

Diagrammer udvisende hver de 16 mulige kombinationer fra hver bedækning (der er 4 gener involveret i hver hest og $4 \times 4 = 16$), de kaldes "Punnett-squares". Husk, at Den Helplettede Knabstrupper har genotypen **LPlp/PATNpatn** eller **LPlp/PATNPATN**, idet den helplettede fremkommer, når der er eet og kun eet LP gen tilstede sammen med mindst eet PATN gen. Her er anvendt 100% PATN gener eller "full-body-sized". Husk også, at det er sandsynligheder, der er tale om, eller chancer. For eksempel i diagram nummer 1 er der 25% chance for at få en helpletet, eller sagt på en anden måde vil, efter et stort antal bedækninger, en fjerdedel være helplettede. Ved at anvende en helpletet hingst eller hoppe med to PATN gener kan man i diagram 2 se, at chancen for helpletet afkom stiger til 50% eller det dobbelte. Man kan også i diagram 2 se, at de "rene" ensfarvede uden hverken LP eller PATN forsvinder og det samme gør de minimalt farvede med kun eet LP gen.

I diagram 6, 10, 12, 17, 22 og 23 kan ses, at en hvidfødt ikke altid giver helpletet afkom for at sige det mildt. I diagram 31, 32 og 32 ses, at også krydsninger mellem to ensfarvede eller med minimal farve kan give helplettede, og i diagram 34 vil det ske hver gang. Det ses også, at en helpletet hingst eller hoppe *aldrig* kan give helpletet afkom hver gang. Endelig ses det af diagrammer 26-30, at man ikke kommer ud af "Appaloosa-fælden" og får farve tilbage, medmindre man igen tilføjer noget PATN.

Den ultimative krydsning ses i diagram 9 (**hvidfødt type 1 X ensfarvet Knabstrupper**), hvor man får den **helplettede** med maksimalt hvidt gen *hver gang!*

Legend: Store bogstaver: Genet er "Tændt", små bogstaver: Genet er "Slukket"

Rød = Helpletet type 1 = **LPlp/PATNPATN**, type 2 = **LPlp/PATNpatn**

Blå = 1/4 plettet, LP-udfarvet, pletter eller lidt hvidt på krydset, minimal distribution af LP gen, ingen PATN gen

Grøn = Ensfarvet, minimal distribution af PATN gen, ingen LP gene

Sort = Ensfarvet, hverken LP eller PATN gene

Gul = Hvidfødt type 1 = **LPLP/PATNPATN**, type 2 = **LPLP/PATNpatn**

Diagram 1: LPlp/PATNpatn (helpletet type 2) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn
lplp/patnpatn	lplp/patnpatn	lplp/patnpatn	lplp/patnpatn

Diagram 2: LPlp/PATNPATN (helpletet type 1) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn

Diagram 3: LPlp/PATNpatn (helpletet type 2) X LPlp/PATNpatn (helpletet type 2)

LPLP/PATNPATN	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/patnpatn
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/PATNPATN	lplp/PATNpatn	lplp/PATNpatn	lplp/patnpatn

Diagram 4: LPlp/PATNPATN (helpletet type 1) X LPlp/PATNpatn (helpletet type 2)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNpatn	lplp/PATNpatn

Diagram 5: LPlp/PATNPATN (helpletet type 1) X LPlp/PATNPATN (helpletet type 1)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN

Diagram 6: LPLP/PATNpatn (hvidfødt type 2) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 7: LPLP/PATNPATN (hvidfødt type 1) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 8: LPLP/PATNpatn (hvidfødt type 2) X lplp/PATNPATN (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 9: LPLP/PATNPATN (hvidfødt type 1) X lplp/PATNPATN (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN

Diagram 10: LPLP/PATNpatn (hvidfødt type 2) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 11: LPLP/PATNPATN (hvidfødt type 1) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 12: LPLP/PATNpatn (hvidfødt type 2) X LPlpPATNpatn (helplettet type 2)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 13: LPLP/PATNPATN (hvidfødt type 1) X LPlp/PATNpatn (helplettet type 2)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 14: LPLP/PATNpatn (hvidfødt type 2) X LPlp/PATNPATN (helplettet type 1)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 15: LPLP/PATNPATN (hvidfødt type 1) X LPlp/PATNPATN (helplettet type 1)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN

Diagram 16: LPLP/PATNPATN (hvidfødt type 1) X LPLP/PATNpatn (hvidfødt type 2)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn

Diagram 17: LPLP/PATNpatn (hvidfødt type 2) X LPLP/PATNpatn (hvidfødt type 2)

LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN	LPLP/PATNPATN
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn

Diagram 18: LPlp/patnpatn (minimal farve) X LPlp/PATNpatn (helplettet type 2)

LPLP/PATNpatn	LPLP/PATNpatn	lplp/PATNpatn	lplp/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	lplp/patnpatn	lplp/patnpatn

Diagram 19: LPlp/patnpatn (minimal farve) X LPlp/PATNPATN (helplettet type 1)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn

Diagram 20: LPLP/patnpatn (minimal farve) X LPlp/PATNpatn (helplettet type 2)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 21: LPLP/patnpatn (minimal farve) X LPlp/PATNPATN (helplettet type 1)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 22: LPlp/patnpatn (minimal farve) X LPLP/PATNpatn (hvidfødt type 2)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 23: LPLP/patnpatn (minimal farve) X LPLP/PATNpatn (hvidfødt type 2)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn

Diagram 24: LPlp/patnpatn (minimal farve) X LPLP/PATNPATN (hvidfødt type 1)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 25: LPLP/patnpatn (minimal farve) X LPLP/PATNPATN (hvidfødt type 1)

LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn
LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn	LPLP/PATNpatn

Diagram 26: LPlp/patnpatn (minimal farve) X LPlp/patnpatn (minimal farve)

LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/patnpatn	lplp/patnpatn	lplp/patnpatn	lplp/patnpatn

Diagram 27: LPlp/patnpatn (minimal farve) X LPLP/patnpatn (minimal farve)

LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 28: LPLP/patnpatn (minimal colour) X LPLP/patnpatn (minimal farve)

LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn
LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn	LPLP/patnpatn

Diagram 29: LPlp/patnpatn (minimal colour) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/patnpatn	lplp/patnpatn	lplp/patnpatn	lplp/patnpatn
lplp/patnpatn	lplp/patnpatn	lplp/patnpatn	lplp/patnpatn

Diagram 30: LPLP/patnpatn (minimal farve) X lplp/patnpatn (ensfarvet f.ex. DV)

LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 31: LPlp/patnpatn (minimal farve) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn
lplp/patnpatn	lplp/patnpatn	lplp/patnpatn	lplp/patnpatn

Diagram 32: LPLP/patnpatn (minimal farve) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn
LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn	LPlp/patnpatn

Diagram 33: LPlp/patnpatn (minimal farve) X lplp/PATNPATN (ensfarvet Knabs.)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn

Diagram 34: LPLP/patnpatn (minimal farve) X lplp/PATNPATN (ensfarvet Knabs.)

LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn

Diagram 35: LPlp/PATNpatn (helplettet type 2) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNpatn	LPlp/PATNpatn
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/patnpatn	LPlp/patnpatn
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNpatn	lplp/PATNpatn
lplp/PATNpatn	lplp/PATNpatn	lplp/patnpatn	lplp/patnpatn

Diagram 36: LPlp/PATNPATN (helplettet type 1) X lplp/PATNpatn (ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn

Diagram 37: LPlp/PATNpatn (helplettet type 2) X lplp/PATNPATN(ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn	LPlp/PATNpatn
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN
lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn	lplp/PATNpatn

Diagram 38: LPlp/PATNPATN (helplettet type 1) X lplp/PATNPATN(ensfarvet Knabs.)

LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN	LPlp/PATNPATN
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN
lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN	lplp/PATNPATN

Note: Specielt for de blå LPlp og LPLP er det svært at beskrive farven.

Diagrammerne er udarbejdet på baggrund af det uvurderlige forskningsarbejde, som udføres i det US-Canadiske genprojekt ved Sheila Archer, Dr. Bellone o.a.