



# Contents

## What's new

### Introduction

A.1	Agronomy at a glance .....	xvi
A.2	Crop overview.....	xvii
A.3	Key management issues .....	xvii
A.4	End uses.....	xviii

## 1 Planning/Paddock preparation

1.1	Paddock selection.....	1
	<i>Soil management</i> .....	2
1.2	Paddock rotation and history.....	2
1.3	Benefits of sunflower as a rotation crop.....	3
1.4	Disadvantages of sunflower as a rotation crop.....	3
1.5	Fallow weed control.....	3
1.6	Seedbed requirements.....	4
1.7	Soil moisture.....	5
	1.7.1 Irrigation.....	6
1.8	Yield and targets .....	7
	1.8.1 Seasonal outlook .....	7
	1.8.2 Water Use Efficiency .....	8
	1.8.3 Nutrient efficiency.....	8
	1.8.4 Double-crop options .....	10
1.9	Nematode status of paddock.....	10
	1.9.1 Nematode testing of soil.....	10
	1.9.2 Effects of cropping history on nematode status.....	11
1.10	Insect status of paddock.....	11
	1.10.1 Insect sampling of soil .....	11
	<i>Soil sampling by spade</i> .....	12
	<i>Germinating-seed bait technique</i> .....	12
	<i>Detecting soil-dwelling insects</i> .....	12

## 2 Pre-planting

2.1	Varietal performance .....	1
	2.1.1 Yielding ability.....	1
	2.1.2 Oil, protein or other quality traits .....	2
	2.1.3 Maturity.....	3

- 2.1.4 Head inclination and stem curvature ..... 3
- 2.2 Planting seed quality ..... 3**
  - 2.2.1 Seed size ..... 3
  - 2.2.2 Seed germination and vigour ..... 4
  - 2.2.3 Safe rates of fertiliser sown with the seed ..... 4
- 3 Planting**
  - 3.1 Seed treatments ..... 1
  - 3.2 Time of sowing ..... 2
  - 3.3 Targeted plant population ..... 3
  - 3.4 Calculating seed requirements ..... 5
  - 3.5 Sowing depth ..... 5
    - Row spacing ..... 5
  - 3.6 Sowing equipment ..... 6
- 4 Plant growth and physiology**
  - 4.1 Plant growth stages ..... 1
  - 4.2 Key development stages of sunflower ..... 2
    - 4.2.1 Germination and emergence ..... 2
    - 4.2.2 Development of the root system ..... 2
    - 4.2.3 Vegetative growth ..... 2
      - Defoliation ..... 4
    - 4.2.4 Bud initiation ..... 7
    - 4.2.5 Flowering ..... 7
    - 4.2.6 Seed filling ..... 9
    - 4.2.7 Physiological maturity ..... 10
    - 4.2.8 Crop desiccation ..... 11
  - 4.3 Sunflower phenology ..... 11
  - 4.4 Drivers of growth and development ..... 13
    - 4.4.1 Genetic ..... 13
    - 4.4.2 Environment ..... 13
      - Day length ..... 13
      - Temperature ..... 14
      - Moisture ..... 15
    - 4.4.3 Nutrition ..... 16
  - 4.5 Adverse effects on growth and development ..... 16
    - 4.5.1 Frost ..... 16
    - 4.5.2 Hail ..... 16
    - 4.5.3 Drought ..... 17
    - 4.5.4 Heat stress ..... 17
    - 4.5.5 Waterlogging ..... 18
  - 4.6 Photos of stages of sunflower development ..... 18

4.7 References and further reading .....22

**5 Nutrition and fertiliser**

5.1 Soil requirements .....2

    5.1.1 pH.....2

    5.1.2 Salinity.....2

    5.1.3 Soil cations and structural stability.....2

5.2 Declining soil fertility ..... 3

    5.2.1 Soil organic matter.....3

    5.2.2 Current situation.....6

    5.2.3 Options for reversing the decline in soil organic matter ..... 7

*Impact of fertiliser N inputs on soil* .....9

5.3 Soil testing ..... 9

    5.3.1 Test strips .....10

    5.3.2 Rules of thumb..... 11

    5.3.3 Soil testing for N..... 11

*Forms of N fertiliser*..... 11

*Calculating N fertiliser application* ..... 11

    5.3.4 Soil testing for P .....13

*Colwell-P* .....13

*BSES-P*.....13

*P buffering index*.....13

5.4 Plant tissue sampling.....14

5.5 Hierarchy of crop fertility needs.....15

5.6 Nitrogen .....16

5.7 Phosphorus.....19

5.8 Sulfur.....20

5.9 Potassium .....21

5.10 Boron .....21

5.11 Zinc.....22

5.12 Fertiliser application guidelines .....22

5.13 Nutritional disorders .....23

**6 Weed control**

6.1 Fallow weed control..... 4

6.2 Pre-emergent herbicides ..... 4

6.3 Post-emergent herbicides .....7

6.4 Inter-row spraying ..... 8

6.5 Cultural control: inter-row cultivation ..... 9

6.6 Potential herbicide damage effect.....10

6.7 References and further reading.....10

<b>7</b>	<b>Insect control</b>	
7.1	Establishment pests.....	1
7.2	Post-establishment pests.....	2
	<i>Bees</i> .....	2
	<i>Management</i> .....	2
7.3	False wireworms.....	4
	7.3.1 Damage .....	5
	7.3.2 Thresholds for control.....	5
	7.3.3 Management .....	5
7.4	True wireworm .....	6
	7.4.1 Damage .....	8
	7.4.2 Thresholds for control.....	8
	7.4.3 Management .....	8
7.5	Cutworms.....	9
	7.5.1 Damage .....	9
	7.5.2 Thresholds for control.....	9
	7.5.3 Management .....	10
7.6	Black scarab beetles.....	11
	7.6.1 Damage .....	11
	7.6.2 Thresholds for control.....	12
	7.6.3 Management .....	12
7.7	Thrips.....	13
	7.7.1 Onion thrips .....	13
	7.7.2 Tomato thrips.....	15
	7.7.3 Western flower thrips .....	16
	7.7.4 Damage .....	16
7.8	Thresholds for control .....	16
	7.8.1 Management .....	17
7.9	Wingless cockroaches.....	17
	7.9.1 Damage .....	18
	7.9.2 Thresholds for control.....	18
	7.9.3 Management .....	18
7.10	Black field earwig .....	19
	7.10.1 Damage .....	20
	7.10.2 Thresholds for control.....	20
	7.10.3 Management .....	20
7.11	Field crickets .....	21
	7.11.1 Damage .....	22
	7.11.2 Thresholds for control.....	22
	7.11.3 Management .....	22

<b>7.12 Rutherglen bug</b> .....	<b>23</b>
7.12.1 Damage .....	25
7.12.2 Monitoring.....	25
7.12.3 Thresholds for control.....	25
7.12.4 Management .....	26
Weed management.....	26
Insecticide use .....	26
Natural enemies.....	26
<b>7.13 Helicoverpa spp.</b> .....	<b>27</b>
7.13.1 Damage .....	30
7.13.2 Thresholds for control.....	30
7.13.3 Management .....	31
<b>7.14 Whiteflies</b> .....	<b>32</b>
<b>7.15 Greenhouse whitefly</b> .....	<b>33</b>
7.15.1 Damage .....	34
7.15.2 Thresholds for control.....	34
7.15.3 Management .....	34
7.15.4 <i>Bemisia tabaci</i> whitefly complex .....	35
7.15.5 Damage .....	36
7.15.6 Management .....	36
<b>7.16 Loopers</b> .....	<b>38</b>
7.16.1 Tobacco looper.....	38
7.16.2 Vegetable looper .....	39
7.16.3 Soybean looper .....	40
7.16.4 Damage .....	42
7.16.5 Thresholds for control.....	43
7.16.6 Management .....	43
<b>7.17 Green vegetable bug</b> .....	<b>44</b>
7.17.1 Damage .....	44
7.17.2 Thresholds for control.....	44
7.17.3 Management .....	44
<b>8 Nematode control</b>	
8.1 Resistant crops .....	1
<b>9 Diseases</b>	
9.1 Principles of disease management.....	1
9.1.1 IPM and biological control .....	1
9.2 Integrated disease management at the farm or crop level.....	2
9.3 Steps to effective disease management.....	3
9.3.1 Risk assessment.....	3
9.4 Providing an accurate diagnosis .....	4



9.4.1	Observations .....	4
9.4.2	Samples .....	12
	<i>Sending infected plant tissue</i> .....	12
9.5	Tools of the trade .....	13
9.6	Sunflower diseases: biology, symptoms, management .....	13
9.6.1	Rust ( <i>Puccinia helianthi</i> ) .....	13
	<i>Economic importance</i> .....	13
	<i>Survival and spread</i> .....	14
	<i>Conditions for infection</i> .....	14
	<i>Symptoms</i> .....	15
	<i>Control</i> .....	16
9.6.2	Powdery mildew ( <i>Golovinomyces cichoracearum</i> ) .....	16
	<i>Economic importance</i> .....	16
	<i>Survival and spread</i> .....	17
	<i>Conditions for infection</i> .....	17
	<i>Symptoms</i> .....	17
	<i>Strategies to minimise powdery mildew buildup</i> .....	18
9.6.3	Stem canker ( <i>Diaporthe/Phomopsis</i> spp.) .....	19
	<i>Economic importance</i> .....	19
	<i>Dispersal and spread</i> .....	20
	<i>Symptoms</i> .....	21
	<i>Infection conditions</i> .....	23
	<i>Control</i> .....	23
9.6.4	Phoma black stem ( <i>Phoma</i> spp.) .....	24
	<i>Economic importance</i> .....	24
	<i>Conditions for infection</i> .....	25
	<i>Dispersal and spread</i> .....	25
	<i>Symptoms</i> .....	25
	<i>Control</i> .....	28
9.6.5	Tobacco streak virus .....	29
	<i>Economic importance</i> .....	29
	<i>Conditions for infection</i> .....	29
	<i>Dispersal</i> .....	30
	<i>Survival</i> .....	30
	<i>Symptoms</i> .....	30
	<i>Control</i> .....	33
9.6.6	Alternaria blight ( <i>Alternaria helianthi</i> , <i>A. alternata</i> ) .....	33
	<i>Economic importance</i> .....	33
	<i>Dispersal and spread</i> .....	33
	<i>Conditions for infection</i> .....	33
	<i>Symptoms</i> .....	34
	<i>Control</i> .....	35
9.6.7	Sclerotinia rot ( <i>Sclerotinia sclerotiorum</i> , <i>S. minor</i> ) .....	35

<i>Economic importance</i> .....	35
<i>Survival and spread</i> .....	36
<i>Conditions for infection</i> .....	38
<i>Symptoms</i> .....	38
<i>Control</i> .....	40
<b>9.6.8 Sclerotium base rot, crown rot (<i>Sclerotium rolfsii</i>)</b> .....	<b>40</b>
<i>Economic importance</i> .....	40
<i>Dispersal and spread</i> .....	40
<i>Symptoms</i> .....	40
<i>Infection conditions</i> .....	41
<i>Control</i> .....	41
<b>9.6.9 White blister (<i>Albugo tragopogonis</i>)</b> .....	<b>42</b>
<i>Economic importance</i> .....	42
<i>Survival and spread</i> .....	42
<i>Conditions for infection</i> .....	42
<i>Symptoms</i> .....	42
<i>Control</i> .....	44
<b>9.6.10 Charcoal stem rot (<i>Macrophomina phaseolina</i>)</b> .....	<b>44</b>
<i>Economic importance</i> .....	44
<i>Survival and spread</i> .....	44
<i>Conditions for infection</i> .....	44
<i>Symptoms</i> .....	44
<i>Control</i> .....	47
<b>9.6.11 Rhizopus head rot (<i>Rhizopus</i> spp.)</b> .....	<b>47</b>
<i>Economic impact</i> .....	47
<i>Survival and spread</i> .....	47
<i>Conditions for infection</i> .....	47
<i>Symptoms</i> .....	48
<i>Control</i> .....	50
<b>9.6.12 Botrytis head rot or grey mould (<i>Botrytis cinerea</i>)</b> .....	<b>50</b>
<i>Economic importance</i> .....	50
<i>Survival and spread</i> .....	50
<i>Conditions for infection</i> .....	50
<i>Symptoms</i> .....	50
<i>Control</i> .....	52
<b>9.6.13 Verticillium wilt (<i>Verticillium dahliae</i>)</b> .....	<b>52</b>
<i>Economic importance</i> .....	52
<i>Survival and spread</i> .....	52
<i>Conditions for infection</i> .....	52
<i>Symptoms</i> .....	52
<i>Control</i> .....	53
<b>9.6.14 Septoria leaf spot (<i>Septoria helianthi</i>)</b> .....	<b>54</b>



<i>Economic importance</i> .....	54
<i>Survival and spread</i> .....	54
<i>Infection conditions</i> .....	54
<i>Symptoms</i> .....	54
<i>Control</i> .....	56
<b>9.7 Biosecurity awareness: potential disease threats for Australian sunflower</b> .56	
9.7.1 Downy mildew ( <i>Plasmopara halstedii</i> ).....	56
<i>Economic importance</i> .....	56
<i>Survival and spread</i> .....	56
<i>Conditions for infection</i> .....	56
<i>Symptoms</i> .....	57
<i>Control</i> .....	59
9.7.2 Broom rape ( <i>Orobanche</i> spp.).....	59
<i>Economic importance</i> .....	59
<i>Survival and spread</i> .....	60
<i>Conditions for Infection</i> .....	60
<i>Symptoms</i> .....	60
<i>Control</i> .....	61
9.8 References and further reading.....	61
<b>10 Plant growth regulators and canopy management</b>	
<b>11 Crop desiccation/spray out</b>	
<i>Drying</i> .....	1
<b>12 Harvest</b>	
12.1 Physiological maturity .....	1
12.2 Machinery setup.....	1
12.2.1 Header set up .....	2
12.2.2 Harvesting hints.....	2
12.3 Receival standards.....	3
<b>13 Storage</b>	
13.1 Storing oilseeds .....	1
13.2 How to store sunflowers on-farm.....	1
13.3 Seed quality and moisture content at storage .....	1
13.4 Types of storage.....	2
13.5 Hygiene—structural treatment.....	2
13.6 Aeration.....	3
13.6.1 Aeration cooling .....	3
13.6.2 Automatic controllers.....	3
13.6.3 Standard aeration fans operation.....	4
13.6.4 Aeration drying .....	4
13.6.5 Drying with heated air.....	5
13.6.6 Fire risk .....	5

13.7 Insect pest control..... 6

**14 Environmental issues**

14.1 Adverse effects on growth and development ..... 1

    14.1.1 Frost ..... 1

    14.1.2 Hail ..... 1

    14.1.3 Drought ..... 2

    14.1.4 Heat stress ..... 2

    14.1.5 Waterlogging ..... 2

**15 Marketing**

15.1 Selling principles ..... 2

    15.1.1 Be prepared..... 2

*When to sell..... 2*

*How to sell..... 2*

    15.1.2 Establish the business risk profile ..... 3

*Production risk profile of the farm ..... 4*

*Establishing a target price ..... 5*

*Income requirements..... 6*

    15.1.3 Managing your price ..... 8

*Methods of price management..... 8*

    15.1.4 Ensuring access to markets ..... 11

*Storage and logistics ..... 11*

*Cost of holding grain..... 12*

    15.1.5 Converting tonnes into cash ..... 14

*Set up the toolbox..... 14*

*How to sell for cash..... 15*

*Counterparty risk..... 18*

*Relative values..... 18*

*Contract allocation ..... 20*

*Read market signals..... 20*

15.2 Northern sunflower: market dynamics and execution ..... 21

    15.2.1 Price determinants for northern sunflower ..... 21

    15.2.2 Ensuring market access for northern sunflowers..... 22

    15.2.3 Converting tonnes into cash for northern sunflowers..... 22