



The University of Reading

**Investigations into the genetic and physiological basis of self-
incompatibility in cocoa (*Theobroma cacao* L.).**

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Abstract

The cultivation of cocoa (*Theobroma cacao* L.) occurs in almost fifty countries across the humid tropics of the world, dominating the domestic economies of some of its producing countries. The inherent heterozygosity of the species and the presence of self-incompatibility in genotypes conferring disease resistance have hampered the development of homozygous breeding lines and repress yields of self-incompatible clones. Investigations were performed into the genetic and physiological basis of the recognition and rejection reactions in the late-acting self-incompatibility mechanism. Three sites of possible physiological interaction were investigated: pollen-stigma recognition; sperm-egg delivery and fusion; and floral abscission. A series of pollination experiments to study pollen-stigma interaction suggests that recognition does not occur at the stigmatic surface. In addition, no homologues of genes implicated in *Brassica* pollen-stigma recognition were conclusively identified. Observations within the ovule using confocal laser scanning microscopy revealed a slower rate of sperm cell delivery to the egg nucleus and polar nuclei following sperm cell release in incompatibly pollinated ovules. In addition, semi-quantitative fluorescent staining suggests that DNA replication may be occurring within the egg nucleus following incompatible pollination. Recognition may occur within the embryo sac between the male and female cytoplasm or between gamete-specific gene products on the nuclear membranes, and may function through the failure of nuclear membrane coalescence or a loss of phase synchrony between gametes preventing karyogamy. Exogenous hormone applications suggest that the repression of abscission of compatibly pollinated flowers is regulated through endogenous auxin, although increased levels of auxin do not lead to fusion of incompatible gametes. Thus, it appears likely that the male gametophyte is recognised by the female sporophyte after pollen germination, causing an uncharacterised cascade that inhibits gamete delivery, synchrony and fusion, and this in turn fails to cause a secondary increase in auxin concentration to repress floral abscission.

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Contents

Abstract	i
Dedication	ii
Acknowledgements	iii
Contents	iv
List of figures	ix
List of tables	xii
Abbreviations	xv
Chapter 1: <i>Introduction</i>	1
1.1 Chocolate	1
1.2 Cocoa, <i>Theobroma cacao</i> L.	3
1.3 Cultivation of cocoa	8
1.3.1 History of cultivation	8
1.3.2 Current agricultural practice	12
1.3.3 Cocoa breeding and self-incompatibility	14
1.4 Plant breeding systems and self-incompatibility	16
1.4.1 Classification of self-incompatibility systems	18
1.4.2 Heteromorphic self-incompatibility	20
1.4.3 Homomorphic gametophytic self-incompatibility	21
1.4.3.1 Genetic control of gametophytic self-incompatibility	21
<i>The recognition and rejection of self in the Solanaceae</i>	22
<i>The recognition and rejection of self in <u>Papaver</u></i>	23
1.4.4 Homomorphic sporophytic self-incompatibility	24

1.4.4.1 Genetic control of sporophytic self-incompatibility	24
<i>The recognition and rejection of self in <u>Brassica</u></i>	25
<i>The recognition and rejection of self outside the Brassicaceae</i>	27
1.4.5 Late-acting or ovarian self-incompatibility	28
1.4.5.1 Late-acting self-incompatibility in the Malvaceae	30
1.5 Fertilisation and embryogenesis of Angiosperms	32
1.6 Late-acting self-incompatibility in <i>Theobroma cacao</i>	34
1.7 Embryogenesis and seed development in <i>Theobroma cacao</i>	42
1.8 Aims of the study	45
Chapter 2: General materials and methods	46
2.1 Plant material	46
2.2 Pollination based experiments	47
2.2.1 Pollination techniques	48
2.2.2 Assessment of self- and cross-compatibility	48
Chapter 3: Mechanisms of fertilisation	50
3.1 Introduction	50
3.2 Materials and methods	51
3.2.1 Confocal observation of ovules	51
3.3 Results	54
3.3.1 The unpollinated ovule	54
3.3.1.1 Developmental chronology	54
3.3.1.2 Discussion	57
3.3.2 The compatible ovule	58
3.3.2.1 Developmental chronology	58
3.3.2.2 Discussion	64
3.3.3 The incompatible ovule	68
3.3.3.1 Developmental chronology	68
3.3.3.2 Discussion	71
3.3.4 Observed differences during fertilisation	73
3.3.4.1 Measurements of sperm progression	73
3.3.4.2 Measurements of relative fluorescence of nuclei	79
3.3.4.3 Discussion	88
Chapter 4: Recognition of self	91

4.1	Introduction	91
4.2	Materials and methods	92
4.2.1	Assessment of self- and cross- incompatibility	92
4.2.2	Pollination manipulation	93
4.2.2.1	Pollen inactivation	93
	<i>Chemical inactivation</i>	94
	<i>Freeze inactivation</i>	94
	<i>Freeze-thaw inactivation</i>	94
	<i>Freeze-heat inactivation</i>	95
	<i>Heat inactivation</i>	95
4.2.2.2	Pollen-kitt removal	95
4.2.2.3	Crude isolation of putative pollen coat signal proteins/polypeptides	96
4.2.2.4	Combined treatments	97
4.2.2.5	Observations of pollen tube growth	97
	<i>In vitro germination of pollen</i>	98
	<i>Observations of pollen tube growth within the style</i>	99
4.2.3	Paternity exclusion analysis by SSR-PCR	100
4.2.3.1	DNA extraction	100
4.2.3.2	SSR-PCR	100
4.2.3.3	Fragment analysis of SSR-PCR products	102
4.3	Results	103
4.3.1	Assessment of self- and cross-compatibility	103
4.3.2	Pollen inactivation	106
4.3.2.1	Chemical inactivation	106
4.3.2.2	Freeze inactivation	106
4.3.2.3	Freeze-thaw inactivation	108
4.3.2.4	Freeze-heat inactivation	109
4.3.2.5	Heat inactivation	109
4.3.3	Pollination manipulation experiments	110
4.3.3.1	Pollination with inactivated pollen	112
4.3.3.2	Pollination with cyclohexane ‘washed’ pollen	113
4.3.3.3	Combined treatments	114
	<i>Heat inactivated and cyclohexane washed pollinations</i>	115
	<i>Pollen ‘masking’ pollinations</i>	122

4.4	Discussion	125
Chapter 5: <i>Genetics of recognition</i>		130
5.1	Introduction	130
5.2	Materials and methods	131
5.2.1	Extraction of DNA	131
5.2.2	Candidate genes	132
5.2.2.1	<i>SRK and SLG</i>	133
5.2.2.2	<i>SCR</i>	134
5.2.2.3	<i>ARC1</i>	135
5.2.3	PCR amplification of DNA	136
5.2.3.1	Nested PCR	136
5.2.4	Electrophoresis of DNA	137
5.2.4.1	Agarose gel electrophoresis	137
5.2.5	Direct sequencing of DNA	138
5.2.6	Cloning of DNA fragments	139
5.3	Results	143
5.3.1	<i>SRK and SLG</i>	143
5.3.2	<i>SCR</i>	151
5.3.3	<i>ARC1</i>	152
5.4	Discussion	156
Chapter 6: <i>Rejection of self through abscission</i>		159
6.1	Introduction	159
6.2	Materials and methods	161
6.2.1	Pollination physiology	161
6.2.1.1	The role of auxin	162
6.2.1.2	The role of ethylene: manipulation of ACC	164
6.2.1.3	The role of ethylene: manipulation of AVG	164
6.2.1.4	<i>In vitro</i> application of ACC and AVG	165
6.2.2	Expression of auxin up-regulated genes	166
6.2.2.1	Candidate gene PCR	166
6.2.2.2	Southern analysis	167
	<i>DNA preparation</i>	167
	<i>DNA restriction</i>	169

<i>Membrane preparation</i>	170
<i>Preparation of the probe</i>	172
<i>Probe hybridisation and stringency washing</i>	172
<i>Visualisation</i>	174
6.2.3 Gene expression during abscission	175
6.2.3.1 Generation of subtractive libraries	175
<i>Extraction of RNA</i>	177
<i>Synthesis of cDNA</i>	179
6.3 Results	182
6.3.1 Pollination physiology	182
6.3.1.1 Auxin	182
6.3.1.2 Ethylene	191
6.3.1.3 <i>In vitro</i> assessment of the role of ethylene	194
6.3.2 Signalling and expression	197
6.3.2.1 <i>SAUR</i> genes	197
6.3.2.2 cDNA subtractive library	201
6.4 Discussion	208
Chapter 7: General discussion	213
References	230
Appendices	245
Appendix 1: cocoa nutrient solutions	245
Appendix 2: DNA extraction protocols	246
Appendix 3: multiplex PCR protocol	249
Appendix 4: buffers and solutions used in DNA experiments	250
Appendix 5: PCR product and plasmid purification protocols	251
Appendix 6: cloning protocol	254
Appendix 7: Southern blot: probe labelling protocol	257
Appendix 8: RNA extraction protocol	259
Appendix 9: mRNA isolation protocol	261
Appendix 10: buffers and solutions used in RNA experiments	262
Appendix 11: cDNA synthesis and cDNA subtraction protocols	263
Declaration	270