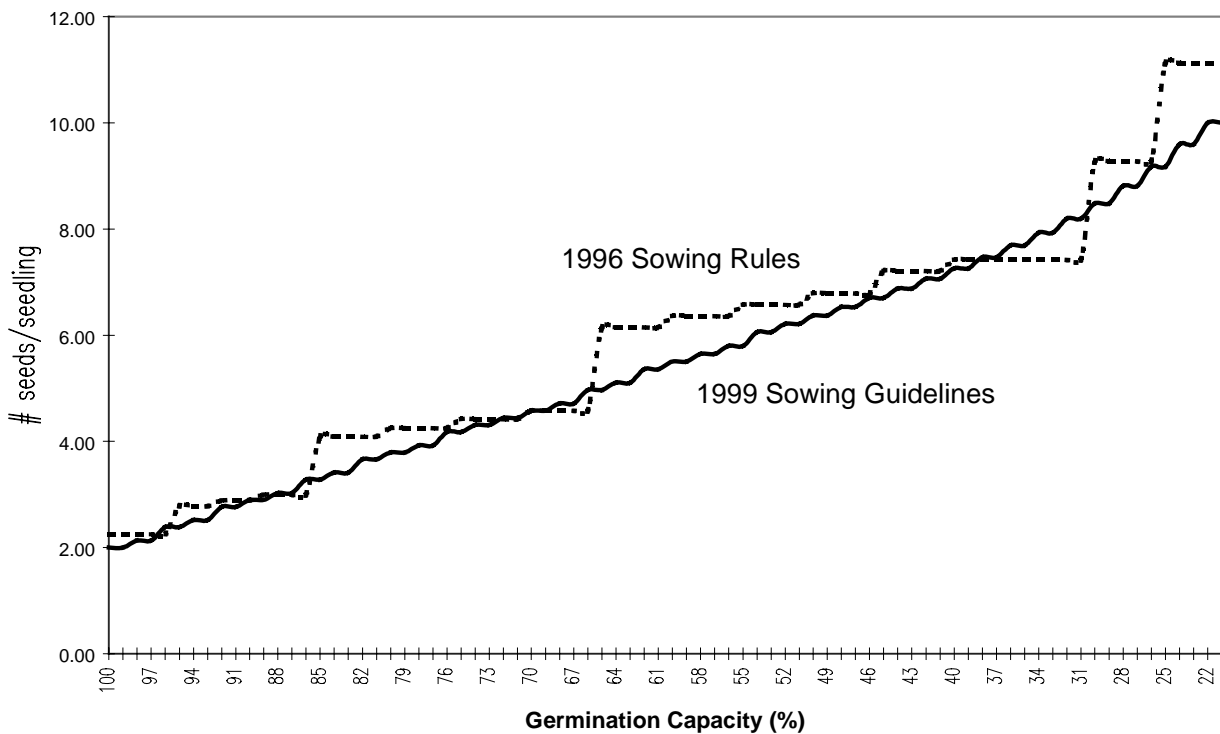




Ministry of Forests Sowing Guidelines

The Sowing Guidelines have been revised as of September 7, 1999. These new guidelines were developed to promote the most efficient use of seed sown to produce forest seedlings. The revised guidelines attempt to create a more consistent relationship between germination capacity (GC) and seeds supplied per seedling. The following figure illustrates the difference in seed allocation between the 1996 Sowing Rules (dotted line) and the 1999 Sowing Guidelines.

1999 Sowing Guidelines vs. 1996 Sowing Rules



These new guidelines are based on results from the December 1998 Sowing Rules Survey, data analysis on excess seed returned to the Tree Seed Centre, contact with BC forest nurseries and data modelling by Extension Services and the Tree Seed Centre. The models used for determining seed use are available as MS-EXCEL spreadsheets and can be customised for your unique situation. Please contact Eric van Steenis for further information on available models.

Section A of the this update explains the Sowing Guideline Calculations. The revised guidelines incorporate the use of ‘fractional’ sowing (e.g. 2.2 seeds per cavity) and a calculated number of seeds per seedling.

Please remember that these are Sowing Guidelines. When a nursery or request agency has determined the need for either more or less seed than calculated in SPAR, there are options available for changing the sowing rules or grams ordered for a seedling request (refer to Section B). These guidelines should encourage more communication regarding efficient seed use between forest nurseries, request agencies and seed owners.

Section C describes optional Nursery Sowing Procedures using the Revised Sowing Guidelines. For those who are not familiar with ‘fractional’ sowing, this section suggests different methods of fractional sowing.

For further information on the sowing guidelines please contact Dave Kolotelo; for gram or sowing guideline changes or SPAR information contact Susan Zedel; and for information on fractional sowing or seed use modelling contact Eric van Steenis.

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Section A: Sowing Guideline Calculations

The Ministry of Forest Sowing Guidelines have been modified in the Seed and Planning Registry System (SPAR), effective September 7, 1999.

Table 1: Factors and Seeds Per Seedling by Germination Capacity (%)

Germination Capacity (%)	Sowing Factor	Correction (Oversow) Factor	Nursery Handling Factor	Seeds Supplied Per Seedling	Viable Seeds Supplied Per Seedling	'Green Trees' - % of Request	Percent Empty Cavities
100-99	1.4	1.25	0.20	2.00	2.00	1.25	0.16%
98-97	1.5	1.25	0.20	2.13	2.09	1.25	0.52%
96-95	1.7	1.26	0.20	2.39	2.29	1.25	0.61%
94-93	1.8	1.26	0.20	2.52	2.36	1.25	0.83%
92-91	2.0	1.26	0.20	2.77	2.55	1.25	0.81%
90-89	2.1	1.26	0.20	2.90	2.61	1.25	0.97%
88-87	2.2	1.26	0.20	3.03	2.67	1.25	1.12%
86-85	2.4	1.26	0.20	3.28	2.82	1.25	1.05%
84-83	2.5	1.26	0.20	3.41	2.86	1.25	1.19%
82-81	2.7	1.26	0.20	3.66	3.00	1.25	1.13%
80-79	2.8	1.26	0.20	3.79	3.03	1.25	1.27%
78-77	2.9	1.27	0.20	3.92	3.06	1.25	1.41%
76-75	3.1	1.27	0.20	4.18	3.17	1.25	1.36%
74-73	3.2	1.27	0.20	4.31	3.19	1.25	1.51%
72-71	3.3	1.27	0.20	4.44	3.20	1.25	1.68%
70-69	3.4	1.27	0.20	4.58	3.20	1.25	1.86%
68-67	3.5	1.27	0.20	4.71	3.20	1.25	2.06%
66-65	3.7	1.27	0.20	4.97	3.28	1.25	2.06%
64-63	3.8	1.28	0.20	5.11	3.27	1.25	2.29%
62-61	4.0	1.28	0.20	5.36	3.32	1.25	2.31%
60-59	4.1	1.28	0.20	5.50	3.30	1.25	2.58%
58-57	4.2	1.28	0.20	5.65	3.28	1.25	2.89%
56-55	4.3	1.29	0.20	5.79	3.25	1.25	3.23%
54-53	4.5	1.29	0.20	6.06	3.27	1.25	3.35%
52-51	4.6	1.29	0.20	6.21	3.23	1.25	3.76%
50-49	4.7	1.30	0.20	6.37	3.19	1.25	4.22%
48-47	4.8	1.31	0.20	6.53	3.14	1.25	4.75%
46-45	4.9	1.31	0.20	6.70	3.08	1.25	5.34%
44-43	5.0	1.32	0.20	6.88	3.03	1.25	6.02%
42-41	5.1	1.33	0.20	7.06	2.97	1.25	6.78%
40-39	5.2	1.34	0.20	7.26	2.90	1.25	7.65%
38-37	5.3	1.36	0.20	7.47	2.84	1.25	8.64%
36-35	5.4	1.37	0.20	7.69	2.77	1.25	9.77%
34-33	5.5	1.39	0.20	7.93	2.70	1.25	11.05%
32-31	5.6	1.41	0.20	8.20	2.62	1.25	12.52%
30-29	5.7	1.44	0.20	8.49	2.55	1.25	14.20%
28-27	5.8	1.47	0.20	8.81	2.47	1.25	16.12%
26-25	5.9	1.50	0.20	9.18	2.39	1.25	18.32%
24-23	6.0	1.55	0.20	9.60	2.30	1.25	20.84%
22-1	6.0	1.61	0.20	10.00	2.20	1.25	24.31%

Definitions of Terms Used in this Extension Note Update:

Germination Capacity	Germination Capacity indicates the proportion of seeds which will germinate normally under favourable conditions. It is based on a specific pre-treatment and test duration provided at the Tree Seed Centre.
Sowing Factor	The average number of seeds per cavity within a container that should be sown to produce a seedling. The new guidelines use fractional sowing factors, e.g. 2.2 seeds per cavity. For information on how these fractions are managed in the nursery, refer to Section C of this Extension Update.
Correction Factor (Oversow)	The factor used to provide for an 'oversow' of the requested number of viable seedlings, to account for non-productive cavities.
Nursery Handling Factor	The factor used to ensure that nursery equipment has sufficient seed to enable sowing of all cavities. A factor of 0.2 seeds per cavity sown is used consistently for all container types.
Seeds Supplied Per Seedling	The number of seeds supplied to produce a seedling: (Sowing Factor x Correction Factor) + (Nursery Handling Factor x Correction Factor)
Viable Seeds Supplied Per Seedling	The viable number of seeds supplied per seedling that can be expected given the respective germination percent of the seed: $(\text{Seeds Per Seedling} \times \text{Germination Percent}) / 100$. For example 100 seeds of an 80% germination seedlot supplies only 80 viable seeds. This information is valuable if one is contemplating seed upgrading at the nursery.
'Green Trees' (% of Request)	The number of cavities containing a viable germinant (relative to the number of seedlings requested) that a nursery can expect to start the crop cycle with given the germination capacity of the seed and suggested sowing and correction factors. It includes an additional 25% to account for losses during growing and possible culling to meet stock specifications at final lift.
Percent Empty Cavities	The percentage of empty cavities generated given the probability of obtaining a germinant at the stated sowing factor and seedlot germination %, assuming 100% sowing accuracy.

Sowing Guideline Calculations and Examples

Use the following formula and Table 1 (to determine seeds supplied per seedling) to calculate the 'grams of seed' required for a seedling request, based on the Ministry of Forests Sowing Guidelines:

$$\text{Grams of Seed} = \frac{\text{No. of Seedlings Requested} \times \text{Seeds Supplied Per Seedling}}{\text{Seeds Per Gram}}$$

Use the Table 1 to determine the **Seeds Per Seedling** based on the **Germination Capacity (%)** of a seed lot. The **Germination Capacity (%)** and **Seeds Per Gram** for all seed lots are available from SPAR. Alternatively the number of potential seedlings from a given quantity of seed can be calculated by rearranging the equation as shown below.

$$\text{Potential Seedlings} = \frac{\text{Grams of Seed} \times \text{Seeds per Gram}}{\text{Seeds Supplied per Seedling}}$$

Sample Calculation:

No. of Seedlings Requested = 15,200

Seed Lot = 60277 Germination = 91% Seeds Per Gram = 349

$$\text{No. of Grams} = \frac{\text{15,200 seedlings} \times \text{2.77 seeds supplied per seedling}}{\text{349 seeds per gram}} = \text{120.64 grams}$$

Note: Seed withdrawals at the Tree Seed Centre are done to the nearest gram (whole number) - e.g. 121 grams. SPAR will automatically round the No. of Grams calculation upwards to the nearest whole gram. You will often see the message '*Potential Trees have been recalculated*' in SPAR when entering a seedling request, due to the rounding factor.

Section B: Procedures for Changing Sowing Rules or Gram Amounts for Seedling Requests

Private forest nurseries and request agencies have the option of modifying the number of grams of seed calculated for a seedling request. Alternately, they can also request a change to the SPAR sowing rules for a seedling request. Another option available to nurseries is the entry of Nursery Specific Sowing Rules.

The gram amounts for ministry funded seedling requests (e.g. SBF) should not be changed by ministry staff. The Nursery Planning Officer at Forest Enterprises Branch will make any necessary gram changes for ministry seedling requests (contact Allan McDonald, 250-387-8945).

A new report, the Nursery Extract Style Report, was developed in spring 1999, to enable easier downloading of seedling request information into a spreadsheet format. The Nursery Extract Style Report is available to all non-ministry SPAR users. Instructions on running and downloading this report are included in this Extension Note Update.

Decreasing Grams using Seedling Request Fast Update

Forest Nurseries and Request Agencies (non-ministry) both have the ability to decrease the grams calculated for a seedling request using the Seedling Request Fast Update screen.

1. From the SPAR Main, select option 4 - Seedling Request Fast Update.
2. Enter the Request ID and press the **Enter** key. The Seedling Request information will appear in View mode.
3. Press **F6** to toggle from '*Trees (000's)*' to '*Quantity (grams)*'. See the following example:

```
-----
Update      View      eXit      Help
-----
SPR17M01 Seedling Request Fast Update (SRU)  M View      V 1.00.00  DB SQLTR2
Request Key.....> 2000RNE0001
Funding Source..... LFP              Licensee Funded Program
Opening/Ecostrata...
Obligation.....
Location.....
Number of Seedlings.      10.5 ('000s)
Nursery.....> NURSERY      00
Stock Type..... PSB              Styroblock
Container Type..... 515A
Stock Age..... 100000              1.0 + 0.0
Planting Year..... 2000              Season.. SU Summer              Month/Day. 0715
Lot Number..... 60434 Owner... MOF      20 MINISTRY OF FORESTS
Requested.Reserved..      0.0 Surplus..      71.0 Quantity
Available.Reserved..      0.0 Surplus.. 38,475.0
Comment.....
Override Comment...
SPR001I Grams of seed/number of cuttings (in 000's) displayed
```

4. Move the cursor to the 'Requested Reserved' or 'Surplus' field where the quantity of grams calculated is found. Press the **Delete** key to delete the current entry and type in the desired number of grams.
5. Press **Enter**. If the gram amount is less than 85% of the original calculated amount, you will be prompted to enter an override comment. Type in a comment and press **Enter**. Confirm the update when prompted.
6. Nurseries should check the Nursery Extract Style Report regularly for any differences between Seedlings Requested and Seedlings Calculated well in advance of the action date at the Tree Seed Centre to monitor any difference.

Increasing Grams using Seedling Request Fast Update

Request Agencies (non-ministry) have the ability to increase the grams calculated for a seedling request using the Seedling Request Fast Update screen. Nurseries do not have this ability, but should communicate any concerns over the amount of seeds supplied directly to the request agency. The request agency may then increase the grams upon agreement with the nursery.

1. From the SPAR Main, select option 4 - Seedling Request Fast Update.
2. Enter the Request ID and press the **Enter** key. The Seedling Request information will appear in View mode.
3. Press **F6** to toggle from '*Trees (000's)*' to '*Quantity (grams)*'.
4. Move the cursor to the 'Requested Reserved' or 'Surplus' field where the quantity of grams calculated is found. Press the **Delete** key to delete the current entry and type in the desired number of grams.
5. Press **Enter**. If the gram amount is greater than 115% of the original calculated amount, you will be prompted to enter an override comment. Type in a comment and press **Enter**. Confirm the update when prompted.
6. Nurseries should check the Nursery Extract Style Report regularly for any differences between Seedlings Requested and Seedlings Calculated well in advance of the action date at the Tree Seed Centre to monitor any difference.

Changing the Sowing Rules for a Seedling Request

As an alternative to changing the number of grams calculated for a seedling request, a forest nursery or request agency may submit a list of seedling requests and alternate sowing rules to the SPAR Administrator (for non-ministry funded seedlings) or the Nursery Planning Officer (ministry funded seedlings). With this alternative, the revised sowing rules for the requests specified will be reported with the correct seeds per cavity, correction factor, etc.

For example, a nursery may request that all of their 1+0 SP 313B Pli requests with a germination capacity of 97-100% be modified to 1.0 seeds per cavity with a 1.35 correction factor.

To change the sowing rules on a request by request basis, the nursery should submit a list of seedling requests, with the 'new' sowing rules for each request to the following contacts:

- For non-ministry funded requests - Susan Zedel, SPAR Administrator via email (Susan.Zedel@gems8.gov.bc.ca) or fax (at Tree Improvement Branch - 250-356-8124).
- For ministry funded requests - Allan McDonald, Nursery Planning Officer via email (Allan.McDonald@gems4.gov.bc.ca) or fax (at Forest Enterprises Branch - 250-356-0472).

Note: If the sowing rule changes result in an increase in the number of seeds supplied per seedling, the nursery must first get the approval of the request agency and forward the approval with their seedling request list.

Nursery Specific Sowing Rules

Nurseries may request the entry of 'Nursery Specific Sowing Rules' in SPAR. When a seedling request is entered and a nursery requested, SPAR will search the Sowing Rule Factor table to see if there is an applicable entry for the nursery, genetic class of the seed lot selected and germination of the seed lot selected. When an entry in the Nursery Specific table is found, the Seeds Per Cavity and Sowing Correction Factor will adjust the Potential Trees calculated on the Lot Selection screen. If a nursery specific entry is not found, the default sowing guidelines will be used.

Following is an example of the information entered on the Sowing Rule Factor screen.

Sowing Rule Factor (SRF)	
Nursery.....>	NURSERY 00
Genetic Class.....	A
Minimum Germination..	98
Maximum Germination..	100
Seeds per Cavity.....	1.0
Sowing Corr. Factor..	1.30

Contact the SPAR Administrator, Susan Zedel (email: Susan.Zedel@gems8.gov.bc.ca or fax: 250-356-8124) for entry of Nursery Specific Sowing Rule Factors.

Note: Nurseries should be cautious when using this feature of SPAR. The sowing rules specified will apply to all stock ages, stock types and container types, which may not be desirable.

Nursery Extract Style Report

The new Nursery Extract Style Report is available to all non-ministry nurseries and request agencies. This report is provided in a format which is easier to download into a spreadsheet program. Nurseries should run this report regularly from September through February as seedling requests are added or updated throughout that time period. The report should be reviewed for any changes to gram amounts and/or sowing rules, in addition to all other information.

To submit a Nursery Extract Style Report

1. From the SPAR Main Menu, select option 10 to go to the Report Submission Menu.
2. From the Report Submission Menu, select option 16 - Nursery Extract. The submission screen will appear as shown below:

SPRE5M01	Nursery Request Extract (NSX)
Sowing Year.....	2000
Request Agency.....>	
Assigned Nursery.....>	Nursery 00
	View Report... Y
Job Class. G Extract File Name..	Printer ID...> Default Printer

3. The report submission parameters will default to the current sowing year. Either the **Request Agency** or **Assigned Nursery** field will default to agency default of the SPAR user.
4. View Report will default to **Y** for yes, as this report can only be downloaded and not printed. The Job Class should be changed to **R** (immediate processing using the reporting database) or **Q** (immediate and using current data).
5. Enter an Extract File Name (up to 8 characters). Press **Enter** and confirm the report submission.
6. The report should appear on the Report Preview list within a few minutes. Follow the procedures found in the SPAR User Guide for downloading a report using Report Preview.

To bring a Nursery Extract report into a spreadsheet (Excel 7 used in this example):

1. In Excel, click on **File**, then **Open**. In the Files of Type drop box, select Text Files (*.txt). Look in the appropriate directory to find the text file that you downloaded from SPAR.
2. Double click on the text filename. The **Text Import Wizard - Step 1 of 3** screen will appear. Click on **'Delimited'**, then click the **Next** button.
3. The **Text Import Wizard Step 2 of 3** will appear. Click on **Comma** as the delimiter. Click on the **Finish** button.
4. The data will appear in spreadsheet format. Delete any columns that are not required for your use, or use the downloaded spreadsheet in an Excel workbook to provide the base data, and modify the columns used in other sheets within the workbook. Save the file in Microsoft Excel Workbook format (.xls).

Section C: Nursery Sowing Procedures using the Revised Sowing Guidelines

In order to utilise seed more efficiently it is important that the exact germination capacity of individual seedlots be reflected in the calculations used for seed allotment. For this reason the sowing guidelines for sowing year 2000 employ germination capacity ranges of 2%, fractional sowing factors in increments of 0.1 seeds/cavity and correction factors in increments of 1%. Using appropriate probability equations, sowing factors have been adjusted for each seedlot's germination capacity so as to minimise the number of empty cavities generated (see table 1 on page 3). Once this was achieved, correction factors were adjusted to achieve a "cavities with Green Trees count" of ~ 125% of requested seedlings ordered. Over and above this an extra 0.2 seeds were supplied per cavity sown to allow for sowing equipment minimum operating requirements and inefficiencies. The latter is termed the "Nursery Handling Factor". In addition, information on the number of seeds supplied per requested seedling is provided in the event nurseries wish to change the sowing and/or correction factors to suit their individual preferences and/or decide to perform seed upgrading at the nursery.

General Recommendations

To help ensure allotted seed meets the goals and objectives set out for it there are some general guidelines one can follow.

- Ensure proper seed handling and storage from arrival on site. Information packages on this subject are available from the BCMOF Tree Seed Centre.
- During sowing, divide seed for large requests into halves, thirds or quarters and monitor its use. Once a fraction of the seed is used up the tally of containers sown should add up to the same fraction of the total needed. If the two do not match an adjustment in sowing factors may be in order.
- Wetting containers immediately after sowing and seed cover application (i.e. gritting) ensures that seed imbibition is not lost or compromised prior to arrival in the growing area where misting/irrigation systems are present. A misting chamber is often incorporated at the end of the sowing line to facilitate this.
- For pelletised Western Redcedar seed, maintaining imbibition is an especially critical issue because the applied coating dries easily and upon doing so immediately begins to extract moisture from the seed.

Fractional Sowing Strategies

Sowing is performed mechanically to ensure seeds are sown as quickly as possible, thereby maintaining maximum crop uniformity.

Fractional sowing means that on average, the number of seeds sown per cavity is not an integer. For example if the fractional sowing factor is 2.2 seeds per cavity that means that 80% of the cavities contain 2 seeds and 20% of the cavities contain 3 seeds. The questions become a) how to accurately set up sowing machinery to perform this way and b) how to distribute the cavities with extra seeds through a crop.

The simplest way to fractionally sow a crop is in two parts. Basically at the two respective integer values so that for the above example the first 80% of the cavities are sown at 2 seeds/cavity and the last 20% of the cavities are sown at 3 seeds/cavity. Every type of sowing machine available is capable of this and a table is supplied on page 12 to suggest the ratios per integer value for each sowing factor from 1 to 6 seeds/cavity.

Vacuum Drum Seeders Vacuum Plate Seeders Vacuum Needle Seeders BCC Type

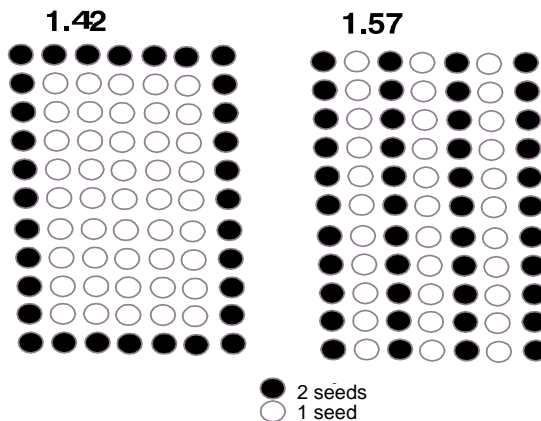
To distribute the cavities with higher integer seeds more evenly throughout the crop requires altering the seeder somewhat or changing sowing line procedures. With the vacuum drum seeder a drum with the higher integer value can be utilised and as per our example 80% of the extra holes taped. The pattern chosen is up to the grower, either linear using scotch tape or random using small round “stickies” are options.

One way to obtain the same result with a Vacuum Plate, Vacuum Needle or BCC Type seeder requires running the crop through the seeder at 2 seeds per cavity, and then again at 0.2 seeds per cavity. The second time through the seeder is taped to drop 1 seed in only 20 % of the cavities in every block. This is cumbersome but may be an option for some nurseries. It can also be done with 2 sowing machines set up in series in the same line.

Vacuum plate and needle seeders can be obtained with plates and needle set-ups containing more than one orifice per cavity to be sown. In this case a 3 hole vacuum plate can be taped to 2.2 seeds/cavity. Vacuum needle seeders are available with single and double needle/cavity designs which can be mixed on the same plate. If triple needle/cavity designs are also available these could be substituted into 20% of an otherwise double needle/cavity plate to achieve our above stated example.

Choosing which cavities to multiple sow.

Logically the cavities that by virtue of container design have more growing space at their disposal are the ones that should definitely have a seedling remaining in them after thinning is accomplished. These are the cavities around the perimeter of the block. Depending on the percentage of edge cavities these should be multiple sown first. After that, depending on how many more are needed, one moves toward the center of the block. The objective is to maximise and randomly distribute the growing space available per seedling so that overall crop growth is as uniform as possible. Below are two examples of fractional sowing in a 77 cavity block, including the fractional sowing rates achieved.



Blocks with different numbers of cavities will have different percentages of edge cavities, e.g. a 45 block has 24 (53%) edge cavities, a 112 block has 40 (36%) edge cavities, a 160 block has 48 (30%) edge cavities. Different blocks lend themselves to different patterns.

Proportion of cavities to sow @ whole sowing factors to achieve suggested fractional sowing factors

Fractional Sowing Factor	Seeds Per Cavity					
	1	2	3	4	5	6
1	100%					
1.1	90%	10%				
1.2	80%	20%				
1.3	70%	30%				
1.4	60%	40%				
1.5	50%	50%				
1.6	40%	60%				
1.7	30%	70%				
1.8	20%	80%				
1.9	10%	90%				
2		100%				
2.1		90%	10%			
2.2		80%	20%			
2.3		70%	30%			
2.4		60%	40%			
2.5		50%	50%			
2.6		40%	60%			
2.7		30%	70%			
2.8		20%	80%			
2.9		10%	90%			
3			100%			
3.1			90%	10%		
3.2			80%	20%		
3.3			70%	30%		
3.4			60%	40%		
3.5			50%	50%		
3.6			40%	60%		
3.7			30%	70%		
3.8			20%	80%		
3.9			10%	90%		
4				100%		
4.1				90%	10%	
4.2				80%	20%	
4.3				70%	30%	
4.4				60%	40%	
4.5				50%	50%	
4.6				40%	60%	
4.7				30%	70%	
4.8				20%	80%	
4.9				10%	90%	
5					100%	
5.1					90%	10%
5.2					80%	20%
5.3					70%	30%
5.4					60%	40%
5.5					50%	50%
5.6					40%	60%
5.7					30%	70%
5.8					20%	80%
5.9					10%	90%
6						100%