

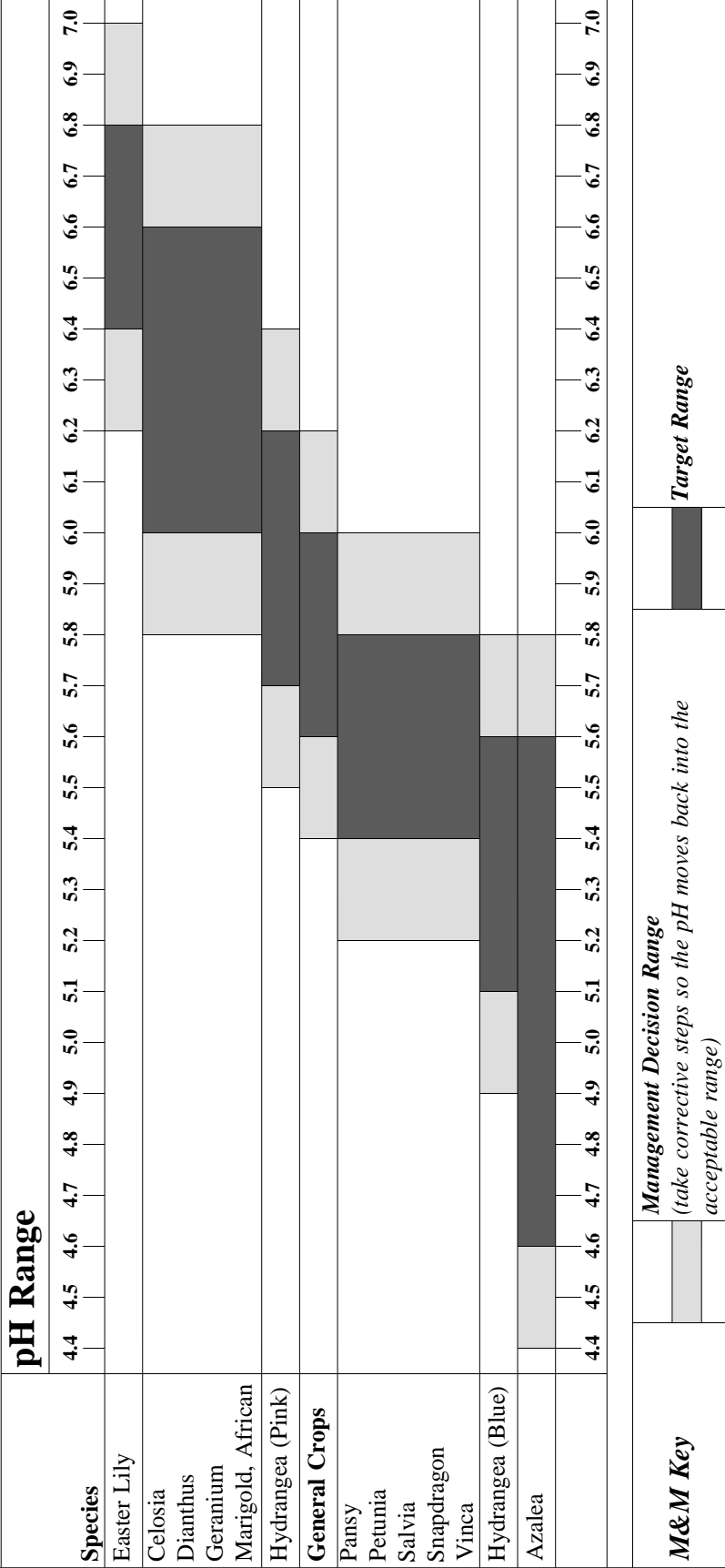
PourThru Sampling Form

Crop: _____ Date: _____ Location: _____	Samples	ml added	ml out	pH	EC	Comments
	1					
	2					
	3					
	4					
	5					
	Average					

Crop: _____ Date: _____ Location: _____	Samples	ml added	ml out	pH	EC	Comments
	1					
	2					
	3					
	4					
	5					
	Average					

Crop: _____ Date: _____ Location: _____	Samples	ml added	ml out	pH	EC	Comments
	1					
	2					
	3					
	4					
	5					
	Average					

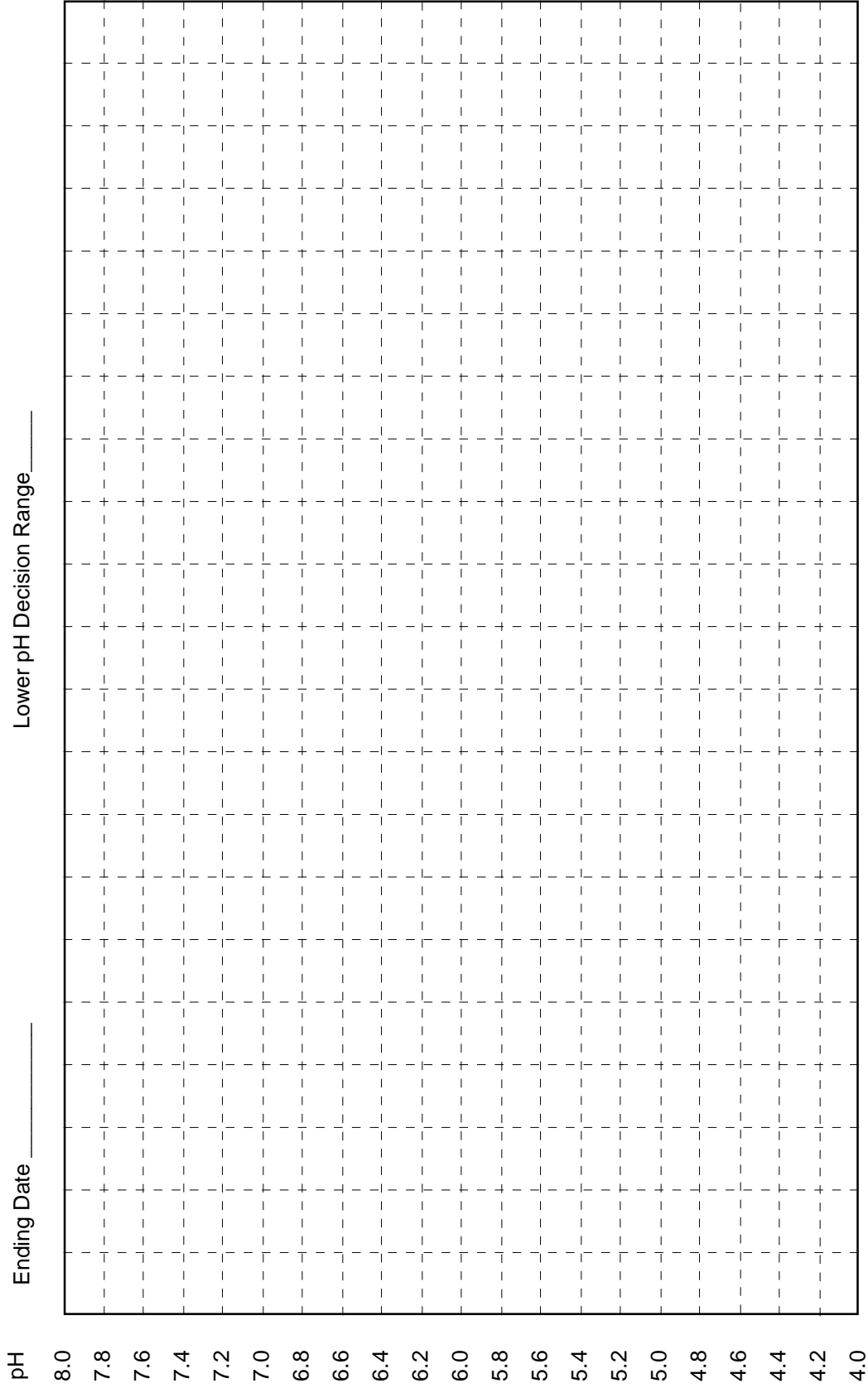
Figure 2. Suggested substrate pH ranges for specific greenhouse crops grown in soilless substrate.



Crop _____ Target pH Range _____

Starting Date (week 0) _____ Upper pH Decision Range _____

Ending Date _____ Lower pH Decision Range _____



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Week

Crop _____

Target pH Range _____

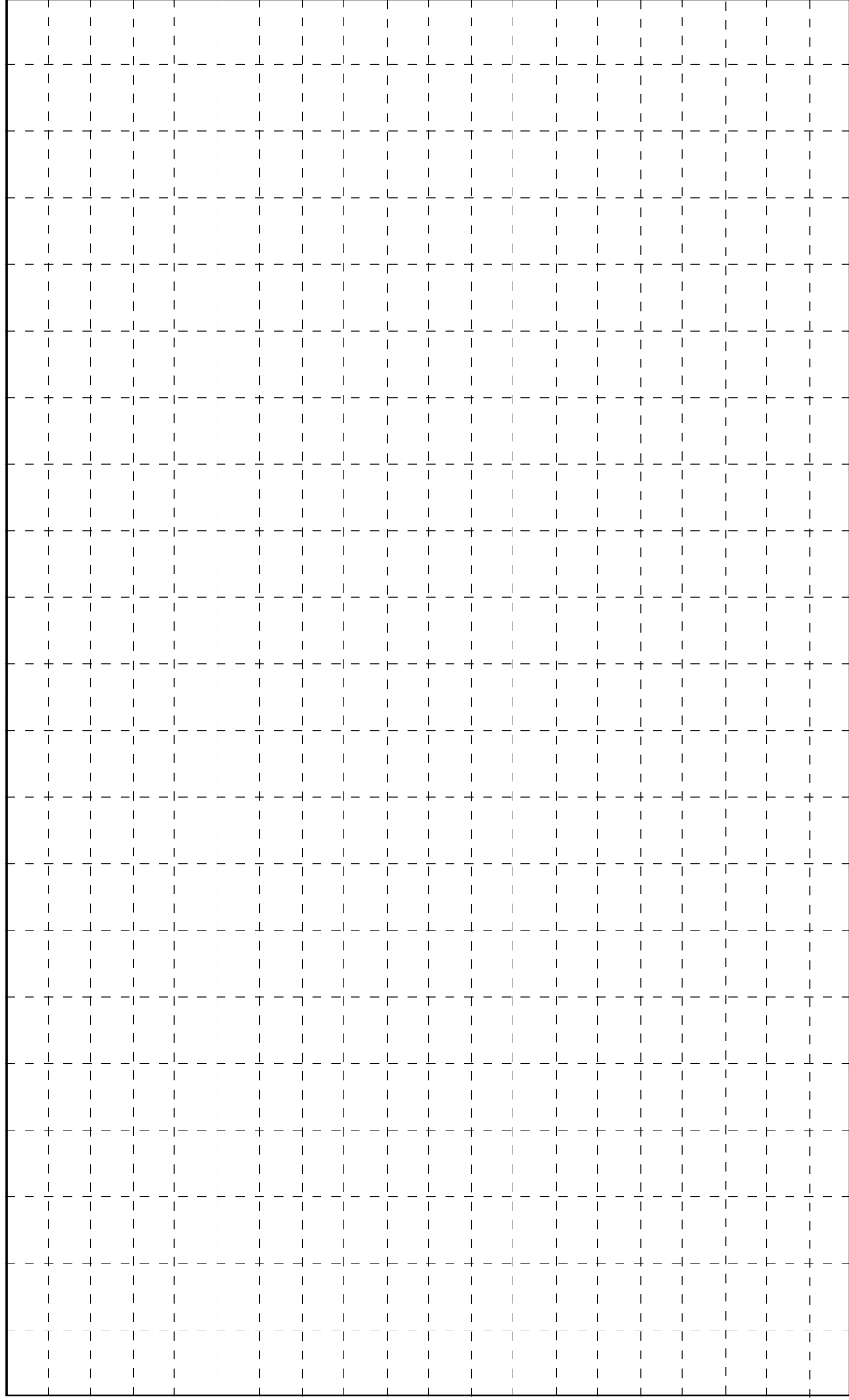
Starting Date (week 0) _____

Upper pH Decision Range _____

Ending Date _____

Lower pH Decision Range _____

pH 8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0



Week

Crop _____ Target pH Range _____

Starting Date (week 0) _____ Upper pH Decision Range _____

Ending Date _____ Lower pH Decision Range _____

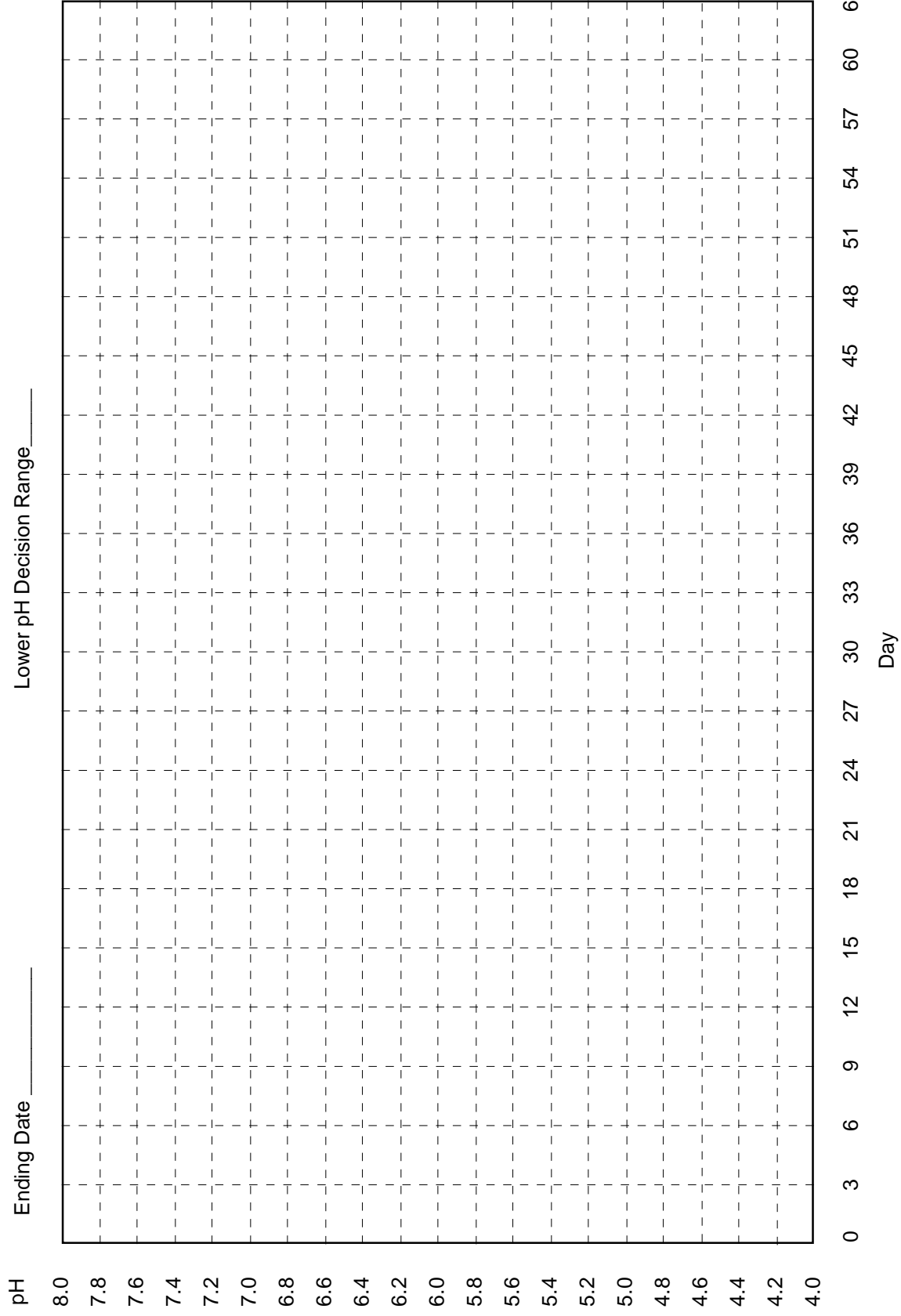


Table 1. The relative nutrient requirements of actively growing greenhouse crops, with EC ranges for both the SME and PourThru methods. Use this classification system and the examples provided in Figure 1 for the SME method or Figure 2 for the PourThru method to determine the suggested target EC ranges for the entire crop production cycle.

Light (SME EC of 0.76 to 2.0 mS/cm) (PourThru EC of 1.0 to 2.6 mS/cm)		Medium (SME EC of 1.5 to 3.0 mS/cm) (PourThru EC of 2.0 to 3.5 mS/cm)	
Aconitum	Crocus (no fertilizer)	Alstroemeria	Kalanchoe
African violet	Cuttings (during rooting)	Alyssum	Larkspur
Ageratum	Cyclamen	<i>Bougainvillea</i>	Lily, Asiatic & Oriental
Amaryllis (no fertilizer)	Freesia	Calendula	Lily, Easter
Anemone	Geranium (seed)	<i>Campanula</i>	Lobelia
<i>Anigozanthos</i>	Gerbera	Cactus, Christmas	Morning glory
<i>Asclepias</i>	Gloxinia	Carnation	Onion
Aster	Impatiens	Cauliflower	Ornamental Kale
Astilbe	Marigold	Centaurea	Ornamental Pepper
Azalea	<i>Narcissus</i> (no fertilizer)	Cleome	Oxalis
Balsam	New Guinea Impatiens	Clerodendrum	Pepper
Begonia (fibrous)	Orchids	<i>Crossandra</i>	Petunia
Begonia (Hiemalis)	Pansy	Dahlia	Phlox
Begonia (Rex)	Plugs	Dianthus	<i>Platycodon</i>
Begonia (tuberous)	Primula	Dusty Miller	Portulaca
Caladium	Salvia	Exacum	Ranunculus
Calceolaria	Streptocarpus	Geranium (cutting)	Rose
Calla Lily	Snapdragon	Hibiscus	Sunflower (potted)
Celosia	Zinnia	Hydrangea	Tomato
Cineraria		Jerusalem Cherry	Verbena
Coleus			
Cosmos			
		Heavy (SME EC of 2.0 to 3.5 mS/cm) (PourThru EC of 2.6 to 4.6 mS/cm)	
		Chrysanthemum	
		Poinsettia	

Adapted from:

- Bunt, A.C. 1988. Media and mixes for container-grown plants. Unwin Hyman Press. pp. 309.
- Devitt, D.A. and R.L. Morris. 1987. Morphological response of flowering annuals to salinity. J. Amer. Soc. Hort. Sci. 112:951-955.
- Dole, J. and H. Wilkins. 1999. Floriculture principles and species, Prentice Hall
- Hofstra, G. and R. Wukasch. 1987. Are you pickling your pansies? Greenhouse Grower. Sept: 14-17.
- Nelson, P.V. 1996. Macronutrient fertilizer programs, p. 141-170. In: D.W. Reed. Water, media, and nutrition for greenhouse crops. Ball Publ., Batavia, IL.
- Wilkerson, D.C. Soilless growing media and pH. Texas Greenhouse Management Handbook. p. 30-34, 45-47.

Stage of Crop Development. The nutrient demands of a crop vary by development stage. Plugs and cutting which are rooting require lower levels of fertility. Fertilizer demands of plugs or cuttings increase as they become established in the growing container. Actively growing plants

have the highest nutrient demands. Finally, nutrient demands decrease as plants set buds and flowers. In fact, extensive research has shown that flower longevity is increased when fertilizer rates are decreased or terminated at visible bud or just prior to flowering.

An EC M&M plan should be fine-tuned to account for each crop’s nutrient demands and stage of development. Use the classification system in Table 1 to establish target EC levels for actively growing plants using either the SME or PourThru extraction methods. Figure 1 (SME) or Figure 2 (PourThru) contains examples of how to adjust your target EC levels to account for the establishment and bloom stages of growth. Table 2 contains interpretative EC values for the 1:5, 1:2, SME, and PourThru extraction procedures. This will help in comparing among the methods and help in establishing target values.

Recording Substrate EC

You should test your crop substrate EC on a routine basis to detect trends over time. Samples can be analyzed either within the operation or sent to a commercial lab. Growers should test their substrate EC prior to use, to assure the EC is within the proper range. The frequency of testing depends on the crop type and stage of development. Weekly testing should be sufficient

for crops such as flats of bedding plant and 4” pots. For long-term crops grown in larger containers (such as 6” poinsettias), monitoring every two weeks may be sufficient to avoid out-of-range substrate EC. A minimum of 5 plants should be tested per block of plants. An average is used to determine if corrective procedures need to be done.

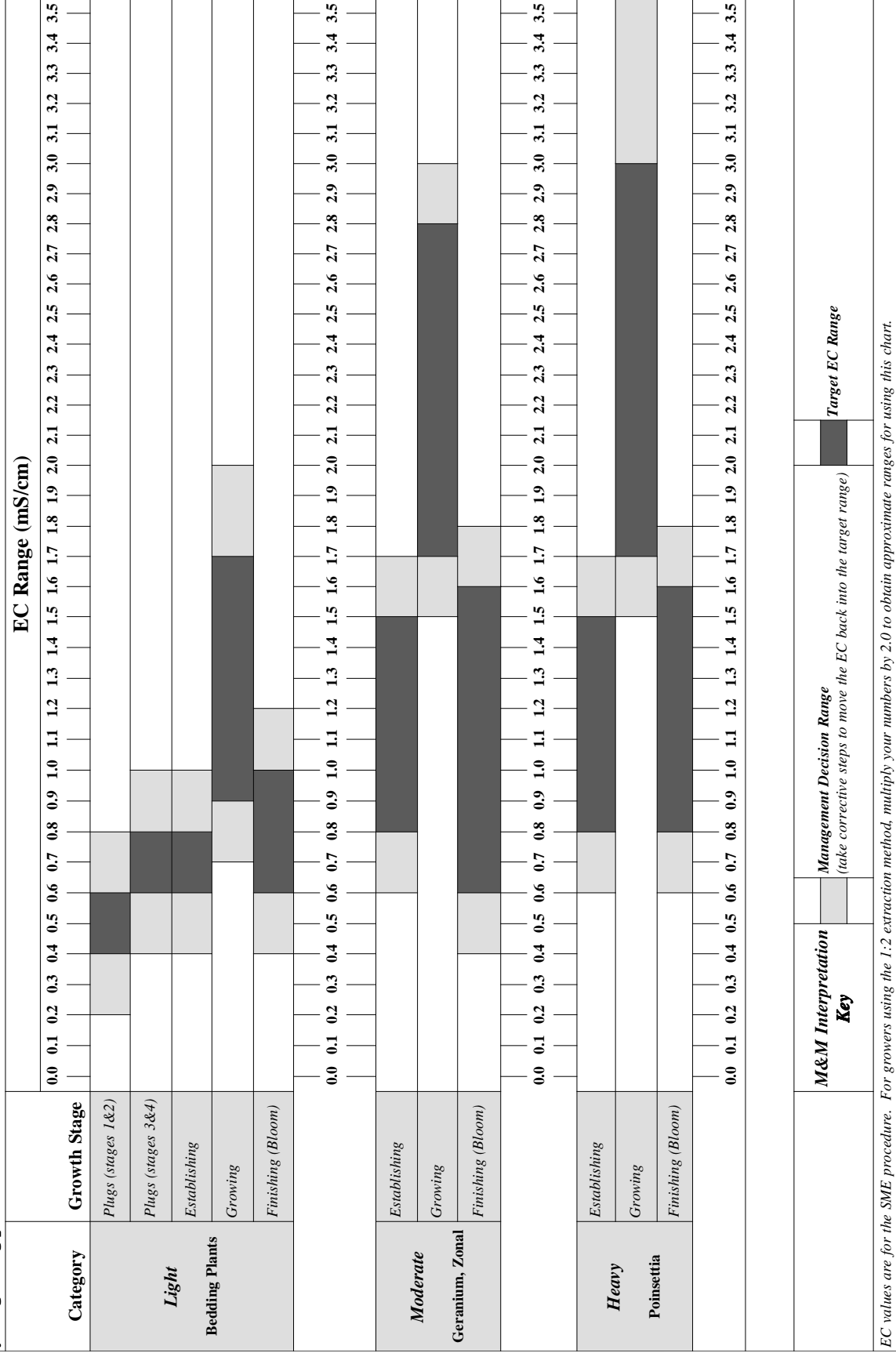
Interpreting Substrate EC

We have developed EC recording charts for your use with the SME and PourThru extraction method and with different time scales at the bottom (located on the following pages). Using the PourThru extraction method values as our example, fill in the target EC range for the active growth phase of the crop based on Table 1 and Figure 2 or your own experiences. Account for the possible lower EC levels during the plant establishment and bloom stages of growth. Establish the upper EC decision range. If the substrate EC climbs into or above this range, action should be taken to lower EC. Decide on

1 : 5	1 : 2	SME	PourThru ²	Indication
0 to 0.12	0 to 0.25	0 to 0.75	0 to 1.0	Very Low. Nutrient levels may not be sufficient to sustain rapid growth.
0.12 to 0.35	0.26 to 0.75	0.76 to 2.0	1.0 to 2.6	Low. Suitable for seedlings, bedding plants and salt sensitive plants.
0.36 to 0.65	0.76 to 1.25	2.0 to 3.5	2.6 to 4.6	Normal. Standard root zone range for most established plants. Upper range for salt sensitive plants.
0.66 to 0.89	1.26 to 1.75	3.5 to 5.0	4.6 to 6.5	High. Reduced vigor and growth may result, particularly during hot weather.
0.9 to 1.10	1.76 to 2.25	5.0 to 6.0	6.6 to 7.8	Very High. May result in salt injury due to reduced water uptake. Reduced growth rates likely. Symptoms include marginal leaf burn and wilting.
> 1.1	> 2.25	> 6.0	> 7.8	Extreme. Most crops will suffer salt injury at these levels. Immediate leaching required.

¹ Adapted from: On-site testing of growing media and irrigation water. 1996. British Columbia Ministry of Agriculture.
² Due to the variability of the PourThru technique results, growers should always compare their results to the SME method to establish acceptable ranges.

Figure 1. Suggested substrate SME EC ranges for floricultural crops grown in soilless substrate. These values are guidelines and adjustments should be made based on your growing practices.



Crop _____

Target EC Range _____

Starting Date (week 0) _____

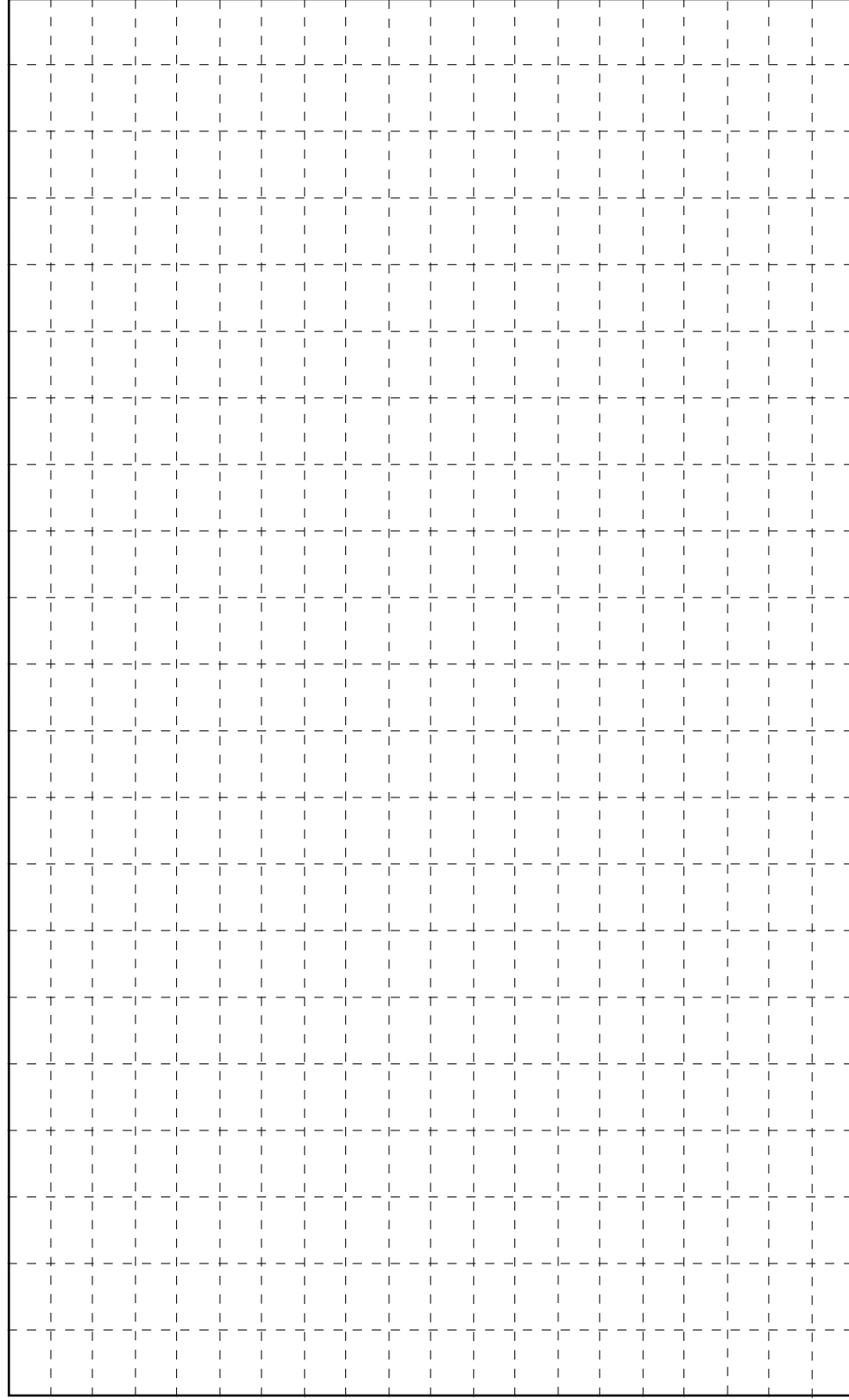
Upper EC Decision Range _____

PourThru

Ending Date _____

Lower EC Decision Range _____

EC (mS/cm)
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Week

Crop _____

Target EC Range _____

Starting Date (week 0) _____

Upper EC Decision Range _____

Ending Date _____

Lower EC Decision Range _____

PourThru

EC (mS/cm)

6.50

6.25

6.00

5.75

5.50

5.25

5.00

4.75

4.50

4.25

4.00

3.75

3.50

3.25

3.00

2.75

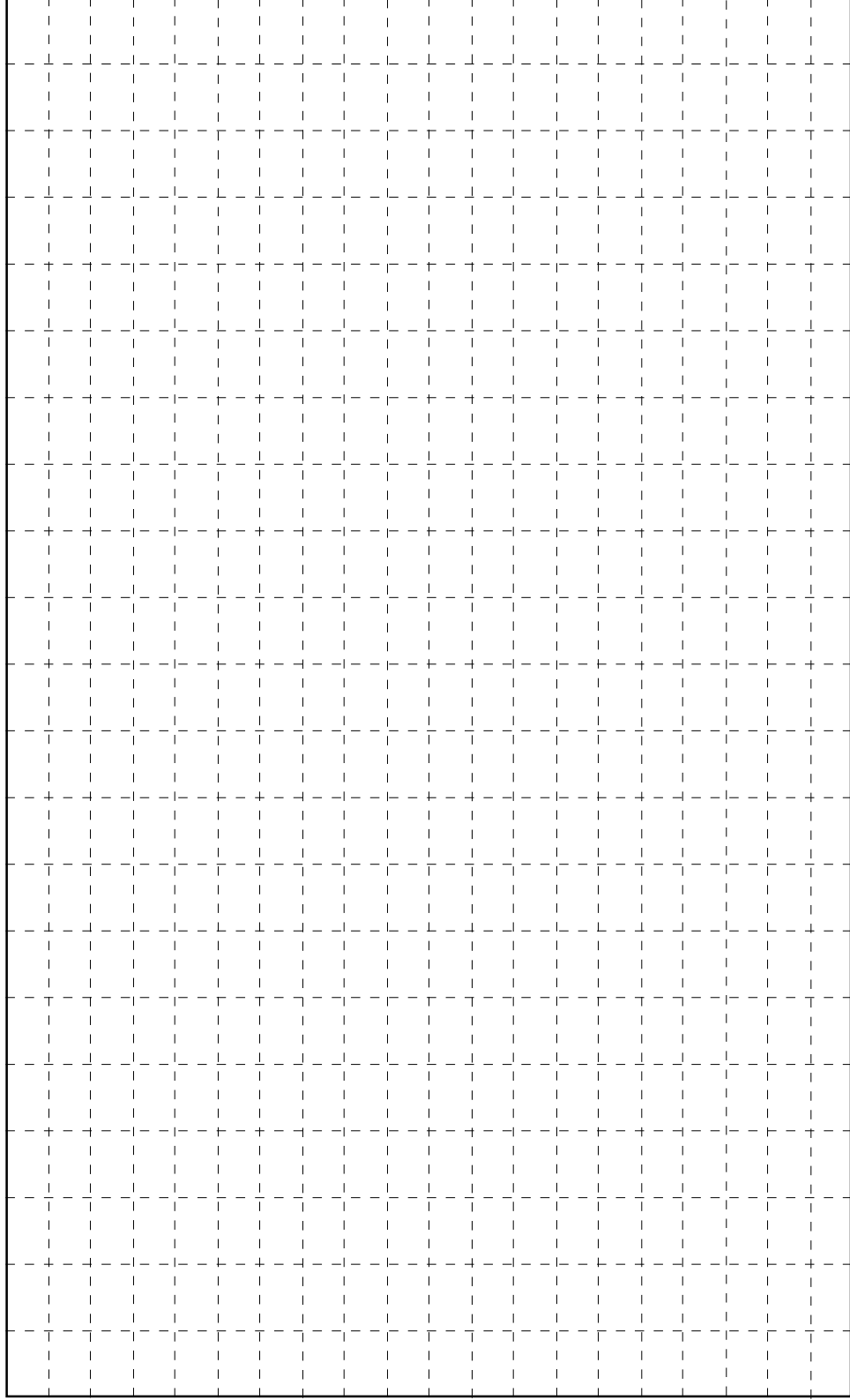
2.50

2.25

2.00

1.75

1.50



0 1 2 3 4 5 6 7 8 9 10

Week

Crop _____

Target EC Range _____

Plugs

Starting Date (week 0) _____

Upper EC Decision Range _____

SME &

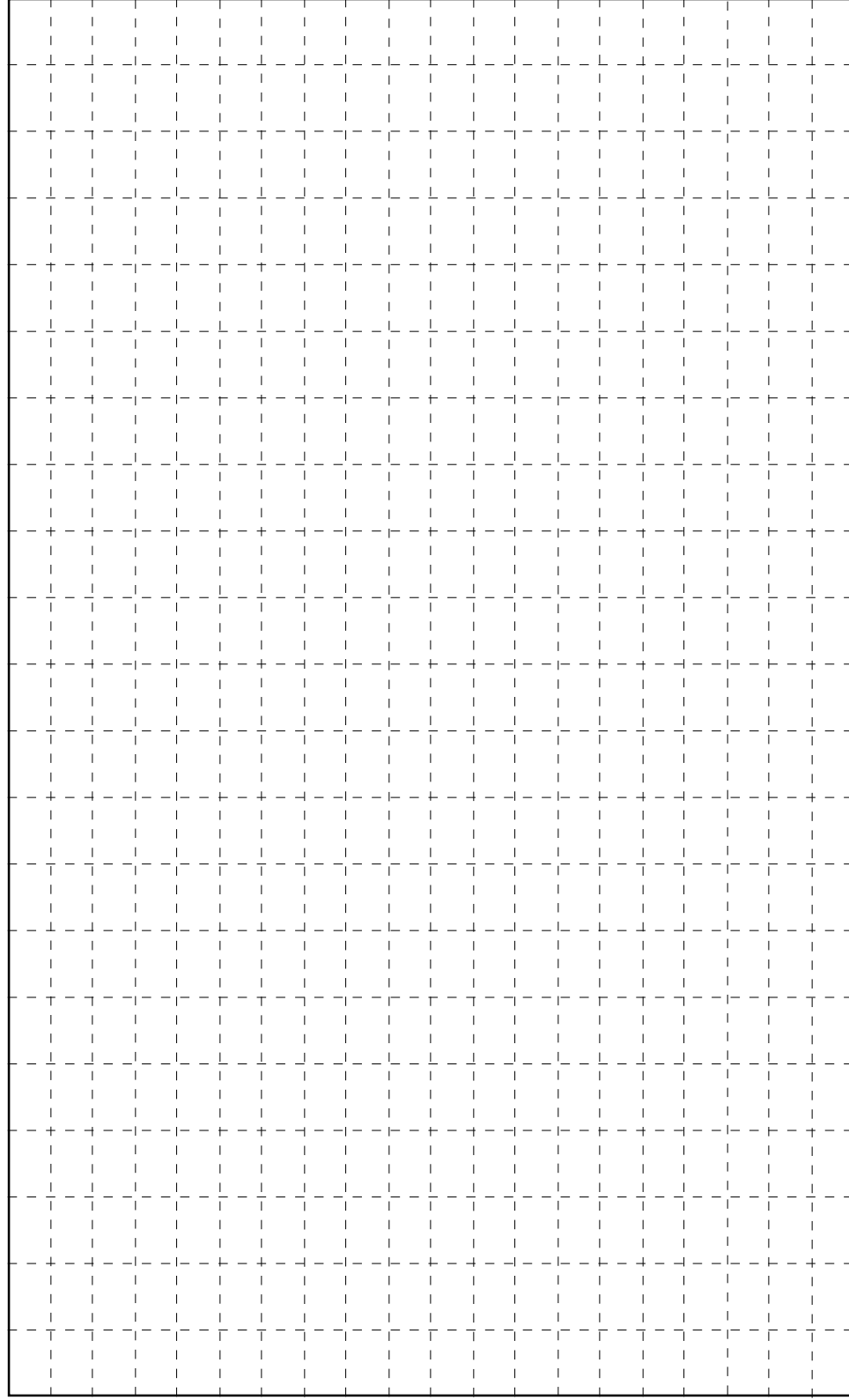
Ending Date _____

Lower EC Decision Range _____

Pour Thru

EC
(mS/cm)

4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00



0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63

Day

Crop _____

Target EC Range _____

SME

Starting Date (week 0) _____

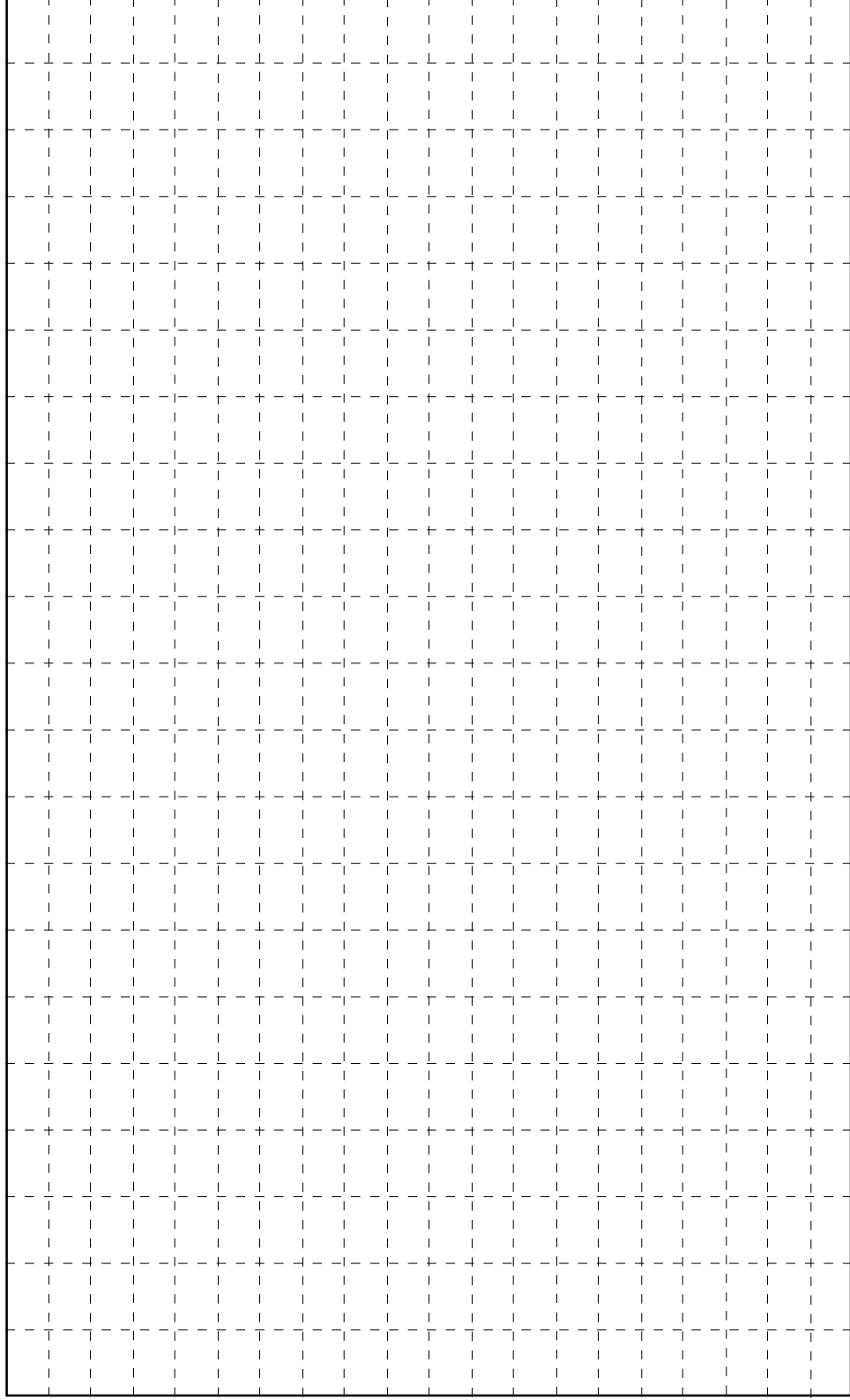
Upper EC Decision Range _____

Ending Date _____

Lower EC Decision Range _____

EC
(mS/cm)

5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Week

Crop _____

Target EC Range _____

Starting Date (week 0) _____

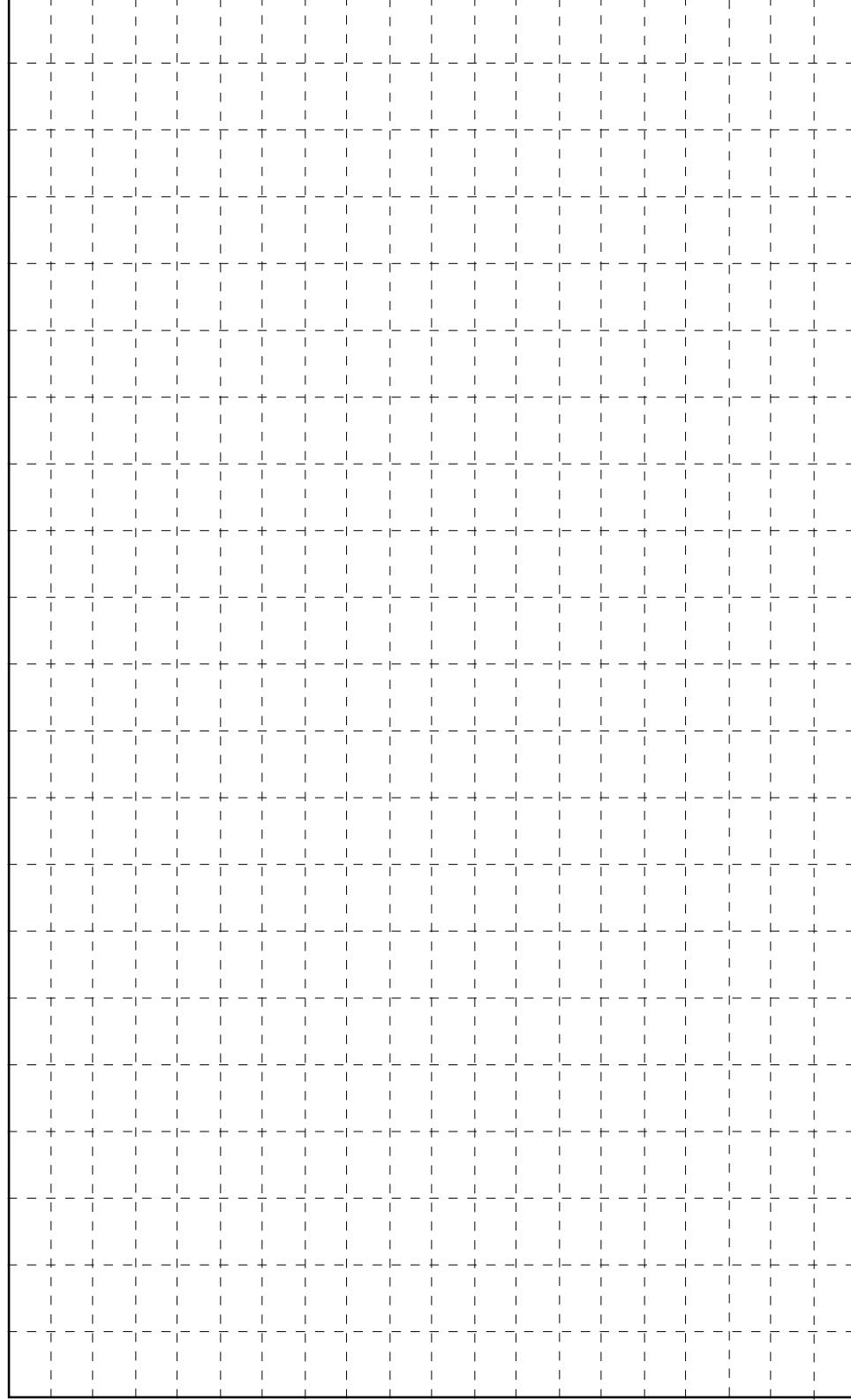
Upper EC Decision Range _____

Ending Date _____

Lower EC Decision Range _____

SME

EC (mS/cm)
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00



0 1 2 3 4 5 6 7 8 9 10

Week