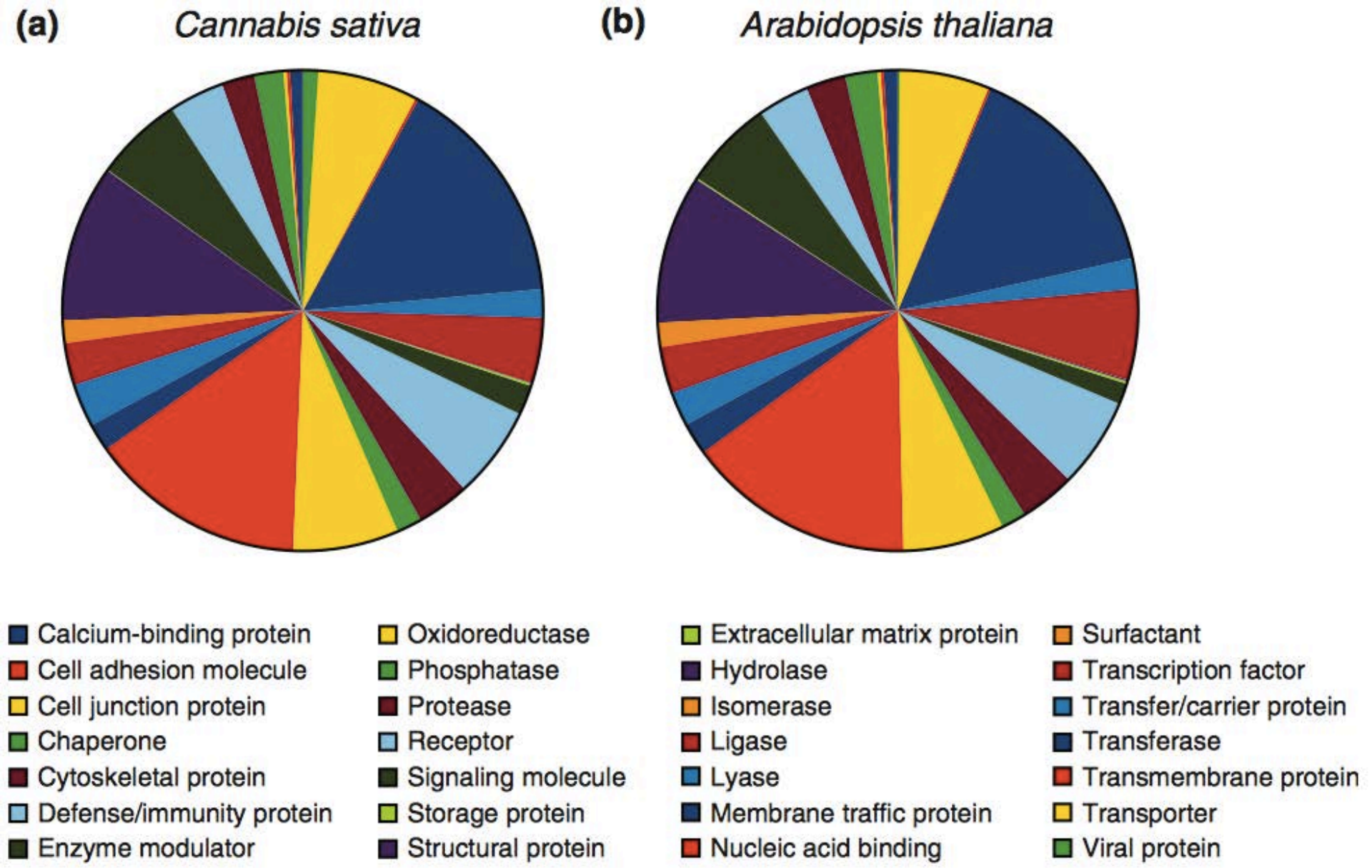
Research and Development of Hemp Genetics in Colorado

John McKay

Why Study Genetics?

- Understanding the Genome
- Evolutionary history of Cannabis
- Genetics of key traits
- Breeding for new markets and production areas



van Bakel *et al. Genome Biology* 2011, **12**:R102
http://genomebiology.com/2011/12/10/R102

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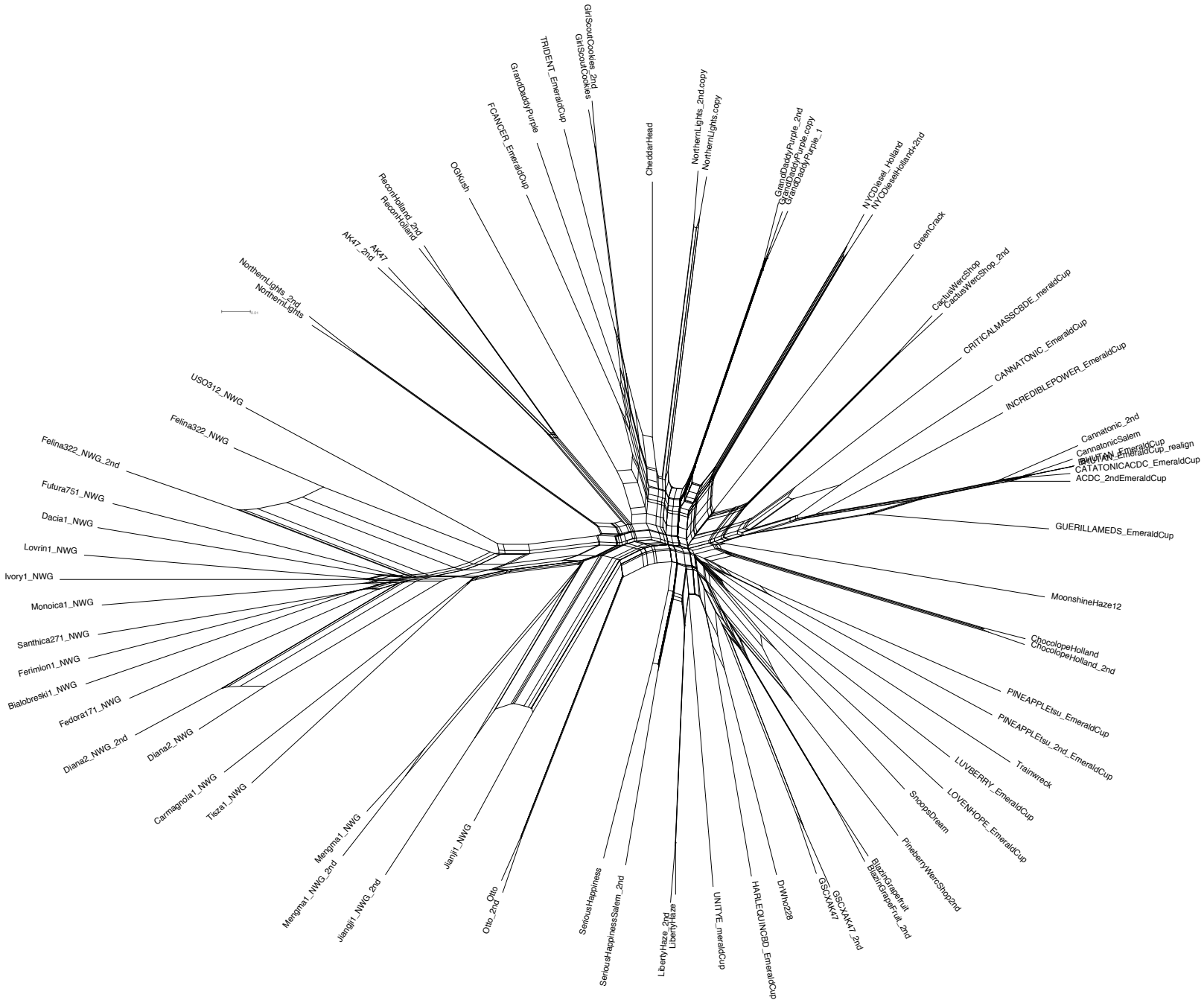
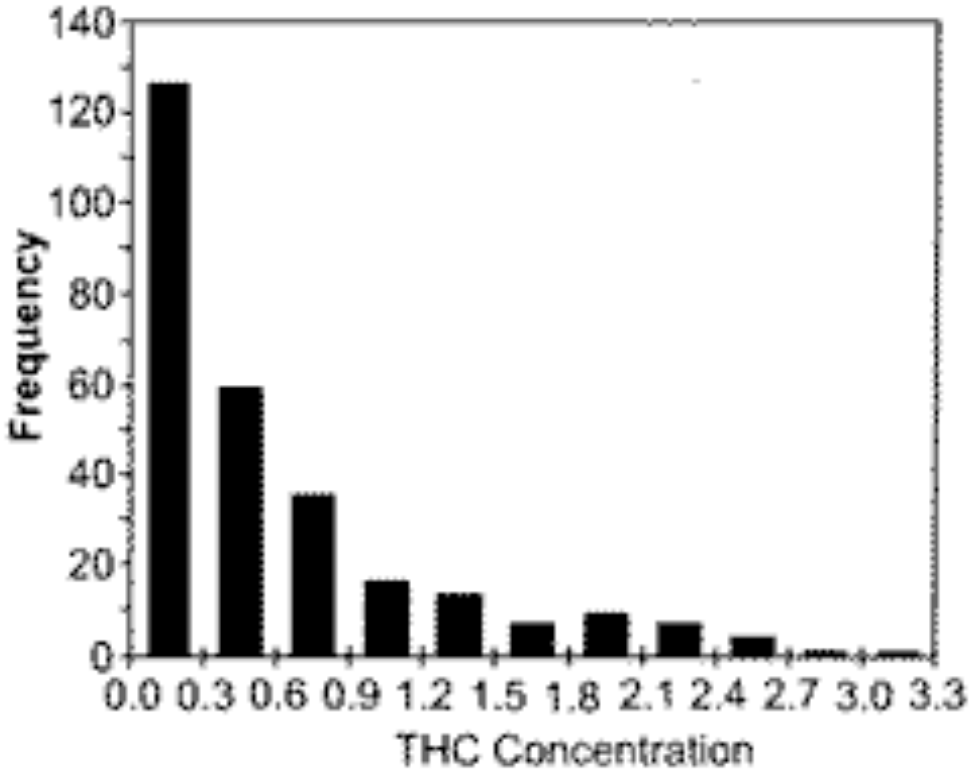
Collaborators

Stefano Amaducci

Brian Campbell

Ryan Lynch


GirlScoutCookies_2nd
GirlScoutCookies
TRIDENT_EmeraldCup
GrandDaddyPurple
FCANCER_EmeraldCup
OGKush
ReconHolland_2nd
ReconHolland
AK47_2nd
AK47
NorthernLights_2nd
NorthernLights
USO312_NWG
Felina322_NWG
Felina322_NWG_2nd
Futura751_NWG
Dacia1_NWG
Lovrin1_NWG
Ivory1_NWG
Monoica1_NWG
Santhica271_NWG
Ferimlon1_NWG
Bialobreski1_NWG
Fedora171_NWG
Diana2_NWG_2nd
Diana2_NWG
Carmagnola1_NWG
Tisza1_NWG
Mengma1_NWG
Mengma1_NWG_2nd
Jiangji1_NWG_2nd
Jiangji1_NWG
Otto_2nd
Otto
SeriousHappiness
SeriousHappinessSalem_2nd
LibertyHaze_2nd
LibertyHaze
UNITYE_meraldCup
HARLEQUINCBD_EmeraldCup
DrWho228
GSCYAK47
GSCYAK47_2nd
BlazinGrapefruit
BlazinGrapefruit_2nd
PineberryWeircShop2nd
SnoopsDream
LOVENHOPE_EmeraldCup
LUVBERRY_EmeraldCup
Trainwreck
PINEAPPLEtsu_2nd_EmeraldCup
PINEAPPLEtsu_EmeraldCup
ChocolopeHolland_2nd
ChocolopeHolland
MoonshineHaze12
GUERILLAMEDS_EmeraldCup
ACDC_2ndEmeraldCup
CATATONICACDC_EmeraldCup
INCREDIBLEPOWER_EmeraldCup
CANNATONIC_EmeraldCup
CRITICALMASSCBDE_meraldCup
CactusWercShop_2nd
CactusWercShop
GreenCrack
NYCDieselHolland-2nd
NYCDiesel_Holland
GrandDaddyPurple_1
GrandDaddyPurple.copy
GrandDaddyPurple_2nd
NorthernLights.copy
NorthernLights_2nd.copy
CheddarHead
GirlScoutCookies_2nd



Anon. 1975. Catalogue of the global collection of VIR. Issue 162, Fiber crops. Vavilov Institute, Leningrad, USSR.

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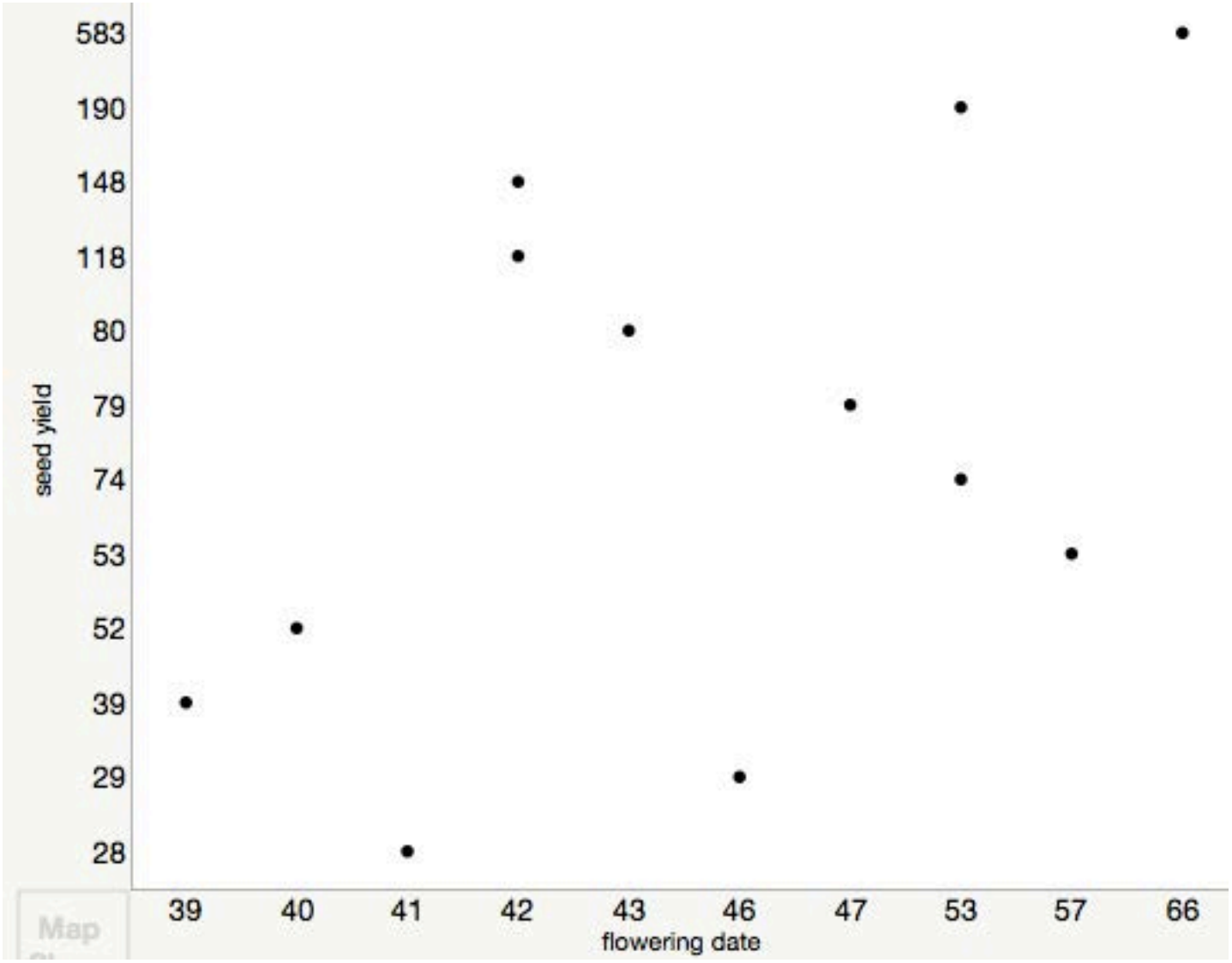
Variety	Latitude	Origin	Type
Jiangji	25	China	Dioecious
Mengma	25	China	Dioecious
Carmagnola	45	Italy	Dioecious
Dacia	45	Romania	Monoecious
Diana	45	Romania	Monoecious
Lovrin	46	Romania	Monoecious
Tisza	46	Hungary	Monoecious
Monoica	46	Hungary	Monoecious
Fédora 17	48	France	Monoecious
Félina 32	48	France	Monoecious
Férimon	48	France	Monoecious
Futura 75	48	France	Monoecious
Santhica 27	48	France	Monoecious
Bialobreskie	52	Poland	Monoecious
Tygra	52	Poland	Monoecious
Uso 31	53	Ukraine	Monoecious

Birds like to eat Hemp Grain



Genetics of key traits

Table 2
Seed fatty acid composition of ten industrial hemp cultivars.

Cultivar	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	α-Linolenic acid
	%				
Alyssa	6.73	2.75	12.63	56.02	15.37
Anka	6.74	2.82	12.74	55.79	15.58
CanMa	6.98	2.34	11.11	56.18	16.04
CFX1	6.87	2.30	11.17	56.58	16.35
CFX2	6.71	2.20	10.76	56.14	16.37
CRS1	6.85	2.33	11.52	56.37	17.09
Delores	6.73	2.69	12.81	56.22	14.69
Finola	6.94	2.08	9.38	56.16	17.27
Jutta	6.75	2.73	13.00	55.56	15.02
Yvonne	6.66	2.70	12.43	55.70	16.00
Mean	6.80	2.49	11.76	56.07	15.98
Max.	6.98	2.82	13.00	56.58	17.27
Min.	6.66	2.08	9.38	55.56	14.69
P-value	0.04	<0.0001	<0.0001	0.90	<0.0001
$LSD_{0.05}$	0.19	0.11	0.84	NS	0.69

E. Vonapartis et al./Journal of Food Composition and Analysis 39 (2015) 8–12

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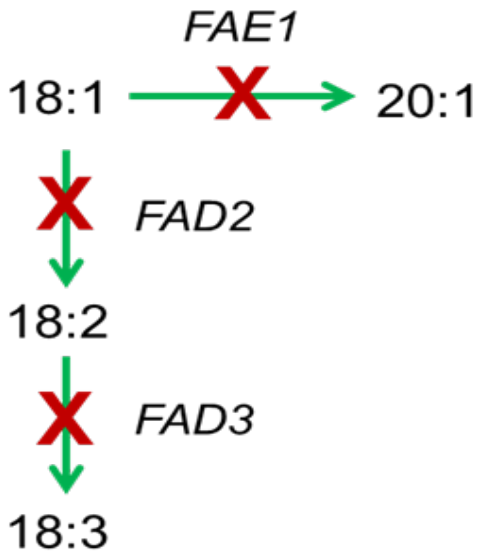

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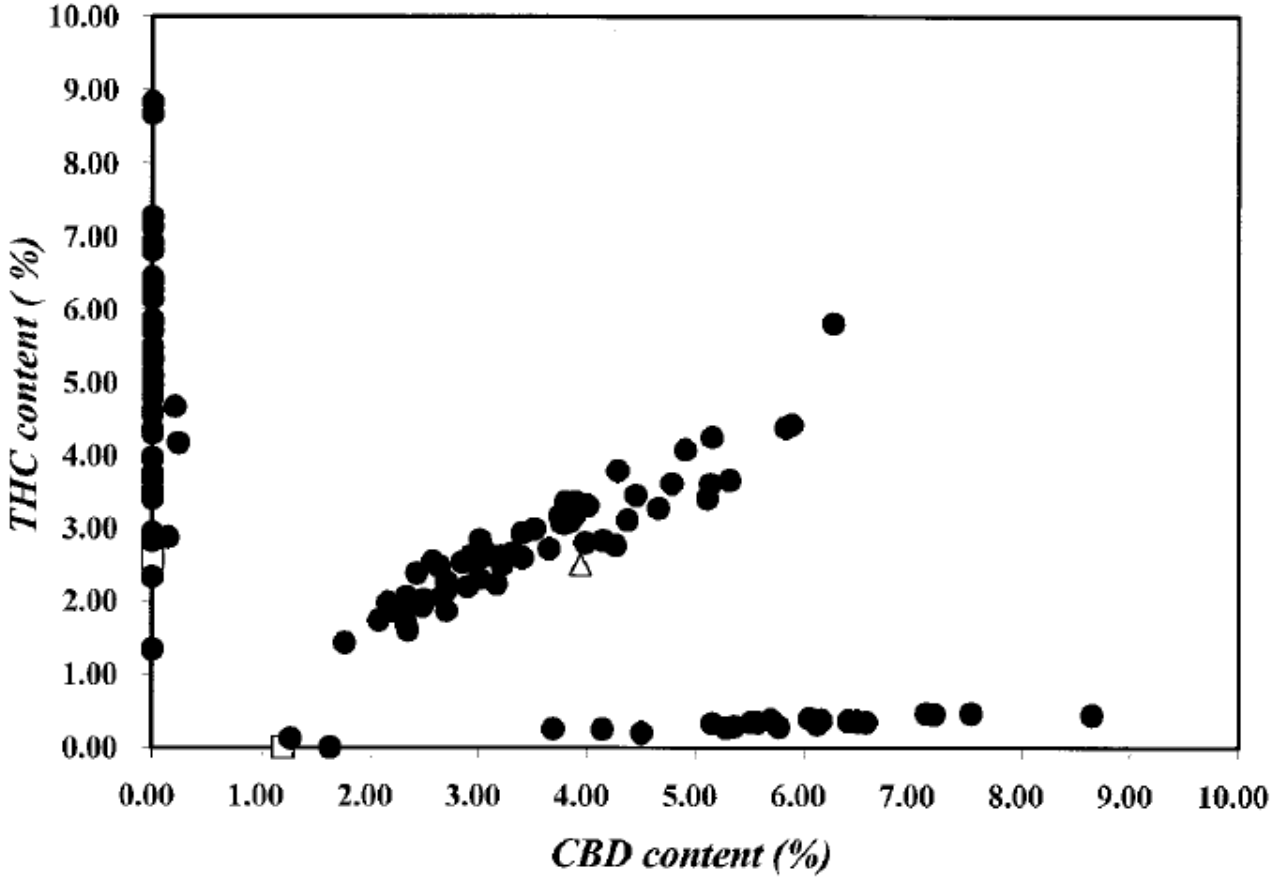


The Inheritance of Chemical Phenotype in *Cannabis sativa* L.

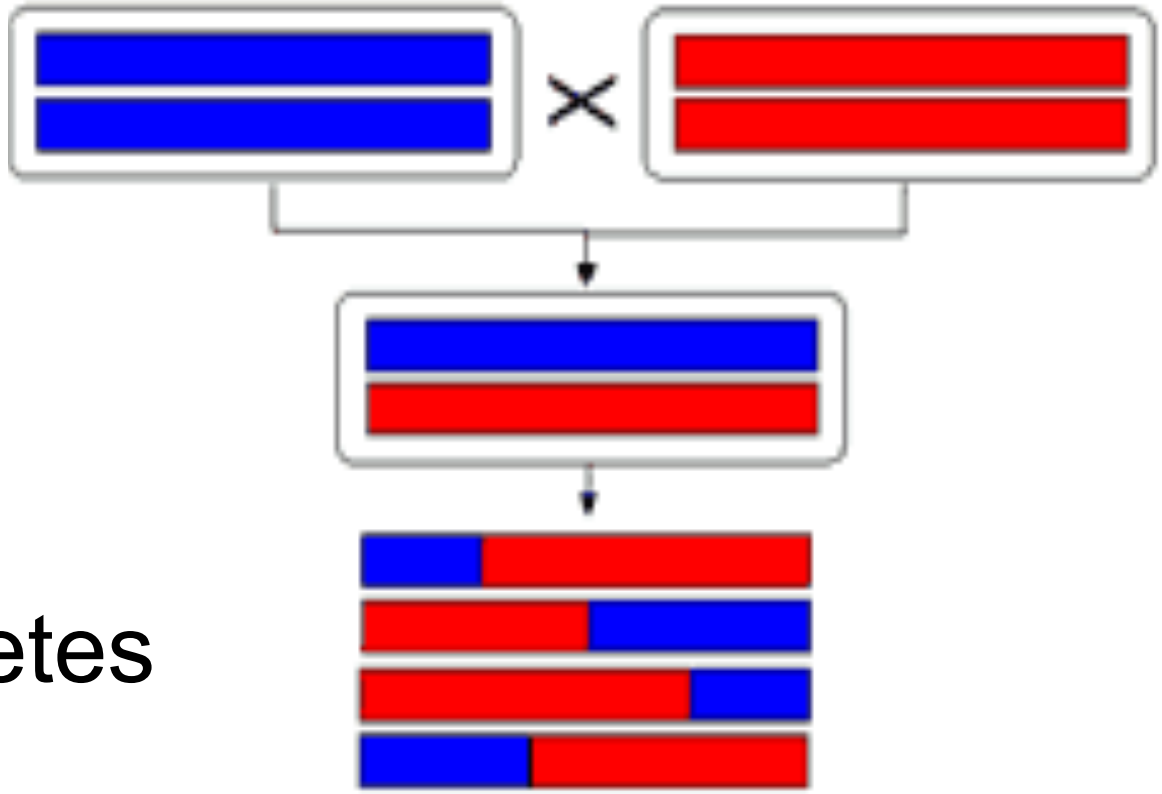
Etienne P. M. de Meijer,*,[1] Manuela Bagatta,[†] Andrea Carboni,[†] Paola Crucitti,[†] V. M. Cristiana Moliterni,[†] Paolo Ranalli[†] and Giuseppe Mandolino[†,2]

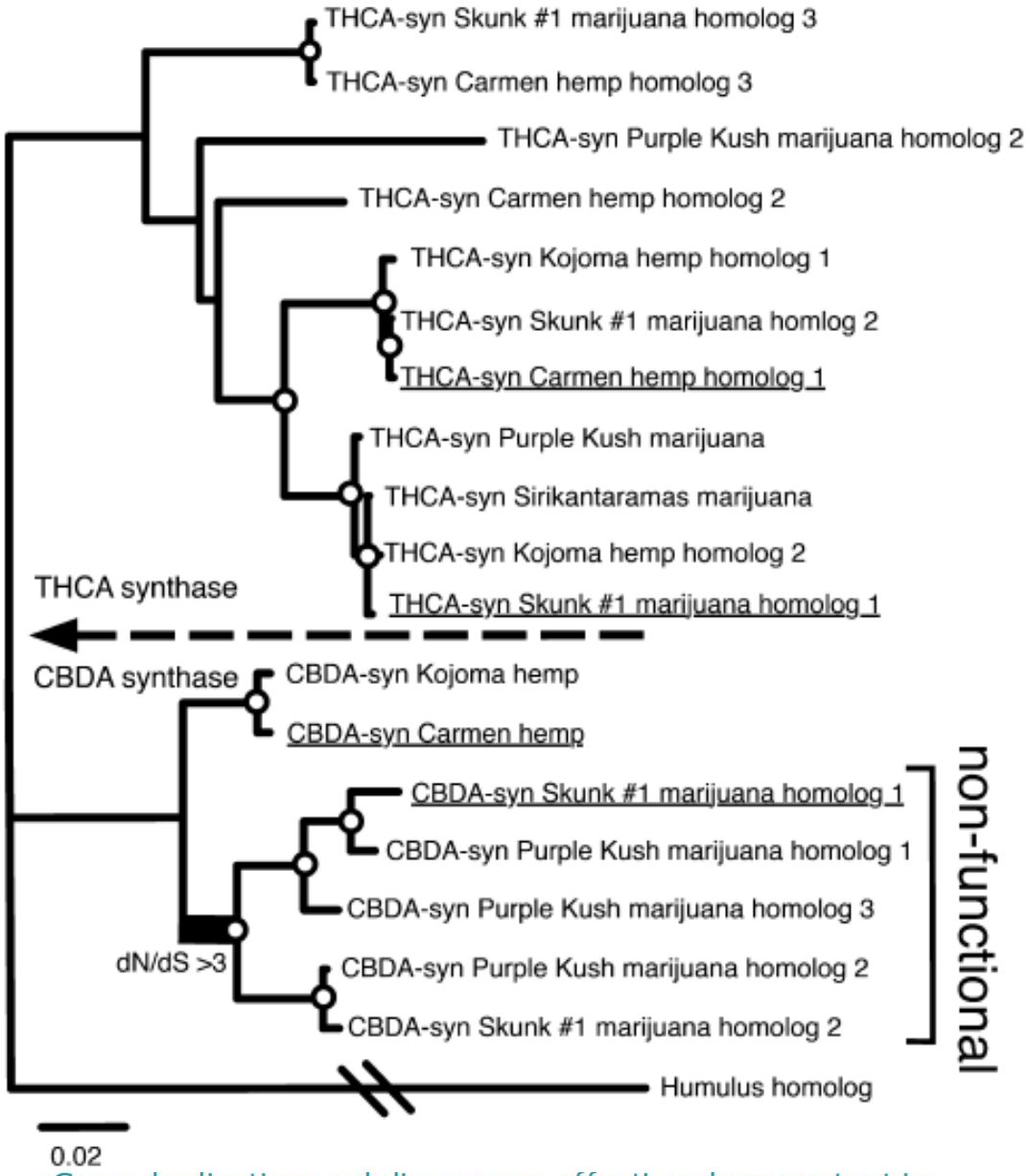
Recombination

Parents

F_1

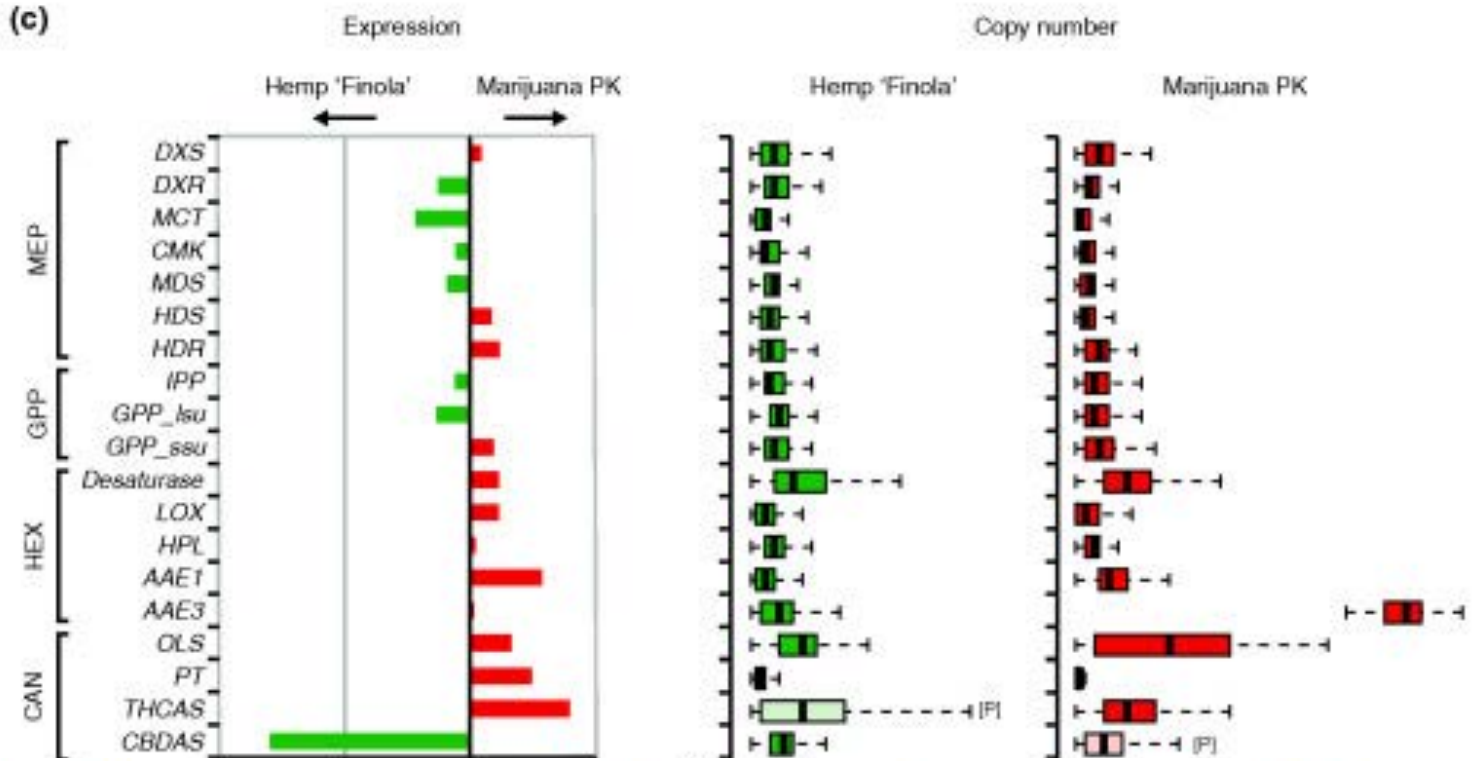
F_1 gametes





Gene duplication and divergence affecting drug content in *Cannabis sativa*

George D. Weiblen[1], Jonathan P. Wenger[1], Kathleen J. Craft[1], Mahmoud A. ElSohly[2], Zlatko Mehmedic[2], Erin L. Treiber[1] and M. David Marks[1]



The draft genome and transcriptome of *Cannabis sativa*

Harm van Bakel[1], Jake M Stout[2,3], Atina G Cote[1], Carling M Tallon[3], Andrew G Sharpe[3], Timothy R Hughes[1,4*] and Jonathan E Page[2,3*]

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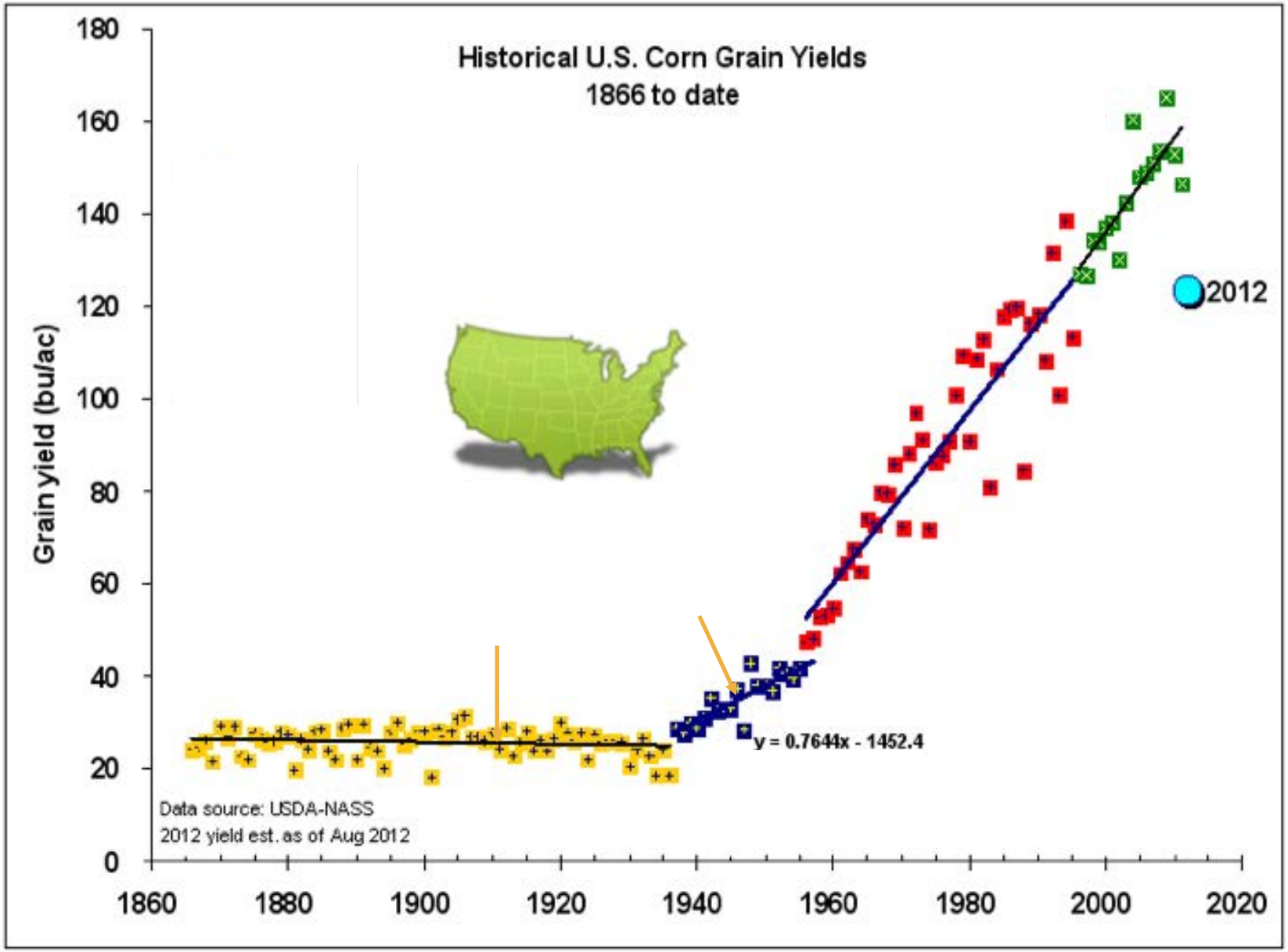
NEW WEST GENETICS



NEW WEST GENETICS

traditional breeding + modern genomics =

hemp varieties optimized for US Markets and large scale production

NEW WEST GENETICS

Team

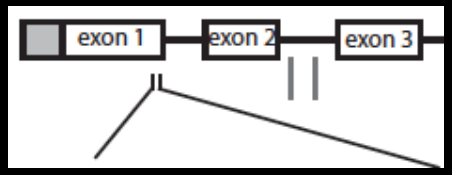
Dr. John McKay
Director of Genetics

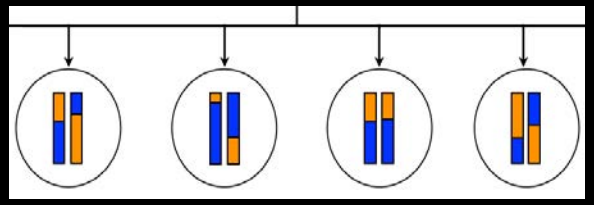
Dr. Rich Fletcher
Director of Breeding
Inventor on 5 Plant Patents

Wendy Mosher
CEO
15 years team alignment
& regulatory compliance

Gretchen Reuning
Plant Production
Published leader in
Plant Genetics.

The Breeding Cycle





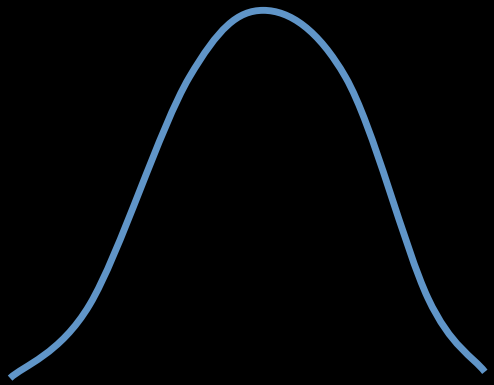
Genetic Discoveries

Recombination

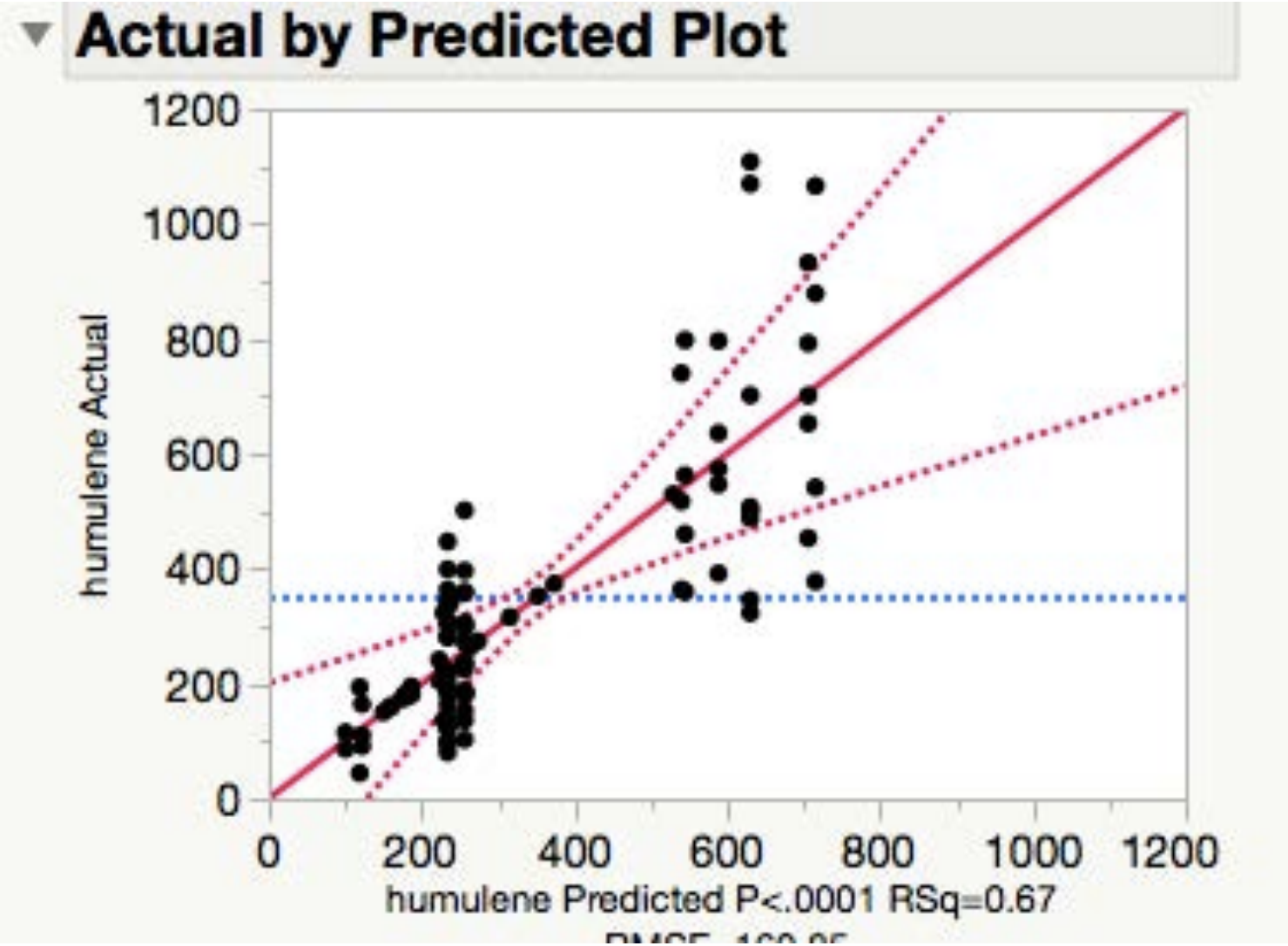
Increased Yield

Phenotyping

Selection



Breeding for Terpenoids



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- Genetics and Evolution
- Chemistry and Biochemistry
- Agronomy and Production
- Market and Value Chain

Crop Science
SOCIETY OF AMERICA

https://www.crops.org/meetings/hemp-meeting/program


Questions?
Colorado State University
NEW WEST GENETICS
John McKay

Seed Yield Estimates