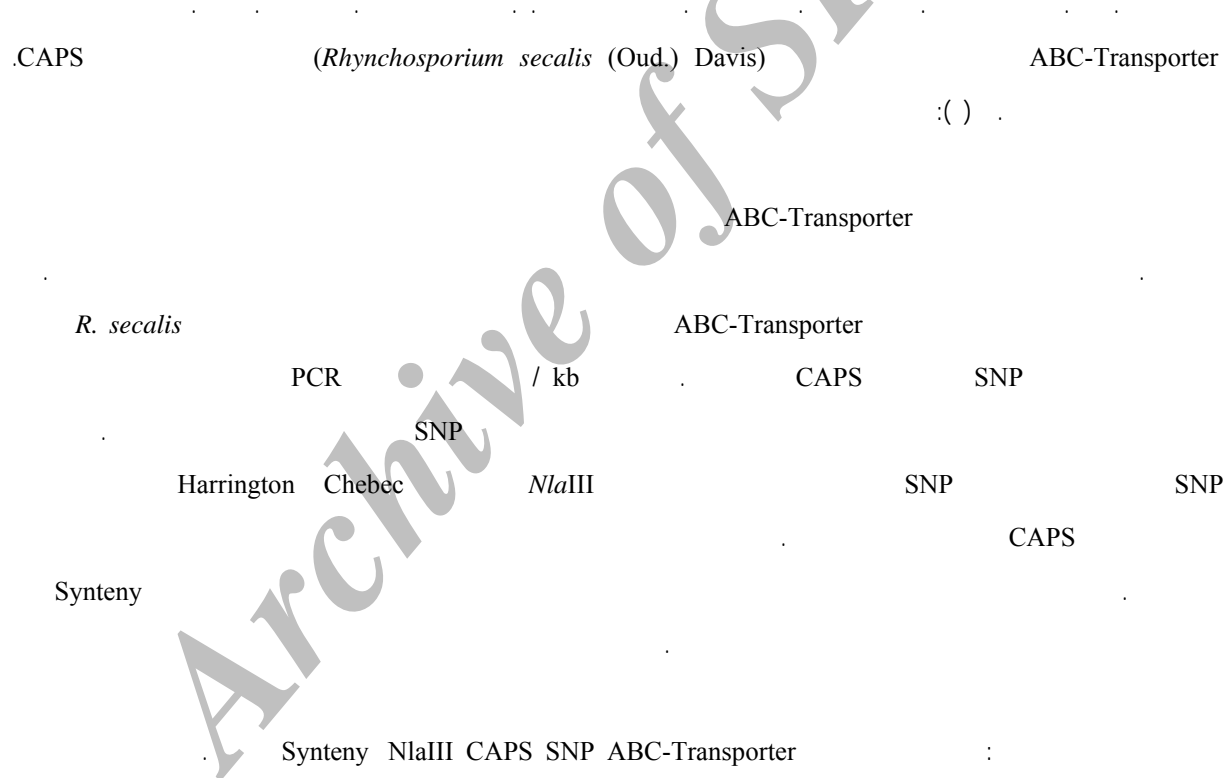


ABC-Transporter
CAPS (*Rhynchosporium secalis* (Oud.) Davis)
Mapping of an ABC-Transporter gene associated with barley scald disease
(Rhynchosporium secalis (Oud.) Davis) **using a CAPS marker**



// :

()

CER5 (Yazaki, 2006)

ABC-T

NpABC1 (Pighin et al., 2004)

ABC-T

(ATP-Binding Cassette Transporter) ABC-T

(

(Jasinski et al., 2001)

PDR ABC-T

(Trans-Membrance Domain) TMD

(α -helix)

)

NpPDR1

(Nucleotide Binding Domain) NBD

Walker B Walker A

(

ABC-T

Signature

NBD TMD

Gm (Sasabe et al., 2002; Stukkens et al., 2005)

(Jasinski et al., 2003; Stukkens et al., 2005)

PDR12

Pleiotropic Drug Resistance (PDR)

Multi-Drug Resistance (MDR)

Multi-Drug Resistance-associated Proteins (MRP)

At PDR8 (Eichhorn et al., 2006)

ABC-T

(*Arabidopsis thaliana*)

(Kobae et al., 2006)

ABC-T

(Fernandez et al., 2001)

ABC-T

(Jasinski *et al.*, 2003)

SNP

(Deletion) (Insertion)

(Brookes, 1998)

DNA

(Alignment)

BAC

kb

SNP

(Rostoks *et al.*, 2005)

(Bacterial Artificial Chromosome)

DNA

BAC

ABC-T

SSH

BAC

R. secalis

SSR

Primer3

(Giordano *et al.*, 1999; Rafalski, 2002)

BAC 7-1 5AATTGCTAGGTGAGATGCTTGTGGTCC

SNP

BAC 7-2 5GCTCTTGATCTTTCCTTGATGTCACC

(Gut, 2001; Kwok, 2000; Rafalski, 2002; Shi,

BAC 7-3 5AATGGGAGTACCATGCCCTTCCTTCTTG

CAPS

SNP

.2001)

BAC 7-4 5GCCATGATTGGATAACACTGCTCTTCA

PCR

(Rostoks *et al.*, 2005; Thiel

/

/ PCR

.*et al.*, 2004)

/ dNTPs

SSH

Taq DNA Polymerase

DMSO %

(Suppression Subtractive Hybridization)

DNA

(Immolys, UK)

Rhynchosporium secalis (Oud.) Davis

ABC-T

PCR

(Single Nucleotide

SNP

Polymorphisms)

(Cleaved Amplified Polymorphic Sequence) CAPS

PCR

Table 1- Barley genotypes.

Genotype	Growth habit	No. of row
Chebece	Spring	Two rowed
Harrington	Spring	Two rowed
Clipper	Spring	Two rowed
Sahara	Spring	Two rowed
Galleon	Spring	Two rowed
Sloop	Spring	Two rowed
Alexis	Spring	Two rowed
Harana Nijo	Spring	Two rowed
Frankiln	Spring	Two rowed
Halcyon	Spring	Two rowed

Haruna Nijo

<http://wheat.pw.usda.gov/ggpages/links.shtml>
<http://genbank.vurv.cz/barley/pedigree/pedigree.asp>

(Min Elute PCR purification, QIAGEN, USA)

CAPS

Big Dye Terminator

Harrington Chebec

Terminator V3.1 Cycle

BAC7-3 BAC7-1

(Willsmore *et al.*, 2006)

Sequencing (Applied Bio Systems. USA)

(Manly *et al.*, Map Manager QTX

2001)

P=0.05-0.001

Contig Express

(Voorrips, 2002) Map Chart

SNP

SNP

NEBcutter2

In Silico

(<http://tools.neb.com/NEBcutter2/index.php>)

ABC-T

PCR

CAPS

SNP

DNA

(Biolabs, NEW England) *Nla*III

BAC7-3 BAC7-4

NEBuffer4) X

BAC7-1 BAC7-3

/ (Biolabs, NEW England

/ (/) BSA

bp bp

PCR /

"...ABC-Transporter"

PCR bp

CAPS SNP

SNP

SNP (Kota *et al.*, 2001)

EST

SNP (Rostoks *et al.*, 2005)

SNP (Van *et al.*, 2004)

()

SNP ABC-T bp

SNP (Van *et al.*, 2004)

SNP (Non-Coding Regions)

SNP (Coding Regions)

SNP

5'-UTR

ABC-T NBD EST 3' UTR

(Rafalski, 2002)

SNP

SNP

(Jasinski *et al.*, 2003)

Harrington Chebec (Van *et al.*, 2004)

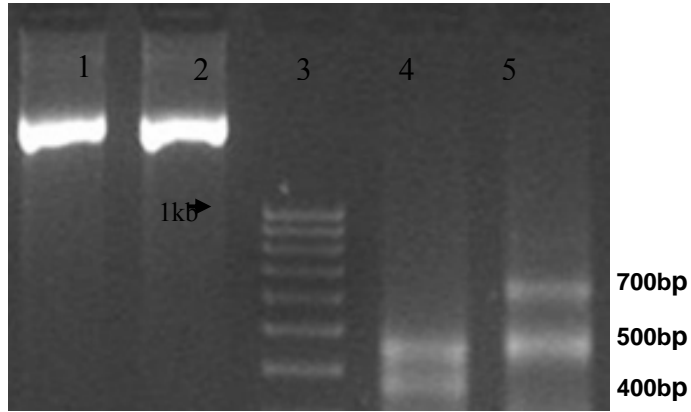
FatI, *NlaIII*

()

CviAII (Sjaskste and Roder, 2004)

SNP C→T SNP

"...ABC-Transporter"



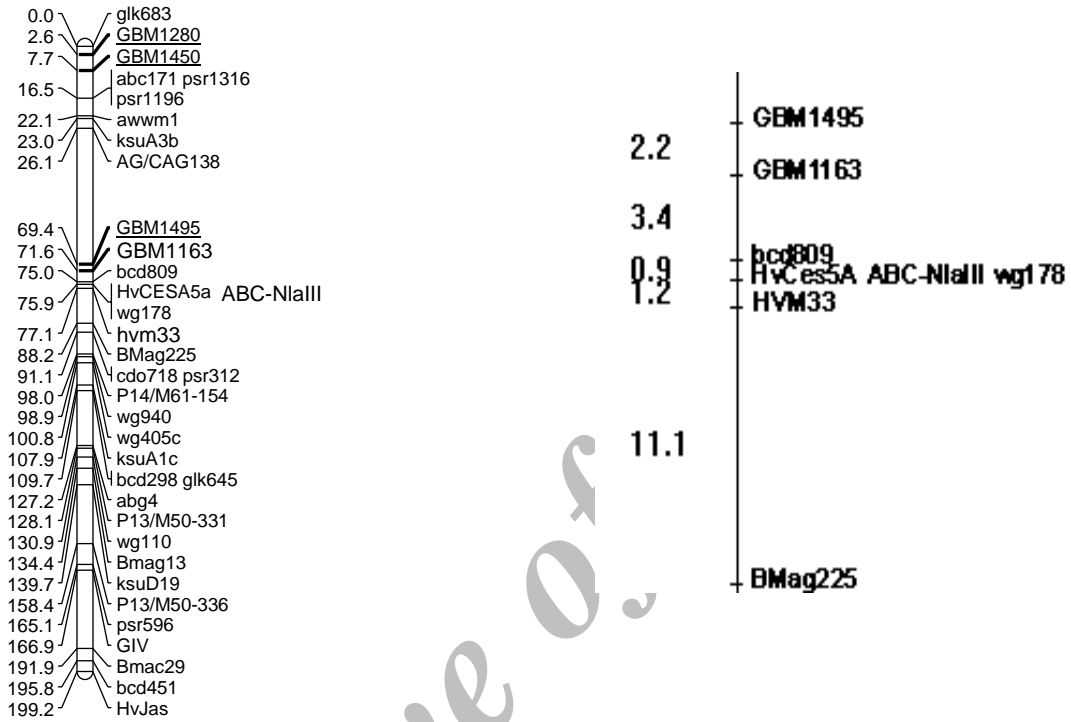
Chebec) (1kb) (PCR) NlaIII PCR
 (Harrington) (

Fig2. Digestion of PCR product by NlaIII,(1 and 2 Parents PCR products), (3- Ladder 1kb), (4- Chebec after digestion), (5- Harrington after digestion)

(Schenk *et al.*, 2000; Zwiigelaar and Dubery
 QTL .2006) ABC-T
 Net blotch
 (Willsmore *et al.*, 2006) SSR / bcd809 RFLP
 / GBM1163
 (Tacconi *et al.*, 2001) Wg178 RFLP
 / Hvm33 SSR
 si
 Graingenes2
 (<http://wheat.pw.usda.gov/GG2/index.shtml>)
 Synteny (Comparative Mapping) (Vershney *et al.*, 2007)
 Hv.CesA5
 ABC-T (Cellulose Synthase)
 Synteny

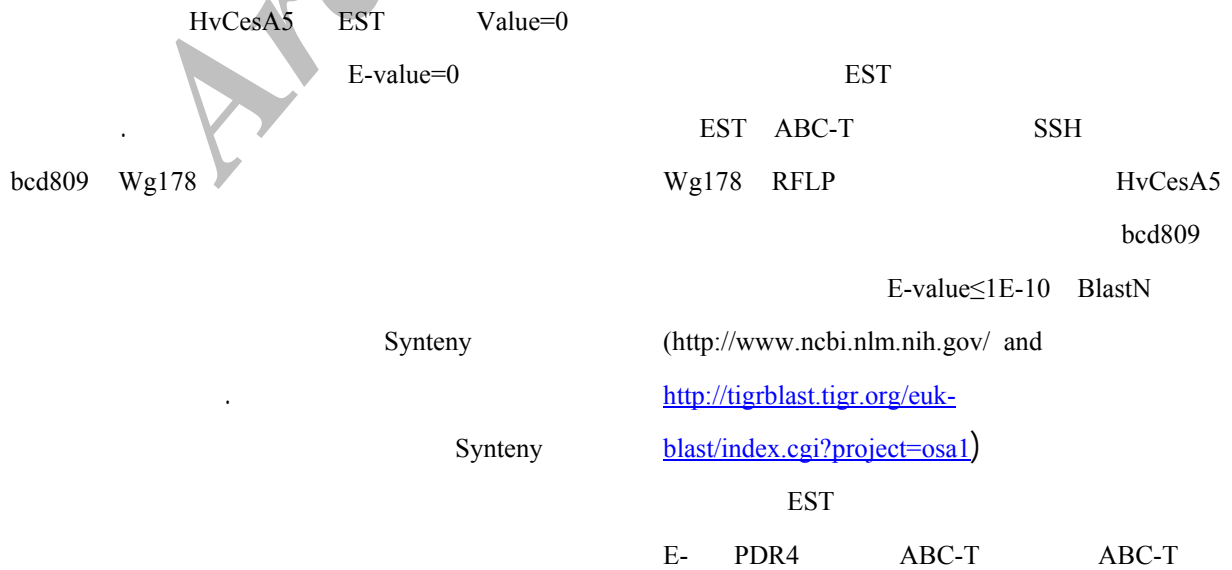
(Stein *et al.*, 2007)

3H_CxH



ABC-T

Fig. 3. Genetic map of ABC-T gene on barley chromosome 3, Genetic distances are in CentiMorgan



"...ABC-Transporter"

(Stein *et al.*, 2007)

(Rostoks *et al.*, 2005 , Thiel *et al.*, 2004)

EST

CAPS

RAPD

RFLP

EST

EST

SNP

CAPS

RAPD

2003)

EST

SNP

SSR

P450

CAPS

(Graner *et al.*, 1999)

CAPS

RFLP

SNP

(Rostoks *et al.*, 2005)

CAPS

CAPS

SNP

SSR

CAPS

SNP

(SARDI)

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Mapping of an ABC-Transporter gene associated with barley scald disease (*Rhynchosporium secalis* (Oud.) Davis) - using a CAPS marker

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A. A. Boushehri⁶, and K. Willmore⁷

ABSTRACT

Aalami, A., C. Oldech, H. Alizadeh, M. Omid, Bihamta, M. R., Boushehri, A. A. and K. Willmore. 2007. Mapping of an ABC-Transporter gene associated with barley scald disease (*Rhynchosporium secalis* (Oud.) Davis)- using a CAPS marker. Iranian Journal of Crop Sciences. 9 (2):157-168

ABC-Transporter proteins superfamily are found in all alive organisms as connection bridge in cellular membranes. These proteins are responsible for transportation of variant substrates such as metabolites that involved in plant defense mechanisms. In this study SNPs and CAPS markers were used for mapping of an ABC-Transporter which is specific for compatible and incompatible interaction against *R. secalis* fungus. A 2.2kb fragment derived from PCR product with specific primers for mentioned gene was sequenced in 10 barley parents. Among observed SNPs, one SNP showed different restriction enzymes sites in Chebec and Harrington parents and converted to CAPS marker. Results mapping revealed position of the gene on long arm of barley chromosome 3. Also, a homology evaluation for this region of chromosome was in accordance with previous studies about high synteny for barley chromosome 3 with rice chromosome 1.

Key words: Barley, Gene Mapping, ABC-Transporter, SNP, CAPS, NlaIII, Synteny, Scald

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