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Investigation concerning clone selection of trees and shrubs used for ornamental and landscaping purposes

Undersøgelser vedrørende klonselektion af træer og buske til anvendelse som landskabsplanter

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Summary

Clone selection in trees and shrubs is necessary because the cultivated plant material is often a mixture of clones and not a defined material, with known growing characteristics. The aim is to obtain a defined genetic (DG) material, with good growing characteristics.

The methods used for clone selection include studying the plant material grown in nurseries, parks and botanic gardens, before collection.

The first selection in the plants, can sometimes be made when collected.

The plants collected will be clones or possibly seed plants.

The collected plants will be preliminary tested and selected before the final test and selection.

The plant material for the final test is propagated from cuttings from one plant thereby ensuring that it is as uniform as possible.

The final test is carried out as a clone test in the field, usually at 2 climatically different places, and with a minimum of 9 plants placed in 3 plots of each clone.

The climatic tolerance, resistance to disease, and the characteristics which are important to the function in landscaping are registered.

The research is closed with a selection of the most valuable clones for cultivation. A nuclear stock plant is established of each selected clone.

The clones are given a new cultivar name, if they cannot be identified as one of the existing cultivar.

Plants, which are produced from the nuclear plants are offered to the nurseries as stockplants.

Key words: Clone selection, trees and shrubs, ornamentals, distribution.

Resumé

Begrundelsen for at udføre klon selektion i træer og buske er, at de dyrkede sorter hyppigt er en blanding af kloner, og ikke er et defineret materiale med kendte dyrkningsegenskaber.

Formålet er at få et defineret genetisk (DG) materiale, med kendte, definerede dyrkningsegenskaber.

Metoden for den anvendte klon selektion omfatter studier af plantematerialet i planteskoler, anlæg og botaniske samlinger, før indsamling til forsøg foretages.

De indsamlede planter er normalt kloner, til tider frøplanter.

Det indsamlede materiale gennemgår en foreløbig afprøvning og selektion, før det afsluttende forsøg udføres med henblik på en selektion.

Plantematerialet til forsøgene formeres vegetativt fra 1 plante for at opnå ensartethed i alder og standard.

Forsøgene udføres som klonforsøg på friland, oftest ved 2 klimatisk forskellige forsøgssteder. Der anvendes for hver klon et minimum på 9 planter fordelt på 3 fællesparceller.

Registrering er udført af egenskaber som klimatolerance og modstandsdygtighed mod sygdomme, kombineret med de dyrkningsegenskaber, der stilles til de pågældende landskabsplanter.

Ved forsøgenes afslutning udvælges de bedste kloner til bestemte funktioner, og der etableres en kerneplante.

Hvis de udvalgte kloner ikke kan identificeres, får de et nyt sortsnavn.

Moderplanter, der er produceret på basis af kerneplanten, udbydes til producenterne.

Nøgleord: Klonforsøg, metode, klonselektion, træer og buske, landskabsplanter.

Introduction

Studies in nurseries, botanical collections and parks have shown, that the cultivated trees and shrubs for landscaping are very variable, within species (*Brander,* 1981), and within the single cultivar (*Brander,* 1980, and *Anon.,* 1971).

A project started in 1965 proved that many cultivars vary from nursery to nursery, each nursery has its own clone or a mixture of clones, (*Anon.,* 1971, and *Brander,* 1970).

In other cases, clones are cultivated under a species name (*Brander,* 1978 and 1979).

The variation within a cultivar can include all kinds of characteristics such as rapidity and habit of growth, hardiness, abundance of flower, flower colour and resistance to disease.

The aim of clone selection, is to obtain uniform and a well defined cultivar, based on one clone.

The most valuable clones are selected based primarily on their growing value, incorporating characteristics, such as tolerance to climatic conditions, especially winter hardiness and wind tolerance, resistance to disease, outer appearance, e.g. growing habit, leaf density, abundance of flowers and fruits.

Similar work on test and selection has been made in other countries which indicates that the same problems also exist elsewhere.

In Norway some work has been done on shrubs. *Bjerkestrand* (1969) reports on selection of the cultivar 'Aas' in *Philadelphus coronarius.*

In Sweden similar work has been started recently, but yet not published.

In The Netherlands much work on trials of ornamentals has been made by the Proefstation Boskoop, but selection of clones has rarely been made from the trials. A report on this work, is given in the yearbooks from Boskoop.

In The United Kingdom clonal selection has been made with fruit trees, root stocks and recently work has been started on ornamental trees and shrubs. *Campbell* and *Goodall* (1980) report on the work carried out and *Humphrey* (1980) reports about the clonal selection scheme.

The same problems also exist in other plants, *Christensen* (1976) reports on the cherry 'Stevnsbær'. *Bech,* (1982) reports on the same problems in pot plants.

The selections made in connection to hybridization is not considered in this publication.

Apart from the above mentioned work, many publications indicate, that much plant material is grown as clones, but only with a species name, such as plants for shelter, as reported by *Olsen* (1976) for *Spiraea* × *vanhouttei* and *Philadelphus coronarius,* which are clones.

Similar problems are described for many other plants by *Brander* (1978 and 1979).

Methods

Suggestions for a trial and test can be proposed by private persons, institutes and associations of growers and landscapers.

The suggestions can be made to The Institute of Landscaping Plants, or to The Plant Control Commission. This commission has to co-ordinate all official work within horticulture for healthy and genetically sound plant material.

The clone selection work is done in collaboration with The Committee for Clone Source, (Klonkildeudvalget), which has representatives from nurseries, landscapers, education, advisory service, plant pathologists and plant protection service.

The committee discusses all problems which arise in connection with planning the clone selection work, and the best use of the results.

The highest priority is given to long living plants, and plants, which have a special purpose such as use for shelters, hedges, street trees, ground-cover, and are given higher priority than plants used as flowering elements in the private garden.

Before collecting plant material, studies are made in botanical collections, parks and in nurseries.

This gives some knowledge of the variation and the possibilities of obtaining a positive result through a clone selection.

In Fig. 1 a scheme shows the methods, from the first suggestion for a trial, to the final selection.

The collection of plants is made mainly from Danish nurseries, but supplemented with cultivars and clones from other countries, e.g. *Forsythia*.

In plant groups, where much breeding and selection has been done in a plant species, a collection of material from botanic gardens will only be of little value, e.g. *Forsythia*.

On the other hand, if no or only little breeding work has been done, a collection of material from botanical collections can be of great value, e.g. *Ribes alpinum* (Table 2).

In these cases the cultivated material is very variable, with many different clones, and collections made by the research staff directly in the nursery and plant collections can be of great value, as the first selection can often then be made in the nursery, on difference in disease and climatic tolerance, e.g. *Pyracantha coccinea*.

In other cases, plants are collected, by asking the nurseries to send plants of the cultivar or clone, which they cultivate, e.g. *Lonicera tatarica*.

2–3 plants of each cultivar, sample or clone are requested from each nursery. Each collected plant is treated as a clone.

The conclusion is, that the method of collecting material for the clone test, will vary from one plant group to another, depending on the problem to be solved.

Preliminary test

In many cases a preliminary test can be of value as it may reduce the number of clones. The final test, can then be improved with further data.

The preliminary tests are made on the 2–3 plants of each cultivar, sample or clone, which are collected from the nursery or the plant collection.

The registering and the selection must be made on characteristics fundamental for growing and which are easy to register.

Such characteristics are mainly the winter hardiness, resistance to disease, and abundance of flowers.

The best clone or clones of each cultivar or sample are selected for further tests.

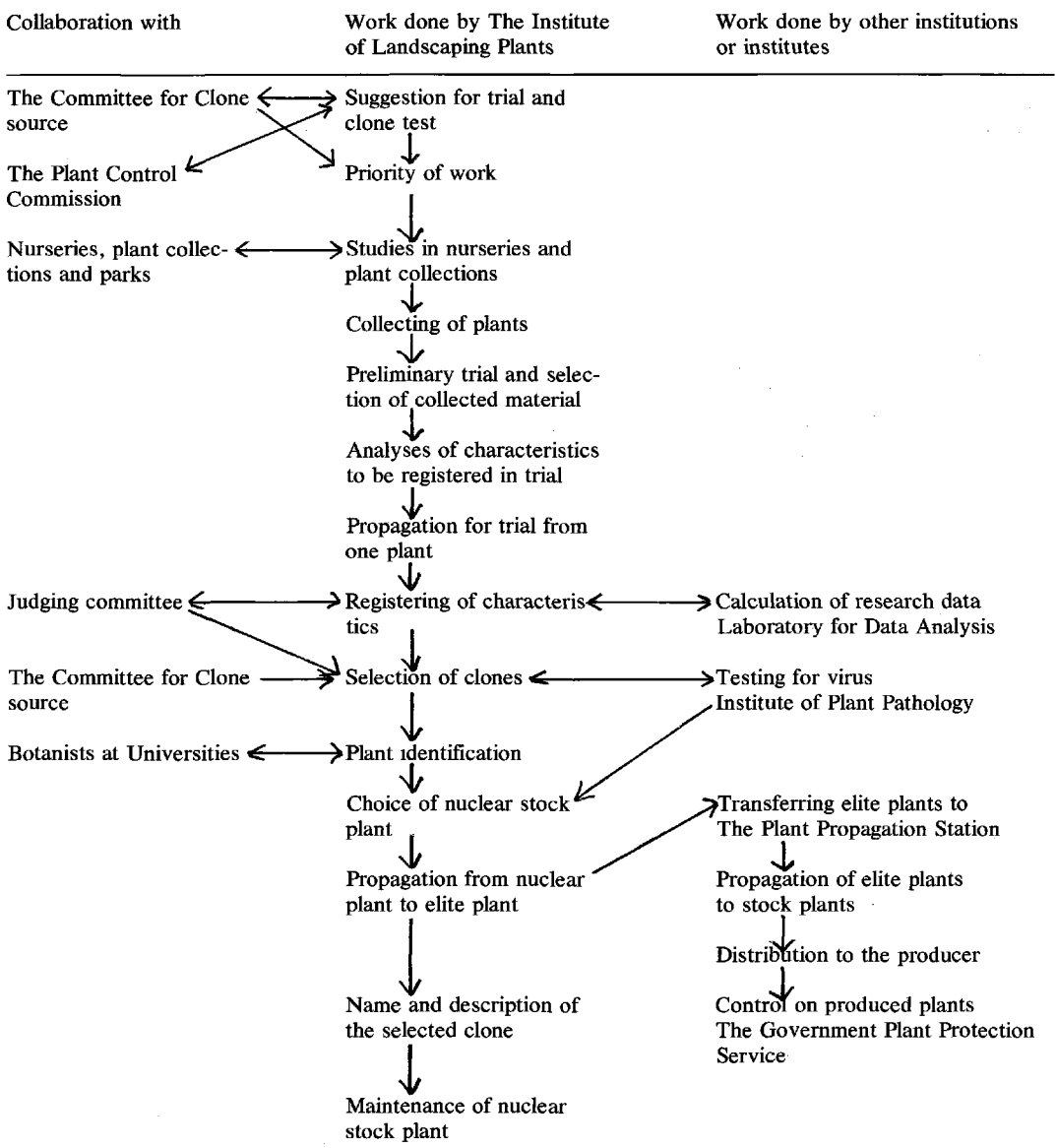
As listed in Table 2, the number of clones is reduced in the preliminary test to half or less, in the mentioned test.

The reduction may be due to, some of the collected clones being very similar to each other, as for *Forsythia*.

In other cases, the number of clones are reduced, with selection of the most healthy ones, as for *Ribes alpinum*, or the most hardy in winter as for *Euonymus fortunei* 'Vegetus'.

The preliminary test is also made in order to obtain further knowledge, so the final test can be carried out in the most satisfactory way.

Fig. 1. Clone selection scheme



Final test

The plant material for the final test has been propagated by cuttings at the same time and by the same method, in order to get the material as uniform as possible for the test.

The propagation material comes from one plant.

In order to test the plant material for the growing value, the trial must be carried out in the field, under natural climatic conditions.

Table 1. Registering in different trials
Registrering i forsøg

Registered characteristics Registrerede egenskaber			*Cotoneaster*	*Euonymus*	*Forsythia*	*Hypericum*	*Lonicera*	*Pyracantha*	*Ribes alpinum*
1.1	Winterhardiness	Overvintring S P	X	X	X	X	X	X	X
1.2	Scorch of leaves in winter	Svidning S P	X	X				X	
2.1	General health	Sundhed – helhed SJP		X	X	X	X	X	X
2.2	Leaf-health	Sundhed – bladpletter S P	X	X	X	X	X	X	X
2.3	Shoot-health	Sundhed – skud S P	X		X		X	X	X
3.1	General impression	Alm. Indtryk J P	X	X	X	X	X	X	X
4.1	Growth habit	Vækstform J P	X	X	X	X	X	X	X
4.2	Branching system	Grenbygning J P			X			X	X
4.3	Density of branches	Grentæthed J P				X	X	X	X
4.4	Branch stiffness	Grenstivhed J P				X		X	X
5.1	Leaf density	Løvmængde J P	X	X	X	X	X	X	X
5.2	Leaf appearance	Løvudseende J P	X	X	X	X	X	X	X
6.1	Leafing	Løvspring S D	X		X		X		X
6.2	Leaf-fall	Løvfald S D	X		X		X		X
7.1	Height of plants	Vækshøjde P M	X	X	X	X	X	X	X
7.2	Width of plants	Vækstbredde P M		X	X		X	X	X
8.1	Ground cover ability	Jorddækningsevne J P	X	X				X	X
9.1	Abundance of flowers	Blomsterrigdom J P	X		X	X	X	X	
10.1	Start of flowering	Blomst udspring S D	X		X	X	X	X	
10.2	End of flowering	Afblomstring S D	X		X	X	X	X	
11.1	Placing of flower	Blomstens placering J P			X	X	X		
11.2	Appearance of flower	Blomstens helhed J P					X		
11.3	Flower form	Blomstens velformethed J P			X	X			
11.4	Flower colour	Blomstens farve J P			X	X	X		
11.5	Flower fragrance	Blomstens duft J P					X		
11.6	Texture of flower	Blomstens textur J P			X				

(to be continued – fortsættes)

(continued – fortsat)

Table 1. Registering in different trials
Registrering i forsøg

Registered characteristics Registrerede egenskaber			*Cotoneaster*	*Euonymus*	*Forsythia*	*Hypericum*	*Lonicera*	*Pyracantha*	*Ribes alpinum*
12.1 Abundance of fruit	Frugtrigdom	J P	X	X		X	X	X	X
13.1 Appearance of fruit	Frugt, helhed	J P	X			X	X	X	
13.2 Placing of fruit	Frugt, placering	J P	X				X	X	X
13.3 Colour of fruit	Frugtfarve	J P	X					X	
14.1 Colouring of fruit	Frugtfarvning	S D	X			X	X	X	
14.2 Fruit fall	Frugtfald	S D	X			X	X	X	

Explanation to table:
Forklaring til tabel:

X = Registered in trial
X = Registreret i forsøg
S = Registered by staff at the institute
S = Registreret af instituttets personale
J = Registered by a judging committee
J = Registreret af en dommerkomité
M = Registered as measurement
M = Registreret som målinger
P = Registered on a point scale from 1–10
P = Registreret på en point skala fra 1–10
D = Registered as a weekly date
D = Registreret ugentlig med en dato

From each clone, a minimum of 9 plants is used placed in a minimum of 3 plots, and at 1–4 different geographical places i Denmark.

The number of plants used, the plots and research places for the trials carried out, are shown in Table 2.

The trials are carried out over a period of 5–15 years, depending on the genus, and the characteristics to be registered.

In the test period no pruning is done, except of dead shoots.

No spraying with chemicals against diseases is carried out, as one of the aims is to register the difference in disease resistance.

Owing to heavy attack of lice spraying with pesticides has been used in a few cases.

Registering and calculation

The growing value is registered on the different characteristics, listed in Table 1.

The method is similar to the one used in variety trials with roses, described by *Brander* (1971 and 1974).

Many characteristics can only be registered, by the means of point, and a scale has been used from 1–10, where 10 expresses the best as concerning growing value, and 1 the worst.

The registering of climate tolerance is made on a permanent optimum and minimum scale, as for wintering, where no damage means 10, and 1 means dead plants.

The same method is used for registering of resistance to disease, where 10 means no attack, and 1, total attack.

Table 2. Method used with the clone selection work
Anvendt metode ved klonudvælgelse

Species/cultivar in test Art/sort i forsøg	Collecting of plants Indsamling af planter				Clone test and selection Klonforsøg og selektion							
	1	2	3		4			5	6	7	8	9
			Number of samples from		Number of clones							
			3.1	3.2	4.1	4.2	4.3					
	Plants sent by grower	Selection made by collection	Nurseries	Plant collections and parks	Preliminary test	Final test	Final selection	Number of plots	Plants in each plot	Number of geographical different test places	Test in the shadow of trees	Test period
Cotoneaster horizontalis	x	x	14	5	51	19	1	3	3	1	x	1976–82
Euonymus fortunei 'Vegetus'	x	x	20	5	23	11	–[1])	5	2	2	–	1974–
Forsythia 'Arnold Giant'	x	–	1	1	4	2	0	8	1–3	4	–	1967–75
Forsythia 'Spectabilis'	x	–	1	1	4	2	0	8	1–3	4	–	1967–75
Forsythia 'Lynwood'	x	–	1	1	4	2	1	8	1–3	4	–	1967–75
Forsythia 'Spring Glory'	x	–	3	0	6	3	0	8	1–3	4	–	1967–75
Lonicera tatarica 'Alba'	x	–	4	0	8	4	1	5	2	1	x	1969–82
Lonicera tatarica 'Rosea'	x	–	4	0	8	4	0	5	2	1	x	1969–82
Lonicera ledebourii	x	x	3	3	14	4	1	5	2	1	x	1969–82
Pyracantha coccinea	x	x	22	9	52	23	2	6	2	2	–	1969–78
Ribes alpinum	x	x	12	12	64	21	2	5	3–2	1	x	1971–80

Explanation (Table 2):
x = The method used = Anvendte metode.
– = The method not used = Ikke anvendte metode.
Samples = The group of plants collected in one nursery or in a plant collection = Gruppe af planter indsamlet i en virksomhed.

Tabeltekst:
1 Planter indsendt af planteskole
2 Selektion foretaget ved indsamling
3 Antal indsamlinger
3.1 Fra planteskoler
3.2 Fra plantesamlinger og anlæg
4 Antal kloner
4.1 Foreløbige forsøg
4.2 Afsluttende forsøg
4.3 Afsluttende selektion
5 Antal fællesparceller
6 Antal planter pr. parcel
7 Antal forsøgssteder
8 Afprøvet i skygge
9 Afprøvningsperiode
[1]) No selection made yet = ingen selektion foretaget endnu.

For many other registered characteristics there is no permanent optimum and minimum scale. It is set for each trial and each judgement, e.g. the highest abundance of flowering gets 10 points, and the lowest flowering gets 1.

The methods for estimating when registering by means of a point scale in research, are described by *Hammarlund* (1969).

Which characteristics are registered by a point scale and which in other ways, can be seen in Table 1.

The time of flowering, leaf fall and so on, are registered once a week.

Registering of some characteristics is made by a judging committee of 6–10 persons. They meet once or twice a year, once in the flowering period, and once e.g. in the fruit period.

The characteristics they look for can be seen in Table 1.

The registration of important characteristics is made every year, while others such as density of leaves may only be registered 2–3 times in the research period.

The research data, which is collected, with registration of the different growing characteristics, is made to an average mean for each characteristic of the whole research period.

This makes a comparative study of the difference between the clones easier.

An average of the collected data for all characteristics is made to give an all-round value view of all growing characteristics.

This average is called main value figure.

Different weights are put on the different characteristics by calculating the average from all characteristics.

Hardiness and resistance to disease is always given the highest weight.

The methods of making the average are described by *Christensen* and *Brander* (1971) and methods for using different weight are also used in roses, described by *Brander* (1971 and 1974).

Selection of clones

The registered data and the average of this is used as the bases, when decision is made on selecting the most valuable clones.

The data is considered in relation to which function the cultivars are to be used.

Only clones necessary to cover the market will be selected, and due to difference in growing interests such as habit of growth, e.g. *Pyracantha coccinea,* where 2 clones were selected, one for ground cover and one for hedges.

The decision of the selection is made in collaboration with the judging committee and The Committee for Clone source.

In order to cover all kinds of possible functions there may be selected clones with lower value figures than clones which are not selected, due to a different habit – or rate of growth.

Testing for virus and similar diseases

When the clone selection is made, the nuclear stock plant will be tested for virus, and other diseases, which are considered important.

This test is made on a general scheme at The Institute of Plant Pathology, Lyngby.

When a new trial is started, and virus is known to be common in the crop, a joint plan for the genetic test and the pathology test is made.

Nuclear stock plant

From the selected clone a nuclear stock plant is chosen. This plant is to be kept at The Institute of Landscaping Plants, so plant material can always be distributed to the grower from this plant.

As the nuclear stock plant could be damaged or die, 1 or 2 extra stock plants are chosen.

The nuclear stock plant must be kept carefully, and has to be checked for any changes, such as mutations.

In many cases the fruits must be removed before maturity, so they will not produce seeds, which in course will produce new plants which will not be identical to the nuclear stock.

In most cases the nuclear plants can be kept outdoors, but in some cases e.g. with some diseases an isolated place in a greenhouse may be necessary.

Introduction and control of the selected clones

The selected clone must be propagated vegetati-

ve and materials distributed to the grower, so the consumer can obtain plants of the selected clone.

The propagation, from the nuclear stock plant to elite plants, is made at The Institute of Landscaping Plants to The Plant Propagation Station, which is run by The Danish Association of Horticultural Producers.

This Propagation Station takes care of further propagation and distribution of stock plants to the producers.

The Government Plant Protection Service has responsibility for the control, which comprises all plants produced in Denmark.

Plants from the important selected clones are approved and put in a special class.

Further details are given by *Jacobsen* (1981).

Naming and description of the selected clones

The selected clones, can in some cases be identified as a named cultivar, and this name will then be used, possibly with addition of a clone name.

The clone which can not be identified with an existing, described cultivar, is given a new cultivar name.

The selected clones are described by *Brander* (1981).

Results of the clone selection within some genera

The genera and groups, where clone tests have been made, are mentioned in Table 1. This publication is based mainly on the results of these tests.

To illustrate results with the described methods, some are given in tables.

Many of the figures are an average point given over a number of years or a single year.

The point is given in a scale from 1–10, (see also Table 1 and the description given under methods of registration).

Not all registered data is given in the tables, only that which shows clearest the difference between the tested clones.

Only some of the tested clones of a species or a cultivar are mentioned, to illustrate the variation found in the particular group.

Cotoneaster

A trial has been made on clones of species with a low habit of growth. One of the species was *Cotoneaster horizontalis*.

Normally cultivated plants under this name are vegetative propagated, but often only with a species name.

As it can be seen in Table 3, there was a big difference between the tested clones.

A clone with a flat branching system would have been suitable for espalier.

All the clones, with rounded leaves had a bushy

Table 3. *Cotoneaster horizontalis* clones average of point in the period 1972–1977

		cl. 2326	cl. 20	cl. 2324	cl. 80	cl. 39	'Cotali' 2861
Samlet værdital	Main value figures	6.6	6.8	6.6	4.9	6.3	5.7
Overvintring	Winter-hardiness	6.2	6.5	6.3	6.5	7.3	7.1
Sundhed	Health of plants	9.1	8.9	9.3	4.9	7.6	7.8
Blomsterrigdom	Abundance of flowers	10.0	9.7	10.0	4.3	10.0	7.7
Bladform	Leaf form	rounded	rounded	rounded	pointed	pointed	pointed
Plantehøjde	Height of plants	70	100	90	90	100	40
Bredde	Width of plants	290	240	280	275	270	95

habit, and are therefore not suitable for espalier, but as they have been cultivated as *C. horizontalis*. They are included in the table, to illustrate the large variation, within the cultivated clones.

The clones with pointed leaves, had a flatter branching system, and were suitable for espalier.

Clone 80 and 39 was considered to be too vigorous in growth, and clone 80 also had poor health of plant and abundance of flowers.

Because of the above mentioned reasons, clone 2861 was selected and named 'Cotali'.

Euonymus

A test has been made of the evergreen low species of *Euonymus,* of which *E. fortunei* 'Vegetus' is one of the most important cultivar.

As can be seen in Table 4, there is a lot of difference between the collected and tested clones.

There is also a difference in leaf colour from light green to dark green.

No selection has been made yet in *Euonymus,* but considering the big difference between the clones, a selection is needed.

Forsythia

In this test only a few clones were collected of each cultivar, but there was still a big difference within the same cultivars.

No clone selection was made in the cultivars 'Arnold Giant', 'Spectabilis' and 'Spring Glory', because 'Lynwood' in general had a higher growing value, than the other 3 cultivars.

The higher value concerns a larger abundance of flowers than 'Arnold Giant' and 'Spectabilis' cl. 173, and a better habit of growth than 'Spectabilis' cl. 479.

Both clones of 'Spring Glory' had a light yellow flower colour and were for that reason not recommended.

Lonicera, deciduous shrubs

Four clones of plants collected as *Lonicera tatarica* 'Alba' were tested.

The difference between them was great, and none of them could be identified as true 'Alba'.

Clone 1328 differed by a broad habit of growth with arching branches, and was considered unsuitable for growing.

The 3 other clones had an upright habit of growth. Clone 1329 had orange red fruits and a poor habit of growth and was not recommended.

From the two last clones, 188 and 225, the former had the best growing value, and was selected and named 'Lavsas'.

Clones of *L. tatarica* 'Rosea' were also tested, but none of them were recommended. Table 6 shows the results for two clones, to illustrate the difference between the cultivated 'Rosea'.

Four clones of *Lonicera ledebourii* were tested clone 1565 was selected for the best growing value, and it was named 'Vian', described by *Brander* (1981).

Table 4. *Euonymus fortunei* 'Vegetus' clones. Average point 1980

		cl. 4078	cl. 3934	cl. 4035	cl. 4104	cl. 4102	cl. 1793	cl. 3289	cl. 4447	cl. 4478
Overvintring	Winter hardiness	7.1	10.0	2.0	6.4	8.9	9.6	8.2	9.0	9.0
Sundhed	Health of plants	5.7	8.3	3.4	6.0	8.3	8.2	7.1	7.5	7.8
Vækst	Habit of growth	1.7	7.0	1.0	1.7	8.0	5.3	7.1	5.6	7.5
Jorddækningsevne	Ground-cover	1.3	5.4	1.0	1.9	7.1	4.2	7.7	3.5	5.9
Frugtrigdom	Abundance of fruit	3.3	5.4	1.0	2.4	6.5	6.0	1.0	4.7	2.9

Table 5. *Forsythia*. Average point from the years 1969–73

		F. 'Arnold Giant' cl. 473	*F.* 'Arnold Giant' cl. 179	*F.* 'Lynwood' cl. 574	*F.* 'Spectabilis' cl. 479	*F.* 'Spectabilis' cl. 173	*F.* 'Spring Glory' cl. 175	*F.* 'Spring Glory' cl. 575
Samlet værdital	Main value figure	4.6	5.8	7.0	7.0	6.0	6.6	6.3
Overvintring	Winter-hardiness	9.0	9.1	8.5	9.1	9.1	9.1	8.6
Sundhed	Health of plants	5.5	6.9	6.0	7.0	7.2	7.1	6.8
Vækstform	Habit of growth	4.0	5.5	6.4	4.5	6.3	4.3	6.2
Blomsterrigdom	Abundance of flowers	3.1	5.0	6.8	8.6	5.2	7.7	5.2
Blomsterfarve	Flower colour	dark yellow	dark yellow	dark yellow	yellow	yellow	light yellow	light yellow

Table 6. *Lonicera*, deciduous shrubs. Average 1970–1974

		L. tatarica 'Alba' cl. 1329	*L. tatarica* 'Lavsas' cl. 188	*L. tatarica* 'Alba' cl. 225	*L. tatarica* 'Alba' cl. 1328	*L. tatarica* 'Rosea' cl. 186	*L. tatarica* 'Rosea' cl. 226	*L. ledebourii* 'Vian' cl. 1565	*L. ledebourii* cl. 1550	*L. ledebourii* cl. 2873	*L. ledebourii* cl. 4317
Point											
Samlet værdital	Main value figure	7.3	6.5	5.6	7.0	6.1	7.0	7.1	5.6	6.0	3.8
Overvintring	Winter-hardiness	9.7	9.3	9.2	9.1	9.2	9.4	8.8	6.3	8.3	8.0
Sundhed	Health of plants	6.0	4.8	4.2	5.8	5.6	5.6	8.5	7.9	7.5	6.6
Blomsterrigdom	Abundance of flowers	8.2	8.8	6.4	7.1	5.7	8.4	5.8	3.4	3.6	1.8
Frugtrigdom	Abundance of fruit	3.5	3.9	3.2	5.9	5.6	6.6	3.5	4.2	3.6	1.5
Measurements											
Antal blomsterdage	Number of flowering days	46	34	24	36	41	52	51	56	50	29
Frugtfarve	Colour of fruit	orange red	red	red	red	red	orange red	black	black	black	black
Højde (1974)	Height of plants	280	300	290	265	200	270	250	130	200	90

Pyracantha

Table 2 shows the number of clones tested. Results for 6 clones are given in Table 7, and they show a big difference in many characteristics. The health of plants, is mainly due to the difference in resistance to scab (*Fusicladium pyracanthae*).

Two clones were selected, one was named 'Beral' and one 'Lani'.

'Beral' was selected for use as ground cover, and 'Lani' as a hedge plant.

The two selected clones had good main value figure, good winter-hardiness and health of plants, compared to the other tested clones.

Table 7. *Pyracantha coccinea* clones. Average point from the years 1970–1972

		cl. 233	cl. 1614	'Beral' cl. 1618	'Kasan' cl. 2431	'Kasan' cl. 1204	'Lani' cl. 1781
Samlet værdital	Main value figure	4.8	4.8	7.8	3.1	4.9	7.5
Overvintring	Winter-hardiness	9.0	8.6	9.4	3.9	8.6	8.2
Sundhed	Health of plants	3.8	3.4	7.5	4.7	3.4	9.5
Frugtrigdom	Abundance of fruit	3.7	3.7	4.2	1.1	3.6	3.0
Jorddækningsevne	Ground cover	4.3	3.7	9.9	2.1	4.6	6.6

Ribes alpinum

Ribes alpinum has often been propagated from seed in nurseries. Table 2 shows the number of clones, which have been tested.

When clones have been cultivated in nurseries, it is mostly done under a species name, as for seed propagated plants.

Only one clone 'Rudolf Smidt', was collected under a cultivar name, and one was collected under a similar name »Smidt type«, but as it can be seen in Table 8, the two clones, had different growing values.

As in the other clone test a big difference is also registered here between the tested clones.

One of the difference is the health of plants, which mainly is due to difference in resistance to anthracnose (*Gloeosporium ribis*).

Two plots of plants placed in shadow under trees had almost no attack of anthracnose.

Two clones were selected, and named 'Dima' ♀ and 'Hemus' ♂. The two clones had generally the highest growing value, of the tested clones.

The tested clone of 'Rudolf Smidt', had also good value figures, but no selection is made of this clone.

Discussion

As described under »Introduction«, the test has primarily had the aim to select clones with good growing value, for the producer and also in relation to the functions of the plants for landscaping.

This makes it necessary, that the final test of the clone has at least to be made outdoors under circumstances much like the ones which are employed for plants in landscaping.

The test for climatic tolerance has been a very important one, but it can be difficult to register winter hardiness, in particular as this can vary a lot from year to year. The best ones proved large difference between clones.

The test for resistance to various disease was only carried out with natural infections in the fields, in the described trials.

In the experiments the diseases, which were

Table 8. *Ribes alpinum* clones. Average data from 1972–1974

		cl. 1206	cl. 2425	cl. 1701	'Dima' cl. 3084	'Hemus' cl. 2400	'Rudolf Smidt' cl. 2162	»Smidt's type« cl. 1209
Samlet værdital	Main value figure	3.7	4.3	5.6	8.5	7.8	7.7	6.0
Overvintring	Winter-hardiness	7.8	8.7	9.8	9.5	9.8	9.7	9.4
Sundhed	Health of plants	2.6	3.2	4.8	8.5	7.6	7.8	5.2
Jorddækningsevne	Ground cover	2.2	2.3	3.6	7.3	8.4	8.2	2.9
Vækst	Habit of growth	4.8	4.8	3.7	6.9	8.2	7.7	4.9
Antal løvdage	Days with leaves (1972)	122	133	166	203	208	205	180
Han-/hunkøn	Male/female			♀	♀	♂	♂	

tested for, were so common, that all plants could easily be infected, e.g. for scab in *Pyracantha,* Table 7.

The test for resistance to disease has in many of the experiments showed a big difference between the tested clones, e.g. *Ribes alpinum,* Table 8.

Resistance to disease is such an important characteristics, that in future tests, a supplement of a test under controlled conditions will be required as it is of great help.

By testing in the field it is important not to give disease control, if the registration, is to be reliable.

It is also important, that a minimum of 3 plots for each clone, placed at random, or in a systematical variable one, should be used, to reach equally possibilities for infections of all clones.

The numerical characteristics are the easiest to register, such as leaf and flower abundance. Registering of characteristics such as appearance of flowers and of leaves is more a matter of taste. Therefore a judging committee has previously set a standard register of these characteristics.

If the clone selection in cultivars and species, is compared with hybridization breeding, it can well bring larger improvements.

Before a hybridization work starts, a knowledge of the plant material is necessary.

The clone trials can supply such knowledge and also provide the best possible clones.

Conclusion

Research on trees and shrubs for use as ornamentals and for landscaping has been carried out since 1965.

On the bases of the research, it can be concluded, that there are often cultivated, genetically very different clones under the same cultivar- or species name.

Research has proved, that through a systematic scheme of collecting plant material, followed by a trial and clone test, it is possible to select the best clones, and in that way improve the general standard of the cultivated plant material.

The variation within the cultivated plants under a cultivar- or a species name, includes all kinds of cultivating characteristics, such as hardiness, health of plants, flower abundance and so on.

The studies and the trials made have shown, that hardiness and health of plants are important characteristics to obtain a good plant quality for the producer and the user of plants in the landscape.

Also flower abundance, leaf density and other characteristics can be used as a good base for selection.

The research has also proved, that cultivar trials for mentioned shrubs would be of little value, due to the big difference between clones within many cultivars.

To obtain results, which can be of value for the producer and for the user of plants, it is necessary to select clones, and introduce these to the plant producer.

The selected clone is marked as DG material, meaning defined genetical.

In many cases the selected clones can not be identified as an exsisting cultivar. The selected clone is then given a new cultivar name, or an addition to the old name.

The selection research work has proved, that identification of cultivars is often difficult, and that the safest method is to identify the material with its clone source.

For that reason nuclear stock plants of all the selected clones are kept permanently at the institute.

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