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BARD

FINAL REPORT
PROJECT No. I-397-82

**Restriction Fragment Length Polymorphisms in
Varietal Identification and Genetic Improvement**

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1986

Standard BARD Cover Page for Scientific Reports

August 1986

BARD

P.O.Box 6

Bet Dagan 50 250, ISRAEL

Bard Project NO. **I-397-82R**

Title of Research Project:

**RESTRICTION FRAGMENT LENGTH POLYMORPHISMS
in VARIETAL IDENTIFICATION
and GENETIC IMPROVEMENT.**

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Project Starting Date: July 83

Type of Report: 1st Annual 2nd Annual Final **X**

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$\frac{630.72}{\text{BAR/BEC}} : 581.15 : 631.52 : 574.190.1$
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Abstract

The proposal to use recombinant DNA to uncover a large panel of otherwise inaccessible genetic markers was made during the course of this work. Genetic variation is monitored at the DNA level itself, and is expressed as a change in length of specific restriction fragments. Documentation for the ubiquity of Restriction Fragment Length Polymorphisms (RFLPs) in representative plants and animals was obtained. The theory on the utilization of RFLPs to specific improvement programs was expanded both for animals and plants.

Objectives

Currently, progress in genetic improvement of agricultural species is hindered by the lack of a suitable amount of available genetic markers. The objective of this project was to develop the tools, both experimental and theoretical, that would enable to uncover a novel type of genetic markers, Restriction Fragment Length Polymorphisms (RFLPs), and to exploit these in a variety of breeding programs. Their disclosing is made possible by making use of recombinant DNA technology in order to monitor genetic variation directly at the DNA level. Genetic engineering is commonly interpreted in terms of the generation of novel transgenic individuals, i.e., as an unconventional breeding method. In contrast to this view, it is utilized here, to assist normal breeding programs by rendering them more precise and more powerful.

Thus, our first goal was to demonstrate the availability of these RFLP markers among economically important representative species (maize and cattle), and second to propose a variety of schemes and aims as to how these markers could be exploited in defined agricultural programs. Calculations were made regarding the feasibility and cost/benefit ratios of the proposed schemes. These led to additional refinements and improvements of the proposed strategies. Currently, work is in progress in our laboratories to further improve and simplify the methodologies involved and to apply them to specific breeding goals.

BODY of the Report :

For convenience, this section is divided in three parts: general, plant and animal genetic improvement, respectively.

Description of cooperation

While the idea on the use of RFLPs originated in Israel, the initial experimental work on maize stocks was the result of a joint effort by the US and Israeli teams. Later, in Israel emphasis was shifted in the experimental area on animals while the theoretical work addressed issues in both living kingdoms. Throughout the whole period of work, information was exchanged between the three laboratories, by mail and by transatlantic visits (The Burrs came once to Israel, and each Israeli investigator visited their US colleagues at least once).

Main Achievements

In this study, both the theoretical and experimental grounds were laid for the subsequent general use of a novel class of highly abundant and ubiquitous genetic markers, "Restriction Fragment Length Polymorphisms (RFLPs)", for the genetic analysis and breeding manipulations of quantitative (polygenic) traits of agricultural importance. These markers are uncovered by recombinant DNA methodology. This represents the development of a general novel research field with potential applications in a large number of specific problems in all agricultural species. These applications could have a direct impact on existing breeding techniques, rendering them both faster, more efficient and increasing the spectrum of traits amenable to improvement.

List of Publications

1. Soller M. and J.S. Beckmann (1982). Restriction Fragment Length Polymorphisms and Genetic Improvement. In : Proceedings of the Second World Congress on Genetics Applied to Livestock Production (Madrid, 1982), **6**: 396-404.
2. Burr, B., S.V. Evola, F.A. Burr and J.S. Beckmann (1983). The Application of Restriction Fragment Length Polymorphism to Plant Breeding. in: Genetic Engineering: Principles and Methods (Eds J.K. Setlow and A. Hollaender, Plenum Press, New York, NY) **5**: 45-59.
3. Soller, M. and J.S. Beckmann (1983). Genetic Polymorphism in Varietal Identification and Genetic Improvement. *Theor. appl. Genet.* **67**: 25-33.
4. Beckmann, J.S. and M. Soller (1983). Restriction Fragment Length Polymorphisms in Genetic Improvement: Methodologies, mapping and costs. *Theor. appl. Genet.* **67**: 35-43.
5. Soller, M. and J.S. Beckmann (1984). Restriction Fragment Length Polymorphisms and Animal Genetic Improvement. *Reviews in Rural Sciences* **6**: 10-18.
6. Beckmann, J.S. and M. Soller (1985). Natural and Induced Restriction Fragment Length Polymorphisms in Animal Improvement. *Animal Blood Groups and Biochem. Genetics* **16** Suppl. 1: 12-13.
7. Kashi, Y. (1985) Restriction Fragment Length Polymorphism in Dairy Cattle. M. Sc. Thesis, The Hebrew Univ. of Jerusalem, Jerusalem, Israel (in Hebrew, with English summary).
8. Beckmann, J.S. and M. Soller (1986). Restriction Fragment Length Polymorphisms and Genetic Improvement of Agricultural Species. *Euphytica* **35**: 111-124.
9. Beckmann, J.S. (1986). Intransigence in 'genetic engineering': transgenics or generics. *Trends in Biotechnol.* **4**: 32.
10. Beckmann, J.S. and M. Soller (1986). Insertional Mutagenesis - A New Tool in the Genetic Engineering of Plants. *Israel J. Bot.* (in press).
11. Beckmann, J.S. and M. Soller (1986). Restriction Fragment Length Polymorphisms in Plant Genetic Improvement. *Oxford Surveys of Plant Molecular and Cell Biology* (Ed. B.J. Mifflin, Oxford Press, Oxford) **Vol 3** (in press).
12. Beckmann, J.S., Y. Kashi, E.M. Hallerman, A. Naveh and M. Soller (1986). Restriction Fragment Length Polymorphism among Israeli Holstein-Friesian Dairy Bulls. *Animal Genetics* **17**: 25-38.
13. Lebowitz, R.J., M. Soller and J.S. Beckmann (1986). Trait-Based Analyses for the Detection of Linkage between Marker Loci and Quantitative Trait Loci in Crosses between Inbred Lines. *Theor. appl. Genet.* (in press).