REGIONAL RESEARCH PROJECT OUTLINE

1. **PROJECT NUMBER** - NER____.  NE-107  Project 213


3. **TITLE**  Breeding and Evaluation of New Potato Clones and Varieties in the Northeast Area.

4. **OBJECTIVES**

   A. To determine regional performance, quality, and storage characteristics of promising potato clones and new varieties.

   B. To evaluate promising clones and new varieties for special purpose needs such as unusual pest outbreaks, processing, export, and/or production situations.

   C. Breeding to develop high quality, widely adapted, highly productive, pest resistant clones and varieties for multiple uses that are low in naturally occurring toxicants.

5. **PROCEDURES**

   A. To determine regional performance, quality, and storage characteristics of promising potato clones and new varieties.

      (1) Foundation Seed Production: Maine. The performance potential of promising clones or new variety can be adequately determined only if seed has been produced under the same conditions as that of the variety it is intended to replace or complement. The Maine State Seed Board has a foundation seed production capability on the Sangerville Farm facility. The University of Maine invites each breeder to furnish 15 to 20 pounds of as nearly disease-free seed as feasible of promising clones and new varieties to Hugh Murphy, Department of Plant and Soil Sciences, University of Maine; Orono, Maine 04473, for foundation seed increase on the Sangerville Farm facility. Seed stock of each clone will be inspected for disease during the growing season, and harvested, and stored in a manner to prevent clonal mixtures.

      (2) Regional Horticultural Performance Evaluations: Each participating state will determine the number of in-state test sites. Requests for seed will be directed to the Maine Experiment Station, c/o Hugh Murphy, Deering Hall, Orono, Maine 04473. The seed will be prepared and shipped in quantities and at times indicated by participant. Participant will record and make available to Mr. Murphy pertinent data on clonal maturity, vine characteristics, and reaction to pests that might be encountered.

At harvest, each participant will determine total yield by replication of tubers above 1-1/2 inches, yield of U.S. No. 1 size tubers (1-7/8 to 4 inches in diameter), and yield of No. 1 size A tubers (2-1/2 to 4 inches). Notes will be recorded on tuber characteristics such as
tuber conformation, growth responses and incidence of pests and damage. A 20-tuber sample from each replication of each clone and variety from each test site will be shipped to Hugh Murphy, Aroostook State Farm, Presque Isle, Maine 04769, for specific gravity and chip quality determinations.

A report will be made each year in the form of a publication entitled, "Performance Evaluation of Potato Clones and Varieties in the Northeastern States." Publication of the report will be done by the Plant and Soil Science Department, University of Maine; Orono, Maine.

(3) Participating Agencies:

AGRICULTURE CANADA - Evaluate selected promising clones and new varieties in the Provinces of New Brunswick, Prince Edward Island, Quebec, and Ontario when necessary. Field performance, quality evaluations, and storage characteristics will be determined.

CONNECTICUT - Study the field performance of selected clones and new varieties grown in accordance with commercial recommended practices. Tubers will be harvested and graded for size. Samples will be shipped to Maine for quality determinations.

MAINE - To evaluate at three or more locations all available clones and new varieties grown at Sangerville Farm for yield, size distribution, specific gravity, chip and french fry quality, reconditioning ability, preparation losses, after cooking darkening, and shrinkage and storage losses. Maine will also make single location measurements for french fry color and texture, storage and sprouting characteristics, after cooking color, and peeling losses on selected clones and new varieties in comparison with standard varieties.

MASSACHUSETTS - To study the field performance of selected clones and new varieties as grown under Massachusetts climatic and production conditions. Samples for quality determinations will be shipped to Maine.

NEW HAMPSHIRE - Evaluate promising clones and new varieties for yield, growth habits, and size distribution of tubers. Quality determinations will be made by the Maine station.

NEW JERSEY - Evaluate plant and tuber characteristics, yield, tuber sizes, and specific gravity of 20 to 30 promising potato clones and new varieties each year. To initiate a uniform computerized data handling system for the plant and tuber characteristics collected on a regional basis.

NEW YORK - The collection of clones and new varieties for regional tests will be grown at Freeville and Riverhead. Data will be taken on yield, appearance, culinary and processing quality, and storage characteristics.

PENNSYLVANIA - Evaluate at several locations growth characteristics, yield and size distribution of tubers, tuber appearance and defects,
and quality characteristics. Eating quality of baked tubers (general taste performance) will be evaluated at several intervals after controlled storage temperatures employing the hedonic taste test by a trained sensory panel.

WEST VIRGINIA - Evaluate performance, quality, and storage characteristics of promising potato clones and new varieties at two locations. The tuber crop will be harvested, graded, and tuber samples retained for storage studies and quality evaluations.

B. To evaluate promising clones and new varieties for special purpose needs such as unusual pest outbreaks, processing, export, and/or production situations.

CONNECTICUT - Selected clones and new varieties will be compared with standard varieties for their response to moisture and temperature stress and weed competition under field and laboratory conditions.

MAINE - Selections from the various Northeastern Breeding Programs and Agriculture Canada will be screened in field and greenhouse tests for resistance and susceptibility to:

1. Acid tolerant scab (*Streptomyces sp.*)
2. Bacterial ring rot (*Corynebacterium epedonium*)
3. Late blight (*Phytophthora infestans*)
4. Early blight (*Alternaria solani*)
5. Viruses (PVX routinely, others irregularly)
6. Green peach aphid (*Myzus persicae*)
7. Potato aphid (*Macrosiphum euphorbiae*)
8. Buckthorn aphid (*Aphis nasturtii*)
9. Colorado potato beetle (*Leptinotarsa decemlineata*)
10. Any special performance notes.

NEW JERSEY - Evaluate all promising clones and new varieties for tolerance to air pollutants that occur (naturally) in New Jersey.

NEW YORK - Selected clones and new varieties will be evaluated at the Long Island Vegetable Research Farm for resistance to scab, leafroll, and mosaic viruses. These tests will be based on field exposure.

Pennsylvania - Isolated test plots for disease resistance will complement regional testing to provide information on disease resistance such as verticillium wilt and late blight of potatoes. Supplemental information on processing and fresh quality of advanced clonal selection will also be provided.

WEST VIRGINIA - Will evaluate promising potato clones and new varieties for multigenic resistance to *Phytophthora infestans*. Seed stocks of clones derived from the breeding programs and grown at Sangerville, Maine will be planted in multi-hill replicated trials in the Tygart River Valley and evaluated for late blight resistance.
1. **EASTERN REGIONAL RESEARCH CENTER (ERRC) (Philadelphia)** - Will conduct research to determine what factors control glycoalkaloid levels in potato tubers. Selected promising clones and lines will be analyzed for glycoalkaloids and glycoalkaloid content will be correlated with other characteristics such as disease resistance, nutritive value, and flavor.

2. **DELSVILLE (BARC)** - a) Will evaluate clonal lines for reaction to certain diseases, b) Evaluate resistance to leafhoppers (*Empoasca fabae*), c) Evaluate potentially promising clones for resistance to viruses, fungal disease, certain insects, low naturally occurring toxicants, and improved quality (chip and french fry) characteristics. Part of this research will be conducted at Presque Isle, Maine, d) Study physiological disorders of potatoes and evaluate selected quality factors.

3. **MAINE (USDA)(Orono)** - Evaluate clones or varieties for field disease resistance to verticillium wilt, common scab, the Rhizoctonia complex, fusarium tuber rot, and silver scurf. Also, evaluate the possible consequential effects of these diseases on tuber storage weight loss, sprout growth, bruise susceptibility, appearance, disease incidence, reconditioning, processing, and reaction to sprout suppressants.

4. **NEW YORK (USDA)(Ithaca)** - Evaluate selected promising clones and new varieties for resistance to Race A of the golden nematode. These evaluations will be made in pot culture.

C. Breeding to develop high quality, widely adapted, highly productive pest resistant clones and varieties for multiple uses that are low in naturally occurring toxicants.

Participants will continue present breeding programs to develop advanced clonal material which will be available to other production areas for regional evaluation for adaptation, yield, and quality. While all breeding programs have some criteria for selection, each program will continue to emphasize certain characteristics to meet the needs of their particular production area. Campbell Institute for Agricultural Research will cooperate on an informal basis on many aspects of the breeding programs.

**AGRICULTURE CANADA** - Will make available for evaluation advanced lines that have been selected for yielding ability and stability, table and processing quality, disease and insect resistance, and exchange with other breeders parents of tuberosum and andigena background that possess specific characteristics.
MAINE - Identify, develop, and supply superior, vigorous, early matur ing, high solids, high yielding, good processing, multiple disease resistant, widely adapted varieties with low alkaloid content and good tuber type.

NEW YORK - Variety development will emphasize the combination of good fresh market quality, chipping ability, and resistance to Race A of the golden nematode. Parent clones will be from selected tuberosum and andigena populations.

PENNSYLVANIA - Conventional and modified breeding procedures will be used to generate new genetic combinations of desirable traits for eventual development of commercially acceptable varieties for both the fresh and processing markets.

UNITED STATES DEPARTMENT OF AGRICULTURE

BELTSVILLE AND PRESQUE ISLE - Identify germplasm with resistance to major pests and good processing characteristics. Through conventional and recurrent selection breeding procedures, develop progenies for evaluation and selection under various pest and environmental stresses. Breeding selection and evaluation will emphasize both russet and white tuber types.

6. JUSTIFICATION

Improvement in potato production in any producing area depends, in part, upon the suitability of varieties grown and the introduction and acceptance (by growers) of new varieties to meet changing needs. The variations in soils and growing conditions between the potato production areas of the Northeastern states represent a unique challenge which can best be met by a coordinated breeding and evaluation program. The potato industry in the Northeastern states is valued at approximately 248 million dollars at the Farm level. Currently, the Northeastern states produce 19 percent of potatoes produced in the United States on 19 percent of the acreage planted to the crop. Approximately 70 percent of the Northeastern potatoes are marketed in the fresh state. The industry in the Northeastern region is in the midst of or adjacent to the largest population megalopolis (Boston-Norfolk-Chicago) in the United States. This region is the United States potato industry's prime marketing area. In spite of the projected increase in yearly per capita consumption of potatoes from the current 120 pounds to 127 pounds by 1980, per acre yields in the Northeastern states are not increasing, and acreage for production is decreasing due to pressure from expanding industry and population increases. Also, consumption of fresh potatoes is anticipated to decline from the current yearly per capita amount of 55 pounds to 29 pounds by 1980, while yearly per capita consumption of potatoes in processed forms is anticipated to rise to 93 pounds during the same time period. The Northeastern states potato industry as a whole is noted as a fresh market supplier, while the Pacific Northwestern states emphasize marketing potatoes in various processed forms. For instance, Idaho already processes over 70 percent of its annual production of approximately 70,000,000 cwt.
Washington and Oregon are rapidly increasing potato production acres, primarily for its projected processing potential. Acreage expansion in those two states is projected at 525,000 acres by 1985, and the potential is for an additional expansion of 700,000 acres by 1995. Research and promotion fiscal support approximating 2 million dollars annually by the state Potato Commissions currently support the industry's production, storage, transport, and marketing activities in three Northwestern states. To remain competitive with the expanding western producing areas, the Northeastern states must have new higher yielding, high quality potato varieties to retain its fresh market base and meet the expanding demands of the potato in its various processed forms. Such varieties must be pest-resistant to minimize production costs and pesticide pollution of the air and water. In the Northeastern states, there are public and private breeding programs that are developing horticulturally promising, pest-resistant clones and varieties to meet the various needs of the industry. Current evaluation of such promising clones is done, for the most part, on an informal basis between breeder and interested cooperators. Regional evaluation of a clone frequently follows its being named as a variety. Such new varieties should be tested in the advanced clonal stage for climatic adaptation in all the major potato growing areas of the Northeastern states to determine their relative potential as additions to or as replacements for the currently grown potato varieties.

When pathogens are exposed to a new genetic base, they change. The mechanism by which this change occurs is not well understood. Natural mutations and selection are probably largely responsible, but some other more obscure mechanism, for example adaptive parasitism, could also be responsible. Regardless of the mechanism, the pathogen changes and plants once resistant are then susceptible. The pathogen, in its altered form, in some way, manages to avoid triggering the hypersensitive defense mechanism of the host, and once the outer barriers of the host have been breached, the pathogen can develop unimpeded. The end result is plant disease. For this reason, and this reason alone, the search for new sources and types of resistance to disease causing agents must continue. It goes without saying that any new source of resistance must then be incorporated through breeding into varietal forms suitable for commercial production. Finally, new progeny selected from inter-specific crosses involving horticulturally superior varieties with new disease resistant lines must be evaluated. One of the proposed objectives of NER— is to develop superior potato varieties for the Northeast Region by combining excellent horticultural characteristics with disease resistant characteristics so as to avoid serious losses from sudden outbreaks of plant pests and diseases.

This research project can provide additional incentives for breeders to develop innovative breeding systems and promote the exchange of improved germplasm for the development of potentially widely adapted, high quality, pest-resistant clones, and a mechanism whereby such promising clones can be evaluated over a wide range of environmental conditions prior to their being named as varieties.

7. RELATED CURRENT RESEARCH

A CRIS report covering the time period of 1967 through 1974 lists some 48 Hatch and Federal projects and 26 State projects that involve various phases of potato breeding, genetics, and variety evaluation. The activities of these projects are known, in part, to the prospective cooperators
in this project either by professional contacts, through publications, or by attending the Annual Meetings of The Potato Association of America. The regional project for the Northeast Region will supplement the present State and Federal projects by promoting a greater exchange of germplasms, evaluation techniques, and development of more commercially acceptable varieties in a shorter period of time to keep the Northeastern potato industry competitive.

The objectives and activities of related regional projects, such as IR-1 and NCR-84, have been considered and are not in conflict with this project. The pooling of the information gained from this project will certainly benefit potato research and industry programs in the Northeast, other areas of U.S.A., and developing countries of the world.

8. PREVIOUS WORK

Improvement of potato varieties by breeding and subsequent evaluation for adaptation to various production areas of the United States, Canada, and other Countries (7, 9, 38, 83) is not new. Many recent advances have also been made in potato genetics to utilize desirable traits found in the wild species of Solanum to improve disease, insect, and nematode resistance (11, 18, 26, 33, 83, 89).

A. The evaluation of potato clones and new varieties has been a function of most potato growing areas of the United States and Canada for many years as documented in the literature (12, 14, 38, 42, 63, 64, 66, 67, 68, 69, 70, 71, 72, 96, 109, 110, 111, 112, 113, 114, 115, 116, 117). Very little evidence exists, however, that suggests a regional approach to uniform variety evaluation in the Northeast other than by Maine, New Hampshire, and Vermont (63, 64, 65, 66, 67, 68, 69, 70), with the inclusion of Massachusetts, New Jersey, and Pennsylvania in 1975 (71). More recently, New York and West Virginia have joined with the above states in order to secure seed from the Sangerville Farm facility. This project will formalize this regional cooperation on a structured and coordinated basis.

From previous evaluation trials the basic yield and quality data have been used in the release descriptions of several varieties (5, 6, 16, 40, 41, 75, 76, 77, 78, 97). In addition, evaluation trials of potato clones and new potato varieties have been the source of information for variety recommendations for various local situations.

B. The evaluation of promising clones and new varieties for special purpose needs has increased since World War II (1, 2, 3, 14, 19, 20, 34, 35, 39, 46, 51, 59, 73, 74, 120). Most of these studies have reported the influence of environment, clone or variety, and variations in culture on specific gravity, chipping quality, or behavior at various storage temperatures. Specific research to determine various facets of insect resistance in various clones and new varieties is limited but satisfactory progress has been made (26, 52, 54, 86). Study of resistance and/or tolerance to foliar and tuber disease which occur both as localized and regional problems has been very extensive (4, 15, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 36, 37, 43, 45, 53, 81, 99, 104, 107, 121, 122, 123). Since the isolation of the golden nematode in North America, considerable study of variety development and evaluation of resistant clones has taken place (11, 83, 84, 100). It would appear that there is a need for more study of viruses, physiological diseases and/or problems and many aspects of clonal and new variety evaluation for special production situations.
C. Breeding and development of clones and varieties having wide adaptation
good quality, and high production, with good pest resistance depends
on the exploitation of the generic variability of not only Solanum
 tuberosum, but all of the tuber-bearing relatives of the potato. The
use of the genetic approach to disease and insect resistance in new
varieties depends, in part, on a greater use of the present knowledge
of genetics and breeding and new techniques or knowledge to fully uti-
"lize the cytogenetic base that we now have. Much knowledge of the
genetic reactions of the potato has been advanced in recent years (32,
47, 48, 49, 50, 55, 60, 62, 80, 90, 91, 93, 98, 105, 119) as they re-
late to improvement of yield quality, pest resistance, and environment.
In addition, the glycoalkaloid problem of recent origin has generated
research such as (17, 61, 94, 102, 108), which has set the stage for
the development and evaluation of clones and varieties that are low in
naturally occurring toxicants.

9. ORGANIZATION

The regional technical committee elects an executive committee composed of
a chairman, vice-chairman, and secretary. In order to provide continuity,
a succession of officers will be established so that the vice chairman be-
comes chairman, the secretary becomes vice-chairman, and a new secretary is
elected each year. The responsibilities of the executive committee members
are as outlined in the Manual of Procedures for Cooperative Regional Res-
earch. The technical committee meets once each year to discuss progress
of the research, review procedures, coordinate research and plan future
research activities.

10. SIGNATURES

_________________________________ Date
Regional Administrative Advisor

_________________________________ Date
Chairman, Regional Association of Directors

_________________________________ Date
Chairman, Committee of Nine

_________________________________ Date
Administrator - CSRS
11. **ATTACHMENTS**

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## Anticipated Resources

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Literature Cited


110. Ibid. 1968. 38th Annual Report of National Potato Breeding Program. USDA-ARS; Beltsville, Maryland.


113. Ibid. 1971. 41st Annual Report of National Potato Breeding Program. USDA-ARS; Beltsville, Maryland.


Additional Publications


