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BARD

FINAL REPORT

PROJECT NO. IS-2806-96

**Molecular Tagging of Drought Resistance in Wheat:
Osmotic Adjustment and Plant Productivity**

A. Blum, H.T. Nguyen

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**BARD Final Scientific Report
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Date of Submission of the report: Nov. 28, 2002

BARD Project Number: IS-2806-96R

Project Title:

Molecular Tagging of Drought Resistance in Wheat: Osmotic Adjustment and Plant Productivity.

Investigators

Principal Investigator (PI): A. Blum

Co-Principal Investigator (Co-PI): H.T. Nguyen

Collaborating Investigators:

Institutions

The Volcani Center, ARO, Bet Dagan
Israel

Texas Tech University, Lubbock, Texas
USA

Keywords *not* appearing in the title and in order of importance. Avoid abbreviations.

Plant breeding, yield, selection

Abbreviations **commonly** used in the report, in alphabetical order:

Budget: IS: \$204,000

US: \$96,000

Total: \$300,000

Signature
Principal Investigator

Signature
Authorizing Official, Principal Institution

Publication Summary (numbers)

	Joint IS/US authorship	US Authors only	Israeli Authors only	Total
Refereed (published, in press, accepted)	1			1
Submitted, in review, in preparation	2			2
Invited review papers				
Book chapters				
Books				
Master theses				
Ph.D. theses				
Abstracts				
Not refereed (proceedings, reports, etc.)				

Postdoctoral Training: List the names and social security/identity numbers of all postdocs who received more than 50% of their funding by the grant.

Cooperation Summary (numbers)

	From US to Israel	From Israel to US	Together, elsewhere	Total
Short Visits & Meetings		2	1	3
Longer Visits (Sabbaticals)				

Description of Cooperation:

Patent Summary (numbers) - NONE

	Israeli inventor (s) only	US inventor (s) only	Joint IS/US inventors	Total
Submitted				
Issued (allowed)				
Licensed				

Abstract (one page maximum, single spaced), include:

List the original objectives, as defined in the approved proposal, and any revisions made at the beginning or during the course of project.

Background to the topic.

Major conclusions, solutions, achievements.

Implications, both scientific and agricultural.

Achievements

Significance of main scientific achievements or innovations

Drought stress is a major limitation to bread wheat (*Triticum aestivum* L.) productivity and its yield stability in arid and semi-arid regions of world including parts of Israel and the U.S. Currently, breeding for sustained yields under drought stress is totally dependent on the use of yield and several key physiological attributes as selection indices. The attempt to identify the optimal genotype by evaluating the phenotype is undermining progress in such breeding programs.

Osmotic adjustment (OA) is an effective drought resistance mechanism in many crop plants. Evidence exists that there is a genetic variation for OA in wheat and that high OA capacity supports wheat yields under drought stress. The major objective of this research was to identify molecular markers (RFLPs, restriction fragment length polymorphisms; and AFLPs, amplified fragment length polymorphisms) linked to OA as a major attribute of drought resistance in wheat and thus to facilitate marker-assisted selection for drought resistance.

We identified high and low OA lines of wheat and from their cross developed recombinant inbred lines (RILs) used in the molecular tagging of OA in relation to drought resistance in terms of plant production under stress.

The significant positive co-segregation of OA, plant water status and yield under stress in this RIL population provided strong support for the important role of OA as a drought resistance mechanism sustaining wheat production under drought stress. This evidence was obtained in addition to the initial study of parental materials for constructing this RIL population, which also gave evidence for a strong correlation between OA and grain yield under stress. This research therefore provides conclusive evidence on the important role of OA in sustaining wheat yield under drought stress.

The measurement of OA is difficult and the selection for drought resistance by the phenotypic expression of OA is practically impossible. This research provided information on the genetic basis of OA in wheat in relations to yield under stress. It provided the basic information to indicate that molecular marker assisted selection for OA in wheat is possible.

The RIL population has been created by a cross between two agronomic spring wheat lines and the high OA recombinants in this population presented very high OA values,

not commonly observed in wheat. These recombinants are therefore an immediate valuable genetic recourse for breeding well-adapted drought resistant wheat in Texas and Israel.

We feel that this work taken as a whole eliminate the few previous speculated doubts about the practical role of OA as an important mechanism of drought resistance in economic crop plants. As such it should open the way, in terms of both concept and the use of marker assisted selection, for improving drought resistance in wheat by deploying high osmotic adjustment.

Agricultural and/or economic impacts of the research findings

Not known yet

Details of cooperation:

Cooperation in performing this research was very close and well synchronized. Its basis was twofold: (a) a close personal relationship and professional compatibility between the two main PI's, and (2) the interface of two domains of expertise – crop stress physiology and agronomy on one hand and plant molecular genetics on the other. Furthermore the corresponding facilities and expertise of the two PI's allowed a very clear-cut division of the areas of responsibility in carrying out this research project. Crop stress physiology, agronomy and field studies were performed in Israel where facilities and climate were compatible with the task. Molecular genetics work was done in the excellent laboratory in Texas.

List of Publications:

Blum A., Zhang J.X. and Nguyen H.T. 1999. Consistent differences among wheat cultivars in osmotic adjustment and their relationship to plant production. Field Crops Res. 64:287-291.