PROTOCOL FOR THE EXAMINATION OF VALUE FOR CULTIVATION AND USE OF

CHICORY VARIETIES

In The Netherlands

2025

Raad voor plantenrassen
(Rvp: Plant Variety Board)

Commissie Samenstelling Aanbevelende Rassenlijst **(CSAR: Recommended List Committee)**

February 2025

Contents

1. Introduction

This protocol sets out the procedures to be used for the examination of the Value for Cultivation and Use (VCU) of chicory varieties in the Netherlands.

VCU testing of chicory varieties comprises regional yield trials, consisting of a two-year trial period (NL1 and NL2) for varieties to be included in the National List followed by a third year of testing (RL3) for varieties to be included in the Recommended List.

This protocol is based on the assumption of sufficient basic knowledge of the trial techniques and the husbandry and processing of chicory. Commonly used methods and treatments and techniques are not explicitly described. Unless otherwise indicated it is assumed that the agronomy should follow the best local practice of an average Dutch arable farm.

After NL2, the *Raad voor plantenrassen* (Rvp; Plant Variety Board) decides whether or not the variety can be included in the National List. Varieties included on the National List are approved for marketing.

After RL3, the *Commissie Samenstelling Aanbevelende Rassenlijst* (CSAR; Recommended List Committee) decides whether or not the variety can be included and classified on the Recommended List.

See the annex for contact details.

2. Trial seed

Coated or uncoated seed is required for all varieties. The seed must comply with the minimum standards for germination rate. The required quantity of seed is established by the Trials Coordinator. In 2024 the required quantity of seed was 350 gram.

In the first year of testing, DUS (Distinctness, Uniformity and Stability) and VCU is based on the same sample originating from the same seed lot. The seed to be used for VCU should be supplied by the applicant of the variety (or his representative) to the VCU Trials Operator. The seed to be used for DUS testing is supplied to Naktuinbouw.

In the second and third year of testing the applicant (or his representative) supplies true to type seed to the Trials Operator. The seed of the standard varieties is supplied by the owners of the variety to the Trials Operator.

When coated seed is marketed, the coated seed is taken from certified seed lots (the lot number concerned should be stated). The Trials Operator keeps a minimum of 5 grams of seed in storage, from each seed lot and for a minimum period of three years.

The samples must be received by the Trials Operator before 20 February. If samples are received after this date, the variety may be removed from the VCU.

3. Trial sites and sowing time

Yield trials are sown on four locations which are representative of the growing area. At least one trial on sandy soil. Two trials are sown with a sowing distance within rows of 8 cm (regular). After emergence is decided which one to harvest.

The yield trials should preferably be sown between 31 March and 15 April.

Furthermore, a special bolting resistance trial is to be sown as early as possible, but no later than 10 March, preferably on clay soil. If sowing before 10 March is impossible, this trial will be cancelled.

4. Varieties to be tested

The total number of varieties to be included in the trial is a minimum of 7 and a maximum of 20. The following varieties should be tested:

- All A (generally recommended) and N (newly recommended) varieties on the Recommended List. If a standard variety is withdrawn from further testing, the breeder concerned must report this withdrawal to the Trials Coordinator. The variety concerned will then automatically be classified as a B variety in the Recommended List.
- Varieties that have been submitted for testing to the Trials Coordinator by breeders and other interested parties.

5. Trial design

The yield trials must be planted on fields or part of fields that are as regular as possible. There must be no after-effects of any previous trials and patches of persistent weeds must be avoided. Satellite images of previous growing seasons can be used for the screening of fields or part of fields which remain homogeneous also under dry conditions. Experience of the grower on the field concerned or observations of the examiner in previous growing seasons should also be used. Irrigation must be possible on all trials.

Before sowing, the seedbed must have settled sufficiently. The sowing depth is 0.5-1 cm, depending on the type of seed and the soil structure of the seedbed. The distance between the rows is 45-50 cm (the number of rows must be adapted to the harvesting system). The trial must be surrounded by discard border strips and/or discard plots on either side of the trial.
Preferably, the plots should be cross-drilled to the main direction of cultivation. This stipulation may be deviated from if this hampers the possibility of mechanical weed control or if it creates too much restrictions for the grower. In case there can be overlap of treatments in the net plots there should be discard plots in the zone of overlap.

The Trials Coordinator supplies the trial plans, which will be made available to the VCU Working Group of Chicory after planting.

Yield trials sown at 4-5 cm sowing distance.
The trials are sown in at least three replicates and the net plot area is at minimum of 27 m^2. The sowing distance on sandy soil (within rows) is a maximum of 5 cm. On clay soil, a sowing distance of a maximum of 4 cm must be observed. The same sowing distance (5 cm on sandy soils and 4 cm on clay soils) must be observed in the border strips and/or discard

plots neighbouring the net plots.
After emergence, the seedlings must be thinned to a minimum stand of 150,000 and a maximum of 160,000 plants per hectare. The border strips and/or discard plots neighbouring the net plots are thinned to the same minimum and maximum number of plants.

Yield trials sown at 8 cm rowing distance
The trials are sown in at least four replicates and the net plot area is at minimum of 36 m^2. A sowing distance of 8 cm is required. After emergence is decided which one to harvest.

Bolting trial
The bolting resistance trial is planted on clay soil on a field which can be irrigated if necessary. The trial is sown in three replicates. The Trials Coordinator supplies the trial plan which will also be made available to the VCU Working Group after planting. The plot size is 1 meter wide (2 rows) * 12 meter long (net). The sowing distance within rows is 6 cm. The trial is not thinned after emergence.

6. Trial husbandry and fertilisation

Fertilisation and weed control should follow best local practice for varieties without specific characteristics. Weeds will be controlled in time, which needs to be continued during the growing season. Please refer to the chicory cultivation manual of Sensus (chicory industry). Irrigation should be possible on all trials. The trial is irrigated if necessary to safeguard the validity of the trial. If the trial is irrigated to stimulate emergence crust formation should be avoided and emerged plants should not be damaged by irrigation.

7. Observations during the growing season

In addition to keeping cultivation records, the Trial Operator observes the following characteristics:

- Plant emergence
- Earliness of ground cover
- Bolting resistance
- Susceptibility to foliar diseases or foliar infections

7.1. Plant emergence

Emergence is determined by counting the number of seedlings in three rows of three metres per plot immediately before thinning. Emergence is expressed as a percentage of the number of seeds sown.

In addition to emergence, the plant population and uniformity of the plots is scored, by counting the number of plants per plot after thinning and the number of bare patches in a row measuring 0.5 linear metres or more. The size of the bare patches is also recorded. A regular visit of the VCU Working Group of Chicory to the trial is organised in June.

If problems are observed with the plant population, a decision will be taken by the Working Group during this visit regarding continuation of the trial.

7.2. Earliness of ground cover

Although the weed suppressant capacity of a variety is determined by both early and late ground cover, the early ground cover only is observed.
Early ground cover is established at the moment that the leaf canopy is almost closed between the rows. The observations must be scored on a scale of 1-9 (1 representing the poorest cover and 9 the best cover).

7.3. Bolting resistance

Bolting resistance is established by noting the number of bolters per plot.
A bolting sensitive variety is included in the bolting resistance trial as a reference variety.

- Early July the number of bolters is counted and removed in all yield trials and in the bolting resistance trial.
- Early August a second counting and removal of bolters is done in the bolting resistance trial.
- Bolters are not removed from the yield trials anymore after early July.
- The number of bolters in the yield trials are counted per plot just before harvest.
- The number of bolters per plot in the bolting resistance trial is counted for a third time at the end of October.

If sufficient difference is observed between the varieties, the average bolting resistance in the yield trials and the bolting resistance in the special bolting resistance trial each account for 50% of the final score for bolting resistance. A high score represents a good level of bolting resistance.

7.4. Susceptibility to mildew, *Alternaria* and any other foliar diseases or leaf damages

Foliar diseases, leaf damage and any nutrient deficiencies are only observed in the event of a clearly visible infection or deficiency and if differences between the varieties are noticeable. The infection is expressed on a scale of 1-9 (9 representing uninfected / undamaged leaves). If the trial is treated using a fungicide, an observation for any foliar diseases must be performed prior to treatment.

8. Harvest

The yield trials are preferably harvested mechanically in October. Harvesting should take place in accordance with best local practice so as to avoid lifting losses, top losses and damaged root tips. At trials sown at 4-5 cm sowing distance the net harvested area per plot is a minimum of 20 m^2. At trials sown at 8 cm sowing distance the net harvested area per plot is a minimum of 27 m^2.

9. Post-harvest observations

9.1. Gross and net root yield

The gross root yield is determined in the field, immediately after harvest. Three samples of 20 kg are taken from the gross yield and (depending on the trial conditions - to be determined by the Trial Operator) sent to a laboratory for determination of the net root yield (i.e. gross yield minus tare) and to determine the inulin content.

9.2. Tare

The total tare percentage is determined. Tare comprises all types of contamination, such as soil, loose leaf residues and rotten roots. The (green) top of the root is not removed. The percentage of rotten roots is determined at harvest. This percentage is reported.

9.3. Root shape and root rot

If the shape of the root is clearly abnormal and this abnormality is such that it influences the lifting losses (e.g. more or less broken root tips, sieve throughput, branching, etc.), this is noted so it can be mentioned in the variety recommendation. If root rot is occurs, the differences between the varieties are to be observed. The amount of root rot is scored in a scale from 1-9 (9 is uninfected).

9.4. Inulin content determination

The inulin content is determined based on Brix measurement, as established in the general terms of delivery agreed between Sensus and the Growers' Association.
The inulin content is determined based on refractometric measurement of the Brix (i.e. the total quantity of soluble dry matter) and is expressed in the inulin value. Parallel research performed by Sensus has revealed a strong correlation between the Brix value and the inulin value. Based on this correlation, a conversion factor has been established to convert the Brix value into an inulin value. The correlation is checked daily during the harvest period.

A rotary drum cutter (Venema Automation) is used to prepare the brei (pulp) samples. Random cuts are made in the root samples. The cuttings (brei) are collected and homogenised. The representativeness and homogeneity of the brei sample is monitored using random checks, whereby a limited margin of error is permitted between successive determinations (8) of the same sample.
The methods of preparing brei samples are also described in the regulations of the Dutch sugar industry: "Uniform method for weight determination, sampling and sample testing of sugar beet in the Netherlands".

Current practice in VCU:
The root samples collected in the field trials are analysed per plot based on the standard regulations. Random sub-samples are cut from the root samples in a Venema rotary drum cutter. These sub-samples are homogenised to create a pulp (brei). A robot is used to scrape a sufficient quantity of brei onto a filter paper. This brei is pressed, and the resulting juice is collected and fed into a refractometer. The refractometer measures the Brix value whereby an automatic temperature correction takes place. Based on the correlation mentioned above, the Brix value is converted into an inulin value.

10. Reporting

At the end of November, a minimum of the following characteristics are reported to the partners who are financially supporting the VCU-testing of new chicory varieties:

- emergence (before the meeting of the VCU Working Group in June)
- earliness of ground cover (if possible before 1 August)
- infection by foliar diseases
- number of plants in the bolting resistance trial.
- bolting resistance
- soil tare
- rotten roots
- net root yield
- inulin value
- inulin yield = net root yield * inulin value.

Multi-year averages will be released for publication as far as possible before 1 December. If additional (quality) characteristics are determined by Sensus, they will be reported before the annual breeder's meetings.

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