

Mensurational Variables Protocol

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Mensurational Variables - Annual Measurement Protocol

The SRC national trials are comprised of three types of experiment known as:

1. Extensive experiments
2. Mixture experiments
3. Intensive experiments.

This protocol first describes the code of measurement procedure for extensive experiments. The procedures for mixture and intensive experiments are then described as variations from the procedure for extensive experiments.

An extensive experiment consists of 9 plots of poplar divided into 3 experiment blocks (replicates), and similarly 9 plots of willow divided into a further 3 experimental blocks. Each experimental block contains 1 monoculture plot of each of 3 varieties of either poplar or willow as appropriate. Plots are composed of an assessment plot and guard stools. An assessment plot consists of 36 stools (6×6), some of which may be missing but whose original positions should be apparent from the planting arrangement. Each assessment plot is surrounded by two rows of “guard” stools that should not be counted in the assessment plot. The assessment plot should be demarked using ink or tape, to avoid confusion with the guard rows. A two-person team should be used for willow plots, one measuring with the callipers, the other holding measured shoots out of the way and ensuring only the inner assessment plot is correctly and fully assessed. Before taking any measurements on shoots, the dead leaves should be removed, to ensure that assessments can be taken without interference from foliage.

1 Diameter assessment

All shoots on all stools are assessed for diameter as defined in the measurement conventions in Appendix 1, with the exception that digital callipers round diameter measurements to the nearest 1 mm, rather than rounding down. The assessment of shoot diameters should follow a pattern, starting at the bottom left-hand corner of the 6×6 stool arrangement, going up six stools, down the next, finishing at the bottom right-hand corner. This will permit measurements to be checked and also allow increment to be tracked on a per-stool basis. Shoot diameter should be measured 1 m vertically from ground level. A plumb bob (that can easily be attached to the callipers) should be used to identify the point of measurement. Digital callipers should normally be used for recording diameters, according to the protocol described in Section 6 below. An exception should be made where shoots in a plot consistently exhibit a lack of apical dominance (Figure 1) or where shoots consistently go double at a point below 1 m (Figure 2). In this case, shoots should be measured for diameter at a height 10 cm from sprouting point using manual callipers, recording the results on the manual diameter assessment form. If these exceptional procedures are adopted, this must be denoted clearly on the form. If only an occasional shoot goes double, the principal shoot should be measured with the digital callipers as previously outlined (Figure 2). If, in any given assessment year, the mean height for a variety does not exceed 1 m because growth is not well advanced, then it is not necessary to take diameter measurements in that year. Measurement should be deferred until the following year and the decision to do so should be reported. Poorly stocked plots should be given the standard assessment. A tally should be kept by the second team member of the number of shoots assessed on each stool.

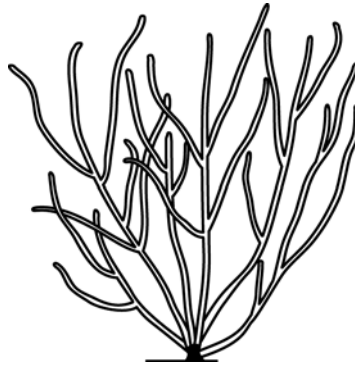


Figure 1. Example of SRC stool with shoots exhibiting lack of apical dominance.

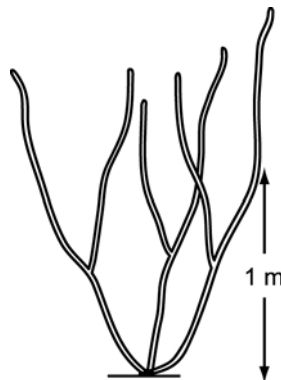


Figure 2. Example of SRC stool with shoots with significant bifurcations below the 1 m measurement point.

2 Length assessment

A sample of shoots should be assessed for length as follows. A total of 10 shoots should be selected from the 3 replicate blocks for each variety combined. The assessment plots for each variety should be inspected in turn, and 3 classes of shoot size (small, medium and large) should be identified subjectively. Length assessment should be carried out on a stratified sample of 3 small, 4 medium and 3 large shoots. Sample sizes of 3, 3 and 4 should be taken from the 3 experimental blocks for the variety. Selection of the size classes of sample shoots in each the 3 experimental should be made by drawing from 10 suitably coded plastic tokens (marked small, medium or large) from a bag or box without replacement. If one or more assessment plot is unsuitable for assessment, sampling should be increased accordingly in any plots for the same variety remaining in other experimental blocks at the site. Length assessment sample shoots must be measured in place and must not be cut from the stools. For each length sample shoot, the following measurements should be recorded on the appropriate form:

- Site name and reference code.
- Variety.
- Sample number (use sequential numbers from 1).
- Shoot diameter at 1 m vertically from ground level as described in Section 1.
- Shoot basal diameter, as defined in Appendix 1 and illustrated in Figure 3.
- Shoot length from sprouting point following any sweep to the point at which the 1 metre diameter was measured, as illustrated in Figure 3.
- Shoot length from sprouting point to tip following any sweep, as defined in Appendix 1 and illustrated in Figure 3. (Note that when a shoot does not exhibit apical dominance, maximum length should be recorded, which may mean measurement of a lateral branch.)

All lengths should be recorded in units of metres to the nearest 0.01 m.

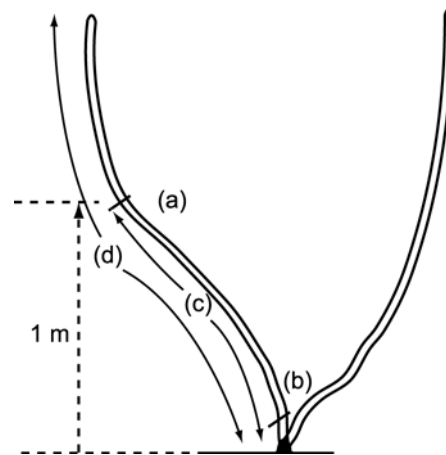


Figure 3. Illustration of measurements taken on length sample shoot.

- (a) Location of 1 m diameter measurement point.
- (b) Location of basal diameter measurement point (see also Figure A1.1, Appendix 1).
- (c) Measurement of true shoot length to 1 m diameter measurement point.
- (d) Measurement of full shoot length.

3 Destructive biomass assessment

A very small sub-sample of shoots should be assessed for biomass. Specifically, a sample of one shoot should be taken for each variety, at each site, in each year of assessment. These shoots are selected from the inner guard row, not the outer guard row and not the assessment plot. The experimental block from which the sample is to be taken is identified separately for each variety by drawing from 3 plastic tokens (with replacement) coded for selection of size class of length sample shoots (marked small, medium or large). These codes are taken to represent respectively the lowest, middle and highest EDC numbers of the 3 replicate plots for the variety being assessed. The size class of the sample to be taken is similarly selected by drawing again from the 3 coded plastic tokens. Before carrying out the destructive procedure, the full assessment procedure for length sample shoots should be carried out and the data recorded on the destructive biomass assessment form. The shoot should then be cut at point of sprouting and removed from the stool. The cut shoot can then be cut up into smaller pieces but all the pieces should be kept in one or more bags clearly marked with site reference, species, variety, EDC number, and the length and diameter details.

4 Procedure for mixture experiments

Mixture experiments are very similar to extensive experiments, but include an additional 6 plots (3 poplar, 3 willow) containing row-by-row mixtures of the 3 varieties from the monoculture plots. Assessment plots consist of a 9×9 matrix of 81 stools, surrounded by 5 rows of guard stools on 3 sides and 6 rows of guard stools on the remaining edge. (This arises from the double-row planting arrangement adopted in the experimental plots.) When assessing mixture plots, the 3 components in each assessment plot representing the 3 varieties should be as 3 completely separate assessment plots, each formed of a 3×9 matrix of 27 stools. Accordingly, the measurement procedures described in Sections 1 to 3 should be carried out and data recorded separately for each component, also clearly distinguishing data from mixture plots from that collected in the monoculture plots.

5 Procedure for intensive experiments

An intensive experiment is similar in principle to an extensive experiment, but consists of 48 plots of poplar divided into 3 experiment blocks (replicates), and 48 plots of willow, again divided into 3 experimental blocks. Each experimental block contains 1 monoculture plot for each of 16 varieties of either poplar or willow as appropriate. The measurement procedures described in Sections 1 to 3 should be carried out and data recorded for each of the 16 poplar and 16 willow varieties in the experiment, with the exception that 3

destructive samples of shoot biomass (1 from each experimental block) should be taken for each of the varieties not represented in extensive experiments.

6 Instructions for use of Masser digital callipers



Measuring SRC stem diameters using Masser callipers

Installing the calliper program on a PC in the office

- i. Insert the calliper program disk into the pc disk drive.
- ii. At the MS-DOS 'c:\' prompt, make a directory called 'FRC' with the command:

```
md FRC
```

- iii. Change directory with the command:

```
cd FRC
```

- iv. At the 'c:\FRC prompt', type the command:

```
copy a:*.*
```

This copies the program and supporting files to the FRC directory on the C drive.

Starting the assessment procedure on-site

- i. Press the trigger on the callipers once and release. This brings up the main menu. The main menu consists of a number of options which appear in sequence on the calliper display screen. When the sequence of options is completed it is repeated in a cycle until an option is selected by pressing the calliper trigger. The options displayed are:

NEW STOOL; NEW EDC; NEW UK SITE; CONFIGURE.

- ii. A cyclic menu of options will scroll through on the screen. Scroll through the options on the menu and press the trigger on the option *NEW UK SITE*. If missed, try again as it reappears in the cycle of options.

- iii. Once *NEW UK SITE* has been selected, the calliper display prompts for entry of a sequence of relevant site and plot details. First, *DATE* must be entered as 2 digits for the month and 4 digits for the year of assessment.
- iv. When the *DATE* has been entered, enter the *UK SITE NO.* This is a unique 2-digit code for the experimental site. (See Section 7, Table 4., for a list of site code numbers.)
- v. A code for *EXPERIMENT TYPE* should now be entered, choose as appropriate from *EXTP* (extensive monoculture), *INT* (intensive) or *EXTM* (extensive mixture) by pressing the trigger on the relevant option. At a mixture site choose the code *EXTP* for the monoculture plots, and when finished assessing all monoculture plots, download the calliper data to the PC. Check that download was successful and clear the callipers of data. Now restart the assessment procedure as at step i, as if for a new site, but this time select *EXTM*, which will prompt the callipers to expect 27 stools in an assessment plot.
- vi. After *EXPERIMENT TYPE*, the *EDC* number for the plot must be entered - use the correct Forest Research EDC number, not the locally used plot number. (See Section 7, Tables 1–3, for lists of EDC numbers).
- vii. A code for *SPECIES* must now be entered. Select either *POPLAR* or *WILLOW*.

Once these data have been entered the diameter assessment procedure can begin.



Measuring SRC stem diameters using Masser callipers

Diameter assessment with callipers

- i. Find the first stool in the assessment plot to be measured.
- ii. Press the trigger on the calliper and hold down; push calliper arms fully over the stem to be measured at the appropriate point, release the trigger and then withdraw. Repeat this process until all shoots on the first stool have been assessed. As shoots are measured, the screen on the callipers will display four columns of information as follows:

First column S = Site number
 E = Plot EDC number

Second column ST = Stool number

Third column Sh = Shoot number

Fourth column DBH = Diameter at 1 m.

For example, after measuring 4 shoots on the first stool in plot EDC 7 at site number 12 , the screen will display:

S = 12 ST = 1 Sh = 4 dbh = 12 (diameter of shoot number 4)
E = 7

- iii. On completion of the first stool, press the trigger once. The main menu should appear with options scrolling through on the screen. The first choice is *NEW STOOL*. Select this option as it appears by clicking once. If missed, try again as it reappears in the cycle of options. When clicking accidentally on *NEW EDC*, the user will be asked to confirm selection of this option. Responding with *NO* permits the user to return to selecting *NEW STOOL*.

Having selected to option *NEW STOOL*, the callipers will be ready to measure shoot diameters on the second stool. Each time a new stool is selected, on the display screen the value of ST will increment by 1 and Sh will reset to the value 1.

- iv. Repeat step (ii) and take diameter measurements as before. Repeat steps (ii) and (iii) for all stools in the assessment plot. When a stool is found to be missing, click the trigger on the calliper once, scroll through the menu to the option *NEW STOOL*. Assuming that the assessment of the previous stool has just been completed, clicking on this option will increment ST to the value for the missing stool. The trigger should now be clicked once again, and the option *NEW STOOL* selected again. Clicking on this option will increment ST again and assessment of the next stool can proceed. In monoculture plots, after 5 stools have been assessed and *NEW STOOL* has been selected from the menu, a buzzer will sound twice to warn that the last stool in the row is about to be assessed. The screen will also display the message *LAST STOOL IN ROW*. If at this point more or less than 6 stools are about to be assessed, data should be reviewed and full notes taken of any errors. (See section below on reviewing data.) In mixture plots the buzzer will sound at the end of each row of 9 stools.
- v. At the end of each successive row of 6 stools the buzzer will sound until 36 stools have been assessed ($3 \times 9 = 27$ in mixture plots).
- vi. On completion of the first plot, locate the next plot and click the trigger on the calliper to display the main menu. Select *NEW EDC*, change the number to the new plot and confirm the change. The calliper will now prompt for entry of a code for species. Click on *POPLAR* or *WILLOW* as appropriate. Assessment of the plot can now proceed as outlined above. This procedure can be repeated until all plots have been measured, subject to the special provisions for mixture plots, as outlined in point (v) of starting the assessment procedure above.

Reviewing data

- i. Click trigger once to scroll through options in the main menu. Select the option *CONFIGURE* using the calliper trigger.
- ii. In the submenu for this option (consisting of *DOWNLOAD DATA*, *ERASE DATA*, *REVIEW DATA* and *LIGHT ON/OFF*), select the option *REVIEW DATA*. The screen on the calliper will now display the following:

(S) Site Number . . (E) EDC Number . . (St) Stool number . . and Number.

Number is the number of shoots recorded by the calliper for the stool numbered as displayed under *St*. The display will scroll through the data for the stools in the assessment plot measured thus far - automatically the stool number will be decremented, also giving number of shoots on each stool. This information should be used to attempt to identify where any error has occurred. Full notes should be made as part of paper records so that data can be edited following downloading.

Downloading data to a PC

- i. At the MS-DOS 'c:\' prompt, change directory on the PC to c:\FRC

Attach the callipers to the PC in their shut-down state. To start the download, type in the command:

download [leave one space] data_id.

- ii. The data_id should consist of an 8-character string that specifies the experimental site, a download number, the species measured and the year of assessment as follows:

site_id+download_number+species_id+year_id

The 'plus' signs indicate concatenation of four codes. The site_id consists of the first 3 letters of the name of the site that has been assessed. Official site names and abbreviations are shown in Table 4 in Section 7. (Note that the 3-character abbreviations are not unique for all sites, but are unique for data received from different Forest Research outstations.) The download_number should take the value 1 for the first download, and should be incremented for each successive download for the site in a given assessment year. The species_id should consist of 2 characters, either 'po' or 'wi', depending on whether poplar or willow data are being downloaded. Finally, the year_id should consist of 2 digits specifying the year of assessment.

From this information, the program constructs a unique 8-character filename for the download, e.g. tru1wi01 for Trumpington, download 1, species willow, assessment year 2001. The download number should be incremented for every subsequent download for that site in the given assessment year.

On pressing return, the screen will display the message:

Data receiving from calliper - Start data transfer from calliper.

- iii. The trigger of the calliper should now be pressed. A small clear box will appear on the display screen behind the cursor. Press the calliper trigger again to access the main menu. Select *CONFIGURE*, and select *DOWNLOAD DATA* from the submenu. Data will now appear on the screen, with 36 entries for each plot. It may take more than one attempt to get a successful download. It is thought that the speed of clicking by the operator may be responsible for this. If the LCD on the callipers locks permanently on the message *TRANSFERRING*, short out the pins on the callipers with a finger to clear the screen and start again.
- iv. The downloaded data files are known as .CSV files. After completing downloading, copy all data files to a 3.5" disc and post to Alice Holt Research Station. Ensure you keep a local copy as a backup in case data gets lost in transit. It is strongly recommended that copies of .CSV files emailed as soon as possible directly to Ian Tubby at Alice Holt (ian.tubby@forestry.gsi.gov.uk), as this permits data to be reviewed rapidly and gives field teams the chance to check for errors on site with minimum inconvenience.
- vi. Once all data has been copied and checked the memory of the callipers must be cleared. To do this, access the main menu on the callipers and select *CONFIGURE*. From the submenu select *ERASE DATA*, and confirm this selection. Callipers are now ready for more work.

Standard identification codes used in SRC national trials
Table 1. Allocation of EDC numbers to plots in extensive monoculture experiments

Poplar variety	Experimental block number			Willow variety
	1	2	3	
Beaupré	1	4	7	Jorunn
Ghoy	2	5	8	Germany
Trichobel	3	6	9	Q83

Table 2. Allocation of EDC numbers to plots in extensive mixture experiments

Poplar variety	Experimental block number			Willow variety
	1	2	3	
Beaupré	1	5	9	Jorunn
Ghoy	2	6	10	Germany
Trichobel	3	7	11	Q83
Beaupré mix	41	81	21	Jorunn mix
Ghoy mix	42	82	22	Germany mix
Trichobel mix	43	83	23	Q83 mix

Table 3. Allocation of EDC numbers to plots in intensive experiments

Poplar variety	Experimental block number			Willow variety
	1	2	3	
Beaupré	1	17	33	Jorunn
Ghoy	2	18	34	Germany
Trichobel	3	19	35	Q83
Boelare	4	20	36	Spaethii
Unal	5	21	37	Dasyclados
Raspalje	6	22	38	ST248155
Gaver	7	23	39	Delamere
Gibecq	8	24	40	Bebbiana
690386	9	25	41	V789
690394	10	26	42	Stott 10
710091	11	27	43	Stott 11
710151	12	28	44	Jorr
710092	13	29	45	Bjorn
Columbia	14	30	46	Tora
Scott	15	31	47	Orm
Fritzi (TT32)	16	32	48	Ulv

Table 4. Location and description of Forest Research SRC national trials and allocation of outstations, site code numbers and site_id codes

Site name	Grid reference	Experiment type	Forest Research Outstation	Site code no.	Site_id for calliper file
Balbirnie	3268 7064	Intensive	Bush	1	bal
Loyton Bampton	2970 1250	Intensive	Exeter	2	loy
Trefeinon	3139 2305	Intensive	Talybont	3	tre
Trumpington	5431 2544	Intensive	Thetford	4	tru
Thorpe Thewles	4402 5238	Intensive	Wykeham	5	tho
Loughall	C900.518	Intensive	Northern Ireland	6	lou
Alice Holt	4809 1427	Intensive	Alice Holt	7	lod
Friar's Court	4295 2005	Extensive Mixture	Alice Holt	8	fri
Bigbrook Farm	2780 1205	Extensive Mixture	Exeter	9	big
Long Ashton	3532 1704	Extensive Mixture	Exeter	10	lon
Myerscough	3509 4401	Extensive Mixture	Wykeham	11	mye
Sunnybrae, Craibstone	3878 8114	Extensive Mixture	Newton	12	sun
Talybont	3105 2233	Extensive Mixture	Talybont	13	tal
Gilder Beck	47774547	Extensive Mixture	Wykeham	14	gil
Castlearchdale	C185.582	Extensive Mixture	Northern Ireland	15	cas
Mawdesley	3494 4160	Extensive Mixture	Wykeham	16	maw
Wensum	6243 3243	Extensive Mixture	Thetford	17	wen
Charity Farm	3464 3268	Extensive Mixture	Midlands	18	chf
Llandovery	2000 2307	Extensive Mixture	Talybont	19	law
Dunnington	5152 4535	Extensive Mixture	Wykeham	20	dun
Loseley	4973 1479	Extensive Mixture	Alice Holt	21	los
Ceredigion	2608 2823	Extensive Mixture	Talybont	22	gre
Bore Place	5501 1481	Extensive Pure	Alice Holt	23	bor
Roves Farm	4215 1885	Extensive Pure	Alice Holt	24	rov
Craigend	2593 6786	Extensive Pure	Bush	25	cra
Tweed horizons	3587 6319	Extensive Pure	Bush	26	twe
Aller Court	3385 1297	Extensive Pure	Exeter	27	all
Demontford University	4982 3761	Extensive Pure	Midlands	28	dem
Oyne	3686 8253	Extensive Pure	Newton	29	oyn
Teanahuig	2627 8535	Extensive Pure	Newton	30	tea
Tair Onen	3033 1743	Extensive Pure	Talybont	31	tai
Llangoed	3118 2412	Extensive Pure	Talybont	32	llan
Writtle College	5662 2065	Extensive Pure	Thetford	33	wri
Dell Piece	5115 2138	Extensive Pure	Thetford	34	rot
Hayburn Wyke	5005 4967	Extensive Pure	Wykeham	35	hay
Londonderry	C455.208	Extensive Pure	Northern Ireland	36	lon
Great Pool Hall	3371 2189	Extensive Pure	Talybont	37	gwe
Harper Adams	3713 3205	Extensive Pure	Midlands	38	har
Charlwood 1	5245 1435	Extensive Pure	Alice Holt	39	chw
Carruchan Ae	2955 5735	Extensive Pure	Mabie	40	car
Delamere	3582 3707	Extensive Mixture	Wykeham	41	del
Llanwrst	2656 3730	Extensive Pure	Talybont	42	hen
Soham	5601 2764	Extensive Pure	Thetford	43	soh
Moray	4089 4587	Extensive Pure	Newton	44	mor
Penrith	Failed	Extensive Pure	Kielder	45	pen
Slebech, Llandovery	2133 2059	Extensive Pure	Talybont	46	sle
Bonython	1708 0217	Extensive Pure	Exeter	47	bon
Dunstall Court	3992 2612	Extensive Pure	Midlands	48	dun
Moscow Farm	4760 3135	Extensive Pure	Midlands	49	mos
Woodford	4123 1347	Extensive Pure	Alice Holt	50	woo

Appendix 1. Definition of Mensuration Standards

Standards for the measurement and calculation of shoot- and stand- level SRC variables have been employed, with some developments, throughout this project. These standards are specified below and are adapted from an earlier report by Robert Matthews (1995). Many of the proposed standards have been adapted from existing standards for high forest mensuration.

A1.1 Measurement conventions

Definition of main shoots/stems

The main stem of a coppice shoot is identified as the single stem that extends from the point of sprouting to the most extreme shoot tip. This does not include side shoots and shoots sprouting at or higher than 10 cm from ground/stool level should be ignored (Figure A1.1).

Diameter

Stem diameter is normally measured at 1.3 m from ground level on natural, commercial and amenity trees, and is known as diameter at breast height (dbh). This convention cannot be easily extended to SRC stands, however, which rarely exceed 12 m in height, and may often need to be assessed before a height of 1.3 m has been reached. The situation is further complicated by the fact that a single coppice 'tree' may consist of a great number of separate stems (shoots) growing from a single stool. The following conventions are therefore proposed for diameter assessment.

Basal diameter. Ideally, shoot diameter should be measured 10 cm from the point at which the shoot sprouts from the stool/ground level, as illustrated in Figure A1.1. This diameter will be referred to as 'basal diameter' or d_{10} . A shoot sprouting from ground level should be regarded as a separate stool. A marked stick should be used to assess the 10 cm point for measurement of diameter. Side shoots and shoots sprouting at or higher than 10 cm from ground/stool level should be ignored.

Diameter at 1 m. An alternative shoot diameter is defined at the point on a main shoot 1 m from ground level as measured vertically. This diameter will be referred to as d_{100} . A shoot sprouting from ground level should be regarded as a separate stool. Side shoots and shoots sprouting at or higher than 10 cm from ground/stool level should be ignored. A marked stick or plumb line should be used to identify the 1 m measurement point.

Callipers should be used for the measurement of diameter. A rounding-down convention should be followed, and basal diameter should be recorded to an accuracy of 1 mm.

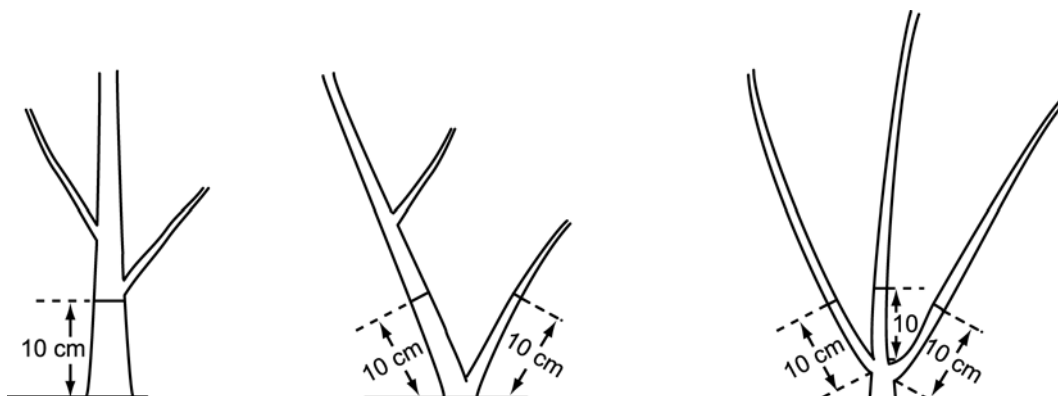


Figure A1.1. Identification of coppice main shoots/stems and location of basal diameter point

Height and length

Tree height is most commonly recorded as vertical height to top of tree from ground level, using an optical instrument for very tall trees. Short rotation coppice shoots will rarely exceed 12 m in length, and will often exhibit considerable horizontal 'sweep'. Instead of measuring vertical shoot *height*, therefore, the following conventions for the measurement of shoot *length* are proposed.

A tape measure should be used to measure shoot length from point of sprouting (ground or stool level) to the most extreme shoot tip, following any departures from straightness. A hooked pole or step ladder should be used to reach the tips of tall shoots.

A rounding-down convention should be followed, and shoot length should be recorded to an accuracy of 10 mm. Shoots less than 10 cm in length should not be recorded.

Shoot form and volume

The principal commercial variable in the forestry industry is tree main stem ('merchantable') volume, measured to a top diameter of 7 cm over bark. This variable is of little relevance to biomass coppice, but some form of measurement of stem volume may be of secondary importance in the assessment of biomass. Sectional measurements of coppice shoots may be required to establish stem form and correlation between d_{10} and d_{100} . The following conventions for the assessment of stem form and calculation of shoot main stem volume are proposed.

In order to calculate shoot main stem volume, three measurements are first taken on the main stem:

- 1. shoot basal diameter;*
- 2. shoot length;*
- 3. shoot mid-diameter.*

Shoot mid-diameter is measured on the shoot main stem mid-way between point of sprouting and extreme shoot tip. A rounding-down convention should be followed. The above conventions for the accuracy of diameter and length measurement should be followed.

Shoot main stem volume is calculated assuming that the shoot main stem is formed by two components:

- a perfect cone of height equal to one half of shoot length, with basal diameter equal to shoot mid-diameter;*
- a perfect frustum of a cone of height equal to one half of shoot length, with basal diameter equal to shoot basal diameter, and top diameter equal to shoot mid-diameter.*

For the assessment of stem form, a measurement of d_{100} should also be made.

Biomass

It is difficult to specify a single convention for the measurement of biomass, partly because of the lack of standard measurement instruments and partly because the biomass to be measured can range across several orders of magnitude. The following guidelines for the measurement of shoot biomass are therefore proposed.

Biomass is measured on an oven-dry basis, and only potentially merchantable biomass is measured. In short rotation coppice, merchantable biomass is effectively the woody biomass contained in the above-ground shoots, excluding the stool, stumps and leaves. The total woody biomass of a single shoot is measured from point of sprouting (minus stump) to shoot tip, including all side branches.

Shoot biomass is measured destructively by cutting down the shoot and weighing it. If practical, oven-dry biomass should be measured directly by drying the entire shoot prior to weighing. If this is not practical, the fresh weight of the shoot should be weighed, and a sample of fresh biomass from the shoot should be removed to establish the moisture content. The removal of a representative sample of fresh biomass will normally require the shoot to be comminuted.

A rounding-down convention should be followed, and shoot biomass should be recorded to an accuracy of 0.1 g.

A1.2 Definition of stand-level variables

Basal area

Shoot basal area can be calculated from shoot basal diameter, assuming that the cross-section of the shoot is a perfect circle.

At the stand level, basal area is defined as the sum of the basal areas of all shoots within the assessment area.

In conventional forestry basal area is calculated from dbh rather than basal diameter, and at the stand level is normally expressed on a per-hectare basis.

Dominant diameter

In conventional forestry, dominant diameter is defined as the quadratic mean (root-mean-square) diameter of the 100 largest dbh trees per hectare. Such a definition works well for crops of mainly single-stemmed trees at densities generally less than 10,000 trees per hectare, and could also be applied to coppice crops. An alternative definition of dominant diameter may be more appropriate for crops of multi-stemmed coppice with densities rarely below 10,000 shoots per hectare and occasionally as high as 500,000 shoots per hectare. The following definition of dominant diameter is proposed for short rotation coppice crops.

Dominant (basal) diameter is defined as the quadratic mean diameter of the largest diameter coppice shoot per stool within the assessment area.

Mean diameter

Mean (basal) diameter is defined as the quadratic mean diameter of all coppice shoots (with basal diameter 1 mm or greater) in the assessment area.

Mean diameter is thus the basal diameter of a shoot of average basal area. This definition is similar to that used in conventional forestry, except that in conventional forestry dbh is used rather than basal diameter, and the dbh cut-off is usually 7 cm as opposed to 1 mm.

Top height

Top height is defined as the arithmetic mean (average) shoot length of a coppice shoot of dominant basal diameter.

The above definition is analogous to that used in conventional forestry.

Mean height

Mean height is defined as the arithmetic mean shoot length of a coppice shoot of mean diameter.

The above definition is analogous to that used in conventional forestry.

Volume

Stand-level main stem volume is defined as the sum of the main stem volumes of all shoots within the assessment area.

The above definition is analogous to that used in conventional forestry. Stand volume is normally expressed on a per-hectare basis.

Biomass

Stand-level biomass is defined as the sum of the biomasses of all merchantable and measurable shoots within the assessment area.

Normally it will be appropriate to express stand level biomass on a per-hectare basis.