GENETICS OF SILK COCOON COLOUR

M.Sc. 4th Semester

Contents

- Introduction
- Genetic analysis of silk cocoon colour
- Relationship between blood colour and cocoon colour
- Linkage group of cocoon colour
- Discovery of other cocoon colour gene
- Morphological traits and genes for various cocoon colour

Dr. Debnirmalya Gangopadhyay
Assistant Professor, Department of Sericulture,
Raiganj University, Raiganj

Introduction

- The unique silk cocoon colour and its elegance has attracted the attention of many silkworm breeders/geneticists.

- *Bombyx mandarina* (possessing pale greenish-yellow cocoons) is the ancestor of modern domesticated *Bombyx mori* races.

- On the basis of cocoon colour and chemical nature of pigments, silkworm races may be broadly divided into three categories-

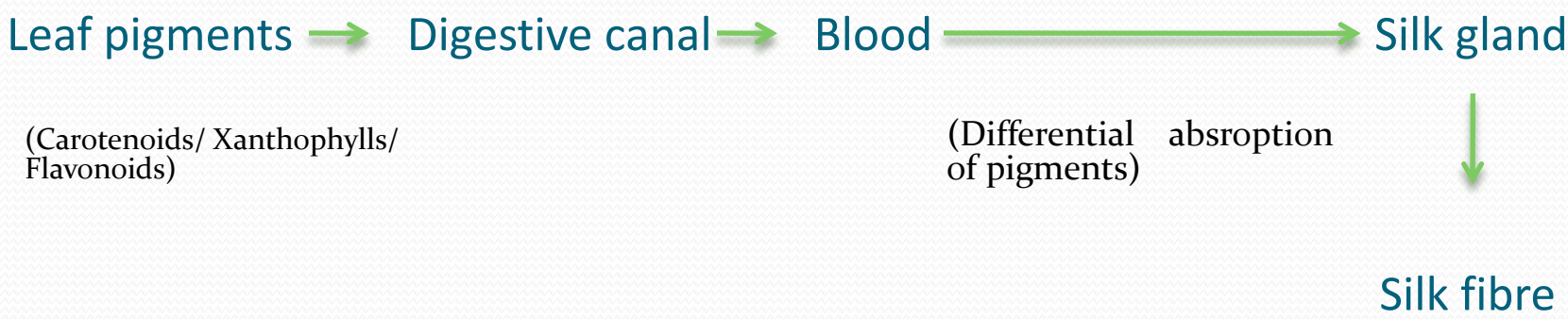
Sl. No.	Type of cocoon colour	Type of pigments
1.	White colour races	Absence of colour
2.	Yellow colour races	Carotenoids and Xanthophylls
3.	Green colour races	Flavonoids

N.B. Other intermediate colour forms are pink, light green, light yellow, sooty white etc.

Colour variation at different cocoon layers

- Cocoon colour may vary at various layers of the cocoon (outside layer is relatively dark than the inside layer).
- Pigmentation of silk filament is subjected to the differential and non-differential accumulation of pigments and its type in the silk gland.
- This differential accumulation of pigments has direct relation with the genotype of the silkworms.

Region of the silk gland		Secretion	
		Substance	Function
Absorbs	Middle I	Sericin I	Most mucous
	Middle II	Sericin II	Secreted copiously
	Middle III	Sericin III	Adheres very closely to fibroin
	Posterior	Fibroin	Main fibrous substance of silk



Pathway of pigments from leaf to silk fibre

Genetic analysis

Early experiments of Countagne (1902) and Toyama (1906, 1912)

Cross I

Yellow cocoon of Orient X White cocoon of Orient — P

↓

All Yellow — F1

↓

Yellow (3) : White (1) — F2

Cross II

Yellow cocoon of Orient X White cocoon of Europe — P

↓

All White — F1

↓

White (3) : Yellow (1) — F2

Phenotype	Genotype	Relationship
Yellow cocoon colour	Y Y	Y dominant to $+^{Y}$
White cocoon colour (Oriental race)	$+^{Y}$ $+^{Y}$	$+^{Y}$ recessive to Y or I (an inhibitory gene)
White cocoon colour (European race)	I I (an inhibitory gene)	I dominant to Y or $+^{Y}$

Genetic analysis- Interpretation

Cross I

Yellow cocoon of Orient X White cocoon of Orient — P

(YY) ($+^{Y}+^{Y}$)

↓

All Yellow — F1

($Y+^{Y}$)

↓

Yellow (3) : White (1) — F2

gametes / gametes	Y	$+^{Y}$
Y	YY (Yellow)	$Y+^{Y}$ (Yellow)
$+^{Y}$	$Y+^{Y}$ (Yellow)	$+^{Y}+^{Y}$ (White)

Genetic analysis- Interpretation

Cross II

Yellow cocoon of Orient (YY) X White cocoon of Europe (II) — P

↓

All White (YI) — F1

↓

White (3) : Yellow (1) — F2

gametes \ gametes	Y	I
Y	YY (Yellow)	YI (White)
I	YI (White)	II (White)

Relationship between blood colour and cocoon colour

Blood colour	Cocoon colour	Genotypes
Yellow	White	Y $+^{f}$ $+^{e}$
	Flesh inner white	Y F $+^{c}$
	Pink inner white	YF Pk $+^{c}$
	Golden yellow	Y F C
Colourless	White (recessive)	$+^{y}$
	White (dominant)	YI
	Sooty plain white	YI^{s}

Linkage groups of cocoon colour

- Cocoon colour inherited autosomally.
- Yellow colour is due to C allele (multiple allele in 12^{th} linkage groups).
- Other linkage groups are – 2, 9, 15, 16 etc.

Blood colour gene

- Normal blood colour ($+^{y}$ recessive to yellow)
- Yellow blood (due to gene 'Y')
- Red blood (due to recessive gene 'rb')

Morphological traits and genes for various cocoon colour

Morphological trait	Gene symbol	Chromosome no.	Locus	Function
Yellow blood	Y	2	25.6	Haemolymph is deep yellow
White blood	$+^{y}$	2	25.6	Recessive to Y
Yellow inhibitor	I	9	0.2	Completely supress yellow colouration of blood
$+^{y}$	I^{s}	9	0.0	Recessive to I
Flesh	F	6	13.6	Flesh colour when combined with YCF
Pink	Pk	-	-	When YCF Pk are in combination
Golden yellow	C	12	14.2	When combined with Y
White	$+^{c}$	12	14.0	Does not allow pigmentation
Green	Ga, Gb, Gc	2, 15	7.0, 7.8	Pigment permeability gene, green colour cocoon