2 General Information

2.1 Introduction

Cornell's 2006 Pest Management Guidelines for Berry Crops is intended to aid the berry grower with general nutrient guidelines and insect, mite, disease, and weed management decisions. Both cultural and chemical management practices are provided.

Although this guide is intended primarily for commercial growers, smaller producers may use it by converting guidelines to the appropriate unit (Table 1).

Table 1. Conversion factors to convert from one unit to another.

To convert from	To	Multiply by
lb/A	lb/100 sq ft	**0.0023**
tn/A	lb/100 sq ft	**4.6**
lb/A	kg/ha	**1.12**
kg/ha	lb/A	**0.893**
lb	oz	**16**
qt of fruit	lb of fruit	**1.5**
qt	pt	**2.0**
pt	qt	**0.5**
gal of liquid	lb of liquid	**8.3**
Strawberries		
lb/A	lb/100 ft of row	**0.008**
Yield in lb/100 ft of row	lb/A	**125**
Yield in qt/100 ft of row	lb/A	**188**
Raspberries and Blackberries		
lb/A	lb/100 ft of row	**0.0184**
lb/A	oz/plant	**0.009**
Yield in lb/100 ft of row	lb/A	**55**
Yield in pt/100 ft of row	lb/A	**73**
Blueberries		
lb/A	oz/plant	**0.015**
Yield in lb/100 ft of row	lb/A	**44**
Yield in pt/100 ft of row	lb/A	**58**
Currants and Gooseberries		
lb/A	oz/plant	**0.012**
lb/A	lb/100 ft of row	**0.0184**
Yield in lb/100 ft of row	lb/A	**55**
Yield in pt/100 ft of row	lb/A	**73**

2.2 Calculating Fungicide and Insecticide Rates for Small Plantings

Recommended fungicide and insecticide rates are presented in terms of product weight or volume per planted acre (i.e., including spaces between rows). For individual small plantings, these rates can be converted by multiplying the recommended pesticide rate (number of pounds, ounces, quarts, etc. per acre) x (number of square feet of individual planted area) divided by (43,560). The resulting figure is the amount of pesticide (in pounds, ounces, quarts, etc.) you will need to apply to the particular planted area in question.

2.3 Site Selection and Preparation

Preparations for a berry planting must begin one year in advance. Select a site with good air and water drainage and have a soil and a nematode analysis performed on representative soil samples. Obtain soil test instructions and sample bags from your local Cooperative Extension Office or from Cornell University, Nutrient Analysis Lab, 804 Bradfield Hall, Ithaca, NY 14853 or call 607-255-4540, or visit http://www.css.cornell.edu/soiltest/ or email djm77@cornell.edu. Samples may be submitted for nematode testing to the Plant Disease Diagnostic Clinic, College of Agriculture and Life Sciences, Ithaca, NY. The best time for collecting samples for nematode testing is during the active growing season. A minimum of 6 soil subsamples, approx. 1" in diameter and 4" in depth should be collected randomly from an area approx. ½ acre in size. Gently mix samples together, transfer about 1 pint of mixed soil to a plastic bag. For best results, ship as soon as possible to the diagnostic lab. Refrigerate sample if it cannot be shipped immediately. For more information and fee schedules visit their website at http://PlantClinic.cornell,edu.

Follow the recommendations of the soil and nematode tests to ensure a good planting in future years. A nutritionally healthy planting in a well-drained soil with exposure to air movement is least susceptible to damage from pests.

2.4 Fumigation

Fumigation may be required if nematode levels are high or if pathogenic fungi or insect pests are present in the soil. Fumigation also provides some weed control (Table 2). The grower can apply some types of fumigants; others must be custom applied. Soil should be friable and moist prior to fumigation, and the soil temperature should be 50° to 90°F. All plant material must be decomposed prior to fumigation.

Table 2. Fumigation suggestions for berry plantings.

Fumigant	Formulation	Rate/acre	EPA Reg. No.
†*1,3 dichloropropene	*Telone II	9-36 gal	62719-32
Better, on cold, dry soils than most other fumigants. Effective on nematodes only.			
†*1,3 dichloropropene + chloropicrin	Telone-C17	10-41 gal	62719-12
Used as a preplant fumigant for strawberries. Controls soilborne diseases and nematodes; little weed control.			
methyl dithiocarbamate	Vapam	40-400 gal	5481-466
Can be applied through irrigation system. Broad-spectrum control of weeds, soilborne diseases, and nematodes.			

*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

† Not for use in Nassau and Suffolk Counties. Pesticide labels that indicate 'Not for use on Long Island, NY' mean that use is prohibited in Nassau and Suffolk Counties only.

CAUTION: Vapors from all fumigants are harmful. Strictly follow cautions given on label.

2.5 Cover Crops

A cover crop planted in late summer after soil fumigation will suppress annual weed growth, improves soil texture, provide organic matter, and may increase soil nitrogen. The cover crop can be incorporated in late fall or in the spring before planting. Certain cover crops (marigold, sudangrass) will either suppress or resist nematode populations. These should be considered on lighter soils or where fumigation is not an option. See Table 3.

Table 3. Suitable cover crops to grow the year before planting berries.

Cover crop	Last day to plant	Seeding rate (lb/a)
Rye	October 1	80-100
Oats	September 15	60-100
Wheat	September 15	80-100
Vetch	September 1	30-40
Ryegrass	August 15	15
Barley	August 15	75-100
Sweet Clover	August 15	20
Red clover	August 15	10-20
Buckwheat	August 1	75
Marigold	July 1	5-10
Sudangrass	July 1	50-90

2.6 Nutrient Guidelines

Maintaining healthy plants is an essential component of pest management. Furthermore, avoiding excessive chemical inputs into the agroecosystem should be an objective of the conscientious grower. The first step in nutrient management is to adjust the soil pH to 6.5 before planting (4.5 for blueberries). Use the soil test results to determine the appropriate amount of lime, sulfur, potash, and phosphorus. Sulfur is useful for lowering the soil pH for blueberry production. The amount of sulfur required depends on soil type, cation exchange capacity, and current pH. In established plantings, sulfur also can be used, but apply no more than 400 lb in any one year, preferably split between fall and spring.

Table 4. Approximate amounts of sulfur (lb/A) required to lower soil pH to 4.5.

	Soil type		
Current pH	**Sand**	**Loam**	**Clay**
5.0	175	530	800
5.5	350	1050	1600
6.0	660	2020	3030
6.5	840	2550	3830

The following are typical nitrogen guidelines for berry crops planted in sites where preplant soil nutrient guidelines were followed. Use leaf analysis for determination of nutrient status in established plantings, and adjust nitrogen fertilization accordingly (see pg. 12). Apply N in a 3 foot band in the row.

Table 5. Nitrogen guidelines for berry crops.

Crop	Age of planting	Amount/timings (actual N)	N source	Comments
Strawberries				
	0	30 lb/A, early June	calcium nitrate	Be sure plants are growing well prior to application.
		30 lb/A, early Sept	ammonium nitrate or calcium nitrate	
	1+	70 lb/A, at renovation 30 lb/A, early Sept	ammonium nitrate, urea, calcium nitrate	Adjust fall amount based on leaf analysis.
Raspberries and Blackberries (summer-bearing)				
	0	25-35 lb/A, 4 weeks after planting	calcium nitrate	Avoid touching plants after planting with fertilizers.
	1	35-55 lb/A in May or split between May and June	urea or ammonium nitrate	Use higher amount on sandier soils or if irrigation is used.
	2+	40-80 lb/A, in May or split between May and June	urea or ammonium nitrate	Use higher amount on sandier soils or if irrigation is used.
Raspberries (fall-bearing)				
	0	25 lb/A, 4 weeks after planting	calcium nitrate	Avoid touching plants after planting with fertilizers.
	1	50-80 lb/A, split between May and June	urea or ammonium nitrate	Use higher amount on sandier soils or if irrigation is used.
	2+	70-100 lb/A, split between May and June	urea or ammonium nitrate	Use higher amount on sandier soils or if irrigation is used. Adjust with leaf analysis.
Blueberries				
	0	Do not fertilize newly planted blueberries *Split between May and June*		Soil should be adjusted to pH=4.5 prior to planting.
	1	15 lb/A	ammonium sulfate or urea	Use ammonium sulfate where soil pH is >5.0
	2	20 lb/A		
	3	25 lb/A		
	4	35 lb/A		
	5	45 lb/A		
	6	55 lb/A		
	7+	65 lb/A		

Table 5. Nitrogen guidelines for berry crops.

Crop	Age of planting	Amount/timings (actual N)	N source	Comments
Currants and Gooseberries				
	0	25 lb/A, 4 weeks after planting	calcium nitrate	
	1	50-80 lb/A, split between May, June, August	calcium nitrate	
	2+	70-100 lb/A, split between May and early August	calcium nitrate	

Table 6. Nitrogen sources and calculation of actual N.

Fertilizer	% actual N in fertilizer
Ammonium nitrate	34.0
Ammonium sulfate	20.5
Calcium nitrate	15.0
Diammonium phosphat	17.0
Potassium nitrate	13.0
Urea	46.0

To calculate the actual amount of fertilizer to apply, divide the desired amount of actual N by the percent N in the fertilizer and then multiply the result by 100. Apply the total amount of fertilizer in a 3-foot band in the row (1 foot for strawberries).

2.7 Other Nutrients

If preplant recommendations are followed, additional P and K likely will not be required unless the soil is very sandy. In the event that potassium is required, the maximum amount of K that one should apply in any one year is 250 lb/A. At these high rates, potassium sulfate (50% K_2O) is a better choice than muriate of potash (60% K_2O), which contains chlorides.

Magnesium is frequently low in blueberry plantings. A typical amount to apply in low to deficient situations is 50-200 lb/A as magnesium sulfate (20% Mg).

Boron is frequently low in fruit plantings throughout the Northeast. If boron is required, then apply no more than 2 lb/A actual boron (10 lb/A solubor) in any one year.

SOIL TEST- Obtain instructions and sample bags from your local Cooperative Extension Office or from Cornell University, Nutrient Analysis Lab, 804 Bradfield Hall, Ithaca, NY 14853 or call 607-255-4540, or visit www.css.cornell.edu/soiltest/or email djm77@cornell.edu.

Leaf Analysis

Strawberries:	Collect 30 leaflets after renovation in July or August.
Raspberries:	Collect 30 newly expanded leaflets from primocanes in early August.
Blueberries:	Collect 30 newly expanded leaves from well-exposed branches in late July.

Wash dirt off leaves, remove excess water, place leaves in a paper bag, dry them, and send to Cornell Nutrient Lab at address listed above for soil test.
Enclose a check for $29, along with the proper form(s) available from the Lab. Request routine tissue analysis ($17) AND *Kjeldahl nitrogen ($12).*

2.8 Principles of Weed Management

Managing weeds is very difficult in berry plantings because of the relatively small size and the low competitive ability of the crop. Good preplant preparation, use of cover crops and crop rotation help reduce weed pressure considerably.

Perennial weeds should be eliminated from the site before planting. This can be achieved with repeated cultivation or with an application of a non-selective systemic herbicide.

It is important to keep areas around the field mowed to prevent weed seeds from blowing into the planting. Also, cultivating, mulching, and pulling weeds by hand help maintain weed-free berry plantings. A chemical strategy alone cannot provide satisfactory weed control for most growers.

Herbicides should be selected on the basis of the anticipated weed problem. Not all herbicides are equally effective against all weeds. Some work only on grasses and others work only on broadleaf weeds (Table 7). In addition, some are only effective when applied prior to seed germination, and others are only effective against emerged weeds. If possible, avoid using the same herbicide in consecutive years. In some cases, mixtures of herbicides at low rates are more effective than high rates of a single herbicide.

Table 7. Effectiveness of labeled herbicides on different classes of weeds.

Note: Not all herbicides are labeled for all crops. Check crop-specific tables in this publication.

Herbicide	Formulation	Annual Grasses	Perennial Grasses	Annual Broadleaves	Perennial Broadleaves
2,4-D	Clean Crop Amine 4	None	None	Good	Good
Excellent postemergent control of morning glory, cocklebur, lambsquarters, pigweed, ragweed, and smartweed. Good control of dandelion.					
clethodim	Select	Good	Good	None	None
Excellent postemergent control of most annual and perennial grasses.					
clopyralid	Stinger	None	None	Specific	Specific
Excellent control of broadleaf weeds in the Composite and Legume families, including dock, jimsonweed, nightshade, ragweed, and sorrel. Little control of other broadleaf weeds.					
†DCPA	Dacthal	Good	None	Fair	None
Good preemergent control of chickweed, foxtail, crabgrass, and lambsquarters. Poor control of mustards and Panicum grasses.					
dichlobenil	Casoron	Good	Good	Good	Good
Good preemergent control of a range of annual and perennial species, including ferns, rushes, and sedges.					
fluazifop-butyl	Fusilade	Good	Good	None	None
Postemergent control of many species when applied to actively growing grasses.					
glyphosate	Roundup	Good	Good	Good	Good
Excellent postemergent control of most weeds. No preemergent activity. Consult label for specific rates for problem weeds.					
napropamide	Devrinol	Good	None	Fair	None
Preemergent control of most annual grasses and chickweed, knotweed, thistle, and sorrel.					

Table 7. Effectiveness of labeled herbicides on different classes of weeds.

Note: Not all herbicides are labeled for all crops. Check crop-specific tables in this publication.

Herbicide	Formulation	Annual Grasses	Perennial Grasses	Annual Broadleaves	Perennial Broadleaves
†norflurazon	Solicam	Good	Fair	Good	Poor
Suppresses nutsedge and perennial grasses. Preemergent control of other grasses.					
oryzalin	Surflan	Good	None	Fair	None
Preemergent control of most grasses and lambsquarters, pigweed, and purslane.					
***paraquat**	*Gramoxone Max	Good	Poor	Good	Poor
Kills annual weeds and the tops of perennial weeds.					
pelargonic acid	Scythe	Good	Poor	Good	Poor
Kills annual weeds and the tops of perennial weeds. Scythe is a contact, non-selective broad spectrum, foliarly-applied herbicide that is not translocated.					
***pronamide**	*Kerb	Good	Good	Fair	None
Controls annual bluegrass at all stages of growth. Excellent preemergent control of ryegrass, barnyardgrass, orchard-grass, foxtails, and nightshade. Partial suppression of quackgrass and chickweed.					
sethoxydim	Poast	Good	Good	None	None
Good postemergent control of most annual and perennial grasses.					
simazine	Princep	Fair	Poor	Good	Poor
Preemergent control of most broadleaf weeds and bluegrass, ryegrass, and crabgrass.					
terbacil	Sinbar	Good	Fair	Good	Poor
Preemergent control of chickweed, crabgrass, foxtail, henbit, lambsquarters, marestail, peppergrass, ryegrass, shepherdspurse, mustards, yellow rocket, prickly lettuce, nightshade, knotweed, ragweed, and smartweed and partial control of quackgrass, nutsedge, and sorrel.					

*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

† Not for use in Nassau and Suffolk Counties. Pesticide labels that indicate 'Not for use on Long Island, NY' mean that use is prohibited in Nassau and Suffolk Counties only.

When choosing to use chemicals, the best weed management is achieved with herbicide combinations – for example, a preemergent grass herbicide mixed with a preemergent broadleaf herbicide. Late fall is usually a suitable time for preemergent applications. An additional application can be made to June-bearing strawberries at renovation.

Purple raspberries and tissue-cultured raspberries in their first year are sensitive to most preemergent herbicides. Napropamide appears to be the least phytotoxic of all the chemicals labeled for this use. Planting through polyethylene mulch or using straw mulch is a better alternative to either cultivation or herbicides in the planting year. Many cultivars of strawberries are also sensitive to terbacil (Sinbar). Use herbicides with caution.

Herbicides are applied on the basis of the sprayed area. Use formula below to calculate rates needed. For example, if plants are set in rows 8 feet apart and there is to be a 4-foot grass aisle and a 4-foot weed-free strip, only 50 percent of the given rate of herbicide will be required per planted acre.

Width of weed-free strip distance between rows	**x**	**Recommended rate of herbicide**	**=**	**Rate per planted acre**

2.9 Principles of Insect and Disease Management

Berry crops are especially susceptible to insects and diseases, and few pesticides are registered for use against insects and diseases. Fortunately, many cultural practices can be used to reduce pest populations and activities, and these should always be used to complement pesticides or circumvent their use.

Choosing cultivars resistant to pests and diseases can reduce pesticide applications considerably. Chemicals should only be used when anticipated crop damage exceeds an acceptable level. Overuse can lead to the development of resistant races and the contamination of nontarget sites. Growers should carefully monitor their plantings and apply pesticides only when needed.

Pesticides are derived from either natural sources or manufactured artificially.