverkocht
41. **Banga, O.** Some factors in the growth rate of red garden beets. November 1952 . . . . f 0,45
42. **Sneep, J.** Practijkproeven met Westlandse Boerenkool 1949–1950 en 1950–1951. December 1952 f 1,—
43. Een bos enthoutjes. Januari 1953 . . . . f 1,35
44. **Banga, O.** Practijkproeven met Ronde Rode Radijs 1951–1952. Februari 1953 . . . . f 0,65
45. **Gerritsen, C. J.** De rassenkeuze bij de Walnoot. Maart 1953 . . . . f 1,15
46. **Kronenberg, H. G.** De veredeling van Klein-Fruit in de Ver. Staten van Amerika . . . . f 0,65
47. **Banga, O.** en **M. Keuls.** Practijkproeven met Berlikumer Wortel 1949. April 1953 . . . . f 0,65
48. **Gerritsen, C. J.** Welke kersen moeten we planten. April 1953 . . . . f 0,45
49. **Banga, O., M. Keuls** en **M. Wattel.** Practijkproeven met Flakkeese Winterwortel 1950–1951. Mei 1953 . . . . f 0,90
50. Algemene Veredelingsdagen 1952. Verslag van voordrachten en discussies. Juni 1953 . . . . . . f 1,50
51. **Sneep, J.** Practijkproeven met Spitskool 1949–1950 en 1950–1951. Juli 1953 . . . . f 0,65
52. **Boom, B. K.** Internationaal reglement voor de naamgeving van gekweekte planten . . . . f 0,75
53. **Kronenberg, H. G.** en **F. Garretsen.** Opbrengstproeven met aardbeiklonen. November 1953 . . . . f 0,35
54. Veredelingsdag Groentegewassen 1953. Verslag van voordrachten en discussies. December 1953 . . f 1,—
55. **Floor, J.** Planten in plastic. Januari 1954 . . Uitverkocht
56. **Banga, O.** Taproot-problems in the breeding of root vegetables . . . . f 0,25
57. **Jensma, J. R.** en **A. Kraai.** Practijkproeven met Rode Kool 1950–1951. Juni 1954 . . . . f 1,10
58. **Jensma, J. R.** en **A. Kraai.** Practijkproeven met Spruitkool 1950–1951. Juli 1954 . . . . f 0,85
59. Veredelingsdag Fruitgewassen 1954. Verslag van voordrachten en discussies. Augustus 1954 . . . . . . f 0,95
60. **Kraai, A.** The use of Honey-bees and Bumble-bees in breeding work. September 1954 . . . . f 0.45
61. **Jensma, J. R.** en **A. Kraai.** Practijkproeven met Witte Kool 1952–1953. Februari 1955 . . . . f 1,35
62. **Banga, O.** en **J. W. de Bruyn.** Selection of Carrots for Carotene Content. Februari 1955 . . . . f 0,25
63. **Kronenberg, H. G.** en **L. M. Wassenaar.** Practijkproeven met aardbeirassen 1952–1954. April 1955 . f 0,90
64. **Keuls, M. and J. W. Sieben.** Two statistical problems in plant selection. April 1955 . . . . f 0,35
65. **Banga, O.** The Institute of Horticultural Plant Breeding. April 1955 . . . . f 0,25
66. **Banga, O.** Uienveredeling met gebruikmaking van inteelt en herstel door heterosis. Juni 1955 . . . . f 0,30
67. **Banga, O.** Carrot yield analysis. September 1955 . f 0,30
68. **Banga, O., J. W. de Bruyn** and **L. Smeets.** Selection of carrots for carotene content. II Sub-normal content at low temperature. September 1955 . . . . f 0,25
69. **Braak, J. P.** Effect of temperature and light on June Yellows in strawberries. September 1955 . . . . . . f 0,25

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18- 1-'50. Uitslag Practijkproeven Tomaten 1948–1949.
10- 3-'50. Uitslag Practijkproeven Wortel Berlikumer 1949.
4-10-'50. Uitslag Practijkproeven Tuinbonen 1949–1950.
29-11-'50. Uitslag Practijkproeven Bak- en Zomerwortelen 1949–1950.
29-11-'50. Uitslag Practijkproeven Platronde en Ronde Kroten 1949–1950.
12-12-'50. Uitslag Practijkproeven Pronkbonen 1950.
21- 3-'51. Uitslag Practijkproeven Westlandse Boerenkool 1949–1950.
3- 9-'51. Uitslag Practijkproeven Spitskool 1950–1951.
7-12-'51. Uitslag Practijkproeven Flakkeese Winterwortel 1950–1951.
23- 1-'52. Uitslag Practijkproeven Vroege en Herfst Rodekool 1950–1951.
31- 3-'52. Uitslag Practijkproeven Spruitkool 1950–1951.
4-11-'52. Uitslag Practijkproeven Ronde Rode Radijs 1951–1952.
4-11-'52. Uitslag Practijkproeven Vroege Rijspeulen 1951–1952.
25-11-'52. Uitslag Practijkproeven Lange Kroten 1951–1952.
23- 1-'53. Uitslag Practijkproeven Radijs Ronde Scharlakenrode Extra Kortloof 1951–1952.
13- 5-'53. Uitslag Practijkproeven Bewaar Rode Kool 1951–1952.
10- 9-'53. Uitslag Practijkproeven Vroege Witte Kool 1952–1953.
18-12-'53. Uitslag Practijkproeven Herfst Witte Kool 1952–1953.
3- 6-'54. Uitslag Practijkproeven Bewaar Witte Kool 1952–1953.
17-11-'54. Uitslag Practijkproeven Stoksnijbonen 1953–1954.
2-12-'54 Uitslag Practijkproeven Ronde Rode Witpunt Radijs 1953–1954.
12- 2-'55. Uitslag Practijkproeven Knolselderij 1953–1954.
1- 9-'55. Uitslag Practijkproeven Vroege Groene Savoye Kool 1954-1955.

(Zijn geplaatst in diverse tuinbouwbladen.)

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Tweede Beschrijvende Rassenlijst voor Populieren, Wilgen en Iepen, 1947. Redacteur Prof. Dr G. Houtzagers . . f 0,50

Achtste Beschrijvende Rassenlijst voor Groentegewassen. 1955. Redacteur Dr O. Banga 75

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Jaarverslag 1950. 1 (1951) . . . . Uitverkocht
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PUBLICATIES VAN HET INSTITUUT VOOR DE VEREDELING VAN TUINBOUWGEWASSEN IN ANDERE ORGANEN OF IN BOEKVORM EVENTUEEL IN SAMENWERKING MET ANDERE INSTELLINGEN [2]

De publicaties, waarvan prijs èn uitgever worden vermeld zijn verkrijgbaar in de boekhandel. Overigens wende men zich tot de opgegeven bronnen of tot de Bibliotheek van het I.V.T.

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[1] Zolang de voorraad strekt kunnen deze publicatie franco worden toegezonden, na ontvangst van het vermelde bedrag op giro no. 425340 van het Instituut voor de Veredeling van Tuinbouwgewassen, S. L. Mansholtlaan 15 te Wageningen onder vermelding van wat verlangd wordt; ook bestaat de mogelijkheid deze publicaties uit de bibliotheek van het I.V.T. te lenen.
[2] Eerder verschenen publicaties zijn vermeld achterin in de Mededelingen nos 1 t/m 65 en in de jaarverslagen van het I.V.T.

ERRATA

De prijs van de hiernaast vermelde Achtste Rassenlijst voor Groentegewassen bedraagt f 1,75.
In plaats van 1955 leze men 1956.