BARD

FINAL REPORT

PROJECT NO. I-487-82

Evaluation of Pollen Specific Methods for More Rapid Gene Transfer in Crop Plants

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1987

BARD

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Title of the research:

**Evaluation of pollen specific methods for more
rapid gene transfer in crop plants**

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Project's Commencement Date: Aug 1, 1983

Type of Report: Final

Signatures:

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Abstract. Compared to the sporophyte, the gametophyte of higher plants has received little attention in regard to breeding methodology. The objective of this research was to evaluate pollen specific methods aimed at faster and more efficient interline gene transfer. Pollen irradiation was shown to affect gene transfer however the magnitude of the effect was low and therefore doesn't justify the utilization of this method in breeding programs. In a study of pollen selection for low temperature adaptation in tomato we demonstrated that progeny of crosses made at low temperatures adapt better to the stress than progeny of crosses made at normal temperatures. This result suggest that pollen selection can be a viable approach in plant breeding.

As the research progressed it became apparent that the question of gene transfer had to be examined in the wider context of the plant's life cycle. We found that the proportion of loci deviating from the expected monogenic segregation ratios is significantly higher (54%) for progeny of interspecific hybrids than for progeny of intraspecific hybrids (13%). This research clarified the mechanisms for two specific examples of deviations in tomato. The first relates to the gametophytic self-incompatibility locus which was mapped to chromosome 1 in tomato. The second example is of differential zygotic abortion in an interspecific *Lycopersicon* cross.

In this study we identified a number of points which if considered can improve the efficiency of breeding programs particularly those aimed at transferring genes from wild species to cultivated crops: 1) When trying to resolve the genetic basis of traits, aberrant segregation of genes can distort the results of the analysis. 2) Recombination frequencies are higher through the female than the male side. 3) Pollen selection can be used to improve the performance of the sporophytic generation.

Objectives

1) To evaluate **pollen selection** as a breeding method. Pollen selection for low temperature adaptation proved to be an efficient method when using measurement of the response of the sporophyte as expressed by the rate of root elongation. The second selection experiment we intended to apply to "salt tolerance". The wild species *L. pennellii* was the source of the tolerance traits. When segregating populations resulting from this hybrid were analysed we found significant deviations from the expected ratios and in the F2 all the deviations favored the wild parent alleles. Since in order to examine the effect of pollen selection under salt stress we needed to analyse the patterns of segregation of markers it was necessary to first characterize the causes of the deviations without the salt treatment. This study was performed and we are presently examining the genetic basis for this differential zygotic lethality.

2) To evaluate **pollen irradiation** as a method for more rapid gene transfer in plant breeding. In tomato we determined that the effect of the irradiation treatments was small and therefore do not justify the research investment. In pepper no irradiation effects were detected.

Description of the cooperation

Throughout the three year program the investigators were in contact regarding the progress of the research and technical aspects that relate to laboratory methodology. This cooperation continued when the principal investigator visited the lab in the US and attempted (unsuccessfully) to transform pollen with naked DNA. The main difficulty in the cooperation relates to the original planning of the proposal which involved two crops studied in the two countries. Subsequently exchange and analysis of genetic material was limited.

Presently the principal investigator is on sabbatical in the US with Dr. Tanksley and some of the topics that are being pursued are a result of this BARD project.

List of publications

- 1) Epstein B (1985) Pollen irradiation for more rapid gene transfer in *Lycopersicon*. M. Sc. Thesis. Submitted to the Faculty of Agriculture of the Hebrew University of Jerusalem.
- 2) Gadish I (1986) Genetic analysis of differential embryo abortion in an interspecific *Lycopersicon* cross. M. Sc. Thesis. Submitted to the Faculty of Agriculture of the Hebrew University of Jerusalem.
- 3) Zamir D (1983) Pollen irradiation in tomato: minor effects on enzymic gene transfer. *Theor. Appl. Genet.* 66:147-151.
- 4) Tanksley SD and J Iglesias-Olivas (1984) Inheritance and transfer of multiple flower character from *Capsicum chinensis* to *Capsicum annuum*. *Euphytica* 33:769-777.
- 5) Tanksley SD (1985) Gametophytic self-incompatibility is controlled by a single major locus on chromosome 1 in *Lycopersicon peruvianum*. *Proc. Natl. Acad. Sci. USA* 82:5093-5096
- 6) Zamir D and Y Tadmor (1986) Unequal segregation of nuclear genes in plants. *Bot. Gaz.* 147:355-358.
- 7) Gadish I and D Zamir (1987) Differential zygotic abortion in an interspecific *Lycopersicon* cross. *Genome* (in press).
- 9) Zamir D and I Gadish (1987) Pollen selection for low temperature adaptation in tomato. (submitted).