THE VALIDATION AND USE OF MARKER-ASSISTED SELECTION IN NS WHEAT BREEDING PROGRAM

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ITMI - COST, CLERMONT FERRAND, 31 August-4 September 2009.
From 1953 up to date 372 varieties of small grains have been developed at IFVC - Novi Sad:

- Winter wheat: 230
- Spring wheat: 31
- Winter barley: 46
- Spring barley: 41
- Winter durum: 2
- Spring durum: 2
- Winter oat: 4
- Spring oat: 4
- Winter triticale: 11
- Winter ray: 1

42 of which are registered abroad:

- Hungary
- Slovakia
- Spain
- Russia
- Ukraine
- Romania
- Greece
- Canada
- Croatia
- (EU) ...

Conventional breeding!
“During the past 20 years, a great number of important major genes and quantitative trait loci have been mapped with molecular markers, enabling the potential use of molecular markers in wheat genotyping, mapping and breeding. 

Landjeva et. al. 2007.
Wheat yields in UK, FR, HU, RO, BG and RS in 1961-2006 period

Climate change, lack of variability, “Yield plato” reached, “False” breeding objectives, Lower inputs...??

UK \( y = 0.122x + 3.197 \)
FR \( y = 0.130x + 2.451 \)
HU \( y = 0.127x + 1.554 \)
SRB \( y = 0.088x + 1.824 \)
BG \( y = 0.081x + 1.997 \)
RO \( y = 0.060x + 1.341 \)

1961-1990

1991-2006

UK \( y = 0.051x + 7.259 \)
FR \( y = 0.034x + 6.624 \)
HU \( y = 0.019x + 3.771 \)
SRB \( y = 0.006x + 3.329 \)
BG \( y = 0.036x + 2.624 \)
RO \( y = 0.029x + 2.347 \)
For all breeders, the most promising and challenging task is the possible use of molecular markers to enhance the selection of superior genotypes for traits that are:

1. difficult or impossible to select phenotypically
2. subject to high environmental error
3. expensive to assess.
The Molecular Lab was established in year 2001 at IFVC

Reducing Costs and Increasing Breeding Efficiency!
Single cross strategy (parents AxB)

Association study (set of genotypes)

Target trait (gene)

Scientist (with sling)

Scientist (with gun)
ITMI mapping population (Opata x Synthetic)
“Locating stable across environment QTL involved in the determination of agronomic characters in wheat”

Borislav Kobiljski, Srbislav Denčić, Ankica Kondić-Špika, Ulrike Lohwasser and Andreas Börner

_Cereal Research Communication (in press, sept.2009)_
Savanahh / Renesansa DH population (single cross)
Savannah x Renesansa map

1A 1B 1D 2A 2B 2D

3A 3B 3D

4A 4B 4D

5A 5B 5BL 5BS 7BS

6A 6B 7D

5D

7A
Detected significant QTL’s in Savannah x Renesansa mapping population

QTL found using marker regression (>0.05) for Savannah x Renesansa comparing sites and years

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<td>Adj Plt Yield Kg</td>
<td>1000 Grain Weight</td>
<td>Crop Erectness</td>
<td>Flowering Time</td>
<td>Crop Height</td>
<td>Tiller number</td>
<td>Hybrid Necrosis</td>
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<td>Sterile spikelets/s</td>
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Where there are only two markers in a linkage group marker regression can not be carried out, in these cases significant (& interesting) QTL found using single marker analysis have been included.

* - Denotes where no assessment was made.
POTENTIAL USES OF MICROSATELLITES IN MARKER – ASSISTED SELECTION (MAS) FOR IMPROVED GRAIN YIELD IN WHEAT

Kobiljski B.
Denčić S.
Hristov N.
Mladenov N.

Quarrie S.
Stephenson P.
Kirby J.

Institute of Field and Vegetable Crops
M. Gorkog 30, 21000 Novi Sad, Serbia and Montenegro

John Innes Centre, Norwich Research Park,
Colney, Norwich, NR4 7UH, UK
Genetic (Core) Collection - 603 genotypes - 38 countries
Pheno data base
(54 traits, 3-8 years)

26 TRAITS (SRB+UK)

603 GENOTYPES

The “worst” 48
The “best” 48

96 genotypes representing overall phenotypic variation

96 wheat “delegates” for molecular screening

Acciaio
Ai-bian
Al KanTzao
Ana
Avalon
Bankuty 1205
BCD 1302/83
Benni multifloret
Bezostaya 1
Brigand
Cajeme 71
Capelle Desprez
Centurk
Ching-Chang 6
Cook
Don.polupatuljasta
Durin
F 4 4687
Florida
Gala
HAYS 2
Helios
Highbury
Hira
Holly E
Hope
Inia 66
INTRO 615
IVanka
Kite
L 1/91
L 1A/91

L - 1
Lambriego Inia
Lr 10
Lr 12
Magnif 41
Mex.17 bb
Mex.3
Mexico120
Minister Dwarf
Mina
Mironovska 808
Nizija
Norin 10/Brev.14
Norin 10
Nov. Crvena
Nova Banatka
NS 22/92
NS 33/90
NS 46/90
NS 55-25
NS 559
NS 602
NS 63-24
NS 66/92
NS 74/95
NS 79/90
Peking 11
Phoenix
PKB Krupna
Pobeda
Purd./Loras
Purdue 39120
Purdue 5392
Red Coat
Renesansa
Rusalka
Siete Cerros
Saitama 27
Sava
Semillia Eligulata
Slavija
Sofija
Sonalika
Suwwon 92
Szegedi 768
Tibet Dwarf
Timson
TJB 990-15
Tom Thumb
Tr. compactum
Tr sphaerococcum
Triple Dirk B
Triple DirkB (cont.)
Triple Dirk S
UC 65680
UPI 301
Vel
Vireo “S”
WWMCB 2
ZG 1011
ZG 987/3
ZG K 238/82
ZG K 3/82
ZG K T 159/82
SSRs used for evaluation of the 96 “delegates”
Advanced lines – yield trials

8 t/ha  5 t/ha  9 t/ha  7 t/ha

10 t/ha  8 t/ha  7 t/ha
### Distribution of presumed “high-yielding” alleles in the 20 LYG and 20 HYG genotypes

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*Alleles No. 12 7 17 20 14 13 7 16 11 16 8 8 8 17*
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Many NSBSIC (NS Breeding Site Important Candidate) QTLs have been determined
Going from DARTs to SSRs!
We are going further – chasing important QTLs for the rest of the genotypes from the Core Collection (app.500) for 20 traits (data - 8 years, 3 field plot reps., on 1,2 m², ..)
Validation of 20 candidate markers which we believe could be of value for the NS wheat breeding program (yield and yield components, pathogen resistance, drought and heat stress tolerance, etc.).

- 20 highest yielders from Core Collection 96 set
- 20 lowest yielders from Core Collection 96 set
- 20 lowest yielding advanced lines
- 20 highest yielding advanced lines
- 16 registered and most popular Serbian varieties

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PLAN OF ACTIONS - STARTING DATE  15. OCTOBER 2009.

1. Routine screening for major genes (Lr, Pm, FHB, Rht, Ppd..)

2. Validation and use of mm for desirable QTLs from biparental populations

3. Validation and use of mm for desirable QTLs from association study (CC)

4. Additional screening for desirable QTLs in 500 genotypes from CC (SSRs)

5. Along with these, new markers of potential value for the NS wheat breeding program will be continually included in the validation process in order to create the best and most up-to-date collection of markers which can be used for MAS.
MOLECULAR BREEDING

Be rational
Be effective
Be enthusiastic
Be decisive
Be inventive
Be natural
Be genuine

2009

THANKS

????