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**SUMMARY RESEARCH PROGRESS REPORT FOR 1992
AND RESEARCH PROPOSAL FOR 1993**

Submitted to:
SLV Research Center Committee
and the
Colorado Potato Administrative Committee (Area II)

TITLE: Potato Growth Analysis Under Field Conditions

PROJECT LEADERS: Frank D. Moore-Department of Horticulture
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PROJECT JUSTIFICATION: This research is designed to provide fundamental information about differences in growth stages and plant behavior that relate to yield potential of potato varieties under the short season, high altitude SLV field conditions. This type of data will provide a more precise basis for developing best management practices for each cultivar of importance to increase profitability and reduce risks to groundwater and other features of the field environment.

PROJECT STATUS: First funded in 1989; 1992 was 4th year.

SIGNIFICANT ACCOMPLISHMENTS FOR 1989 - 1992:

Overview of Project

1992 was the fourth and final year of a unique effort to study potato plant growth and development under field conditions. This type of research has not been done before--on potatoes in Colorado. Only a few other U.S. potato researchers have conducted work of this type, and then on a more limited scale. This is a "first" to precisely measure and compare growth attributes of an early maturing versus a late maturing potato variety throughout the entire growing season. We also believe we have: (a) developed a more precise and complete explanation why certain varieties are adapted to the SLV; (b) identified some measurable and genetically controlled components of yield that may aid in the development of new varieties; (c) developed some research methods that should help SLV Research Center scientists analyze the growth pattern of any variety under SLV conditions; and (d) provided important baseline data that will enhance development of a computer simulation growth model that has potential value for both research scientists and growers.

In order to verify varietal performance and validate accuracy of research methods it was necessary to conduct nearly identical experiments during more than one season. The repeatability of the data from year to year strongly suggests that the key growth attributes represent genetically controlled--varietal specific characteristics.

Major Results

I. The results of this four year study can be best illustrated by comparing the performance of two varieties Sangre and Russet Nugget as measured by growth analysis methods. Both of these varieties were developed at the SLV Research Center by the same breeders and both varieties are being successfully grown for commercial production. Yet these two varieties are considerably different in maturity and top/tuber growth patterns.

Maturity Rating: The "general maturity" of these two potatoes was known at the time of naming and release--before this study was started. These results, however, add important specifics:

(a) In spite of being nearly equivalent in rate of emergence and top growth early in the season Sangre tuberizes at least 10 days earlier than Nugget.

(b) Nugget's tuber growth curve actually continues to increase at the end of the season--clearly indicating a very late maturity. Sangre, (and Centennial) on the other hand, is genetically programmed to complete it's tuber yield by the end of August in most seasons and allow time for tuber maturity before harvest.

Leaf Area Development: Both varieties are similar in leaf area growth up to 40-45 days after emergence; Sangre, at that time has nearly reached it's max--and it then abruptly stops top growth. However, Nugget continues to produce top growth for at least two more weeks and then gradually tapers off leaf/stem production; typical of a non-determinate potato.

Tuber Bulking: Perhaps the most interesting difference between Sangre and Nugget focuses on tuber initiation and bulking.

(a) Tuber no./hill: Sangre initiates tubers about 10 days earlier than Nugget. Also, the subsequent rate of tuber number increase (per hill) is also strikingly different. Sangre reaches the 5 tuber/hill point about 19 days after emergence while Nugget's 5 tuber/hill level occurs about 38 days after emergence. The 8 tuber/hill level for Sangre is roughly 23 days after emergence vs 6 to 8 weeks for Nugget.

(b) Partitioning begins when dry matter allocation to the tubers is first observed. Sangre is 10 days earlier than Nugget and partitions at a greater rate. Also the time when dry matter allocation to tubers exceeds that directed to tops began 16 to 17 days later for Nugget than for Sangre.

II. Another accomplishment involved development of a more efficient method to measure leaf area index of field grown plants. The LICOR Plant Canopy Analyzer was shown to not only require considerably less labor, eliminate the need to destroy plants in order to get readings and provide more consistent data than the conventional method. This new method will enable measurement of plant canopy development for almost any type of field experiment in which plant top growth is important.

III. Computer crop simulation model: Considerable progress was made towards getting an operational model validated for SLV conditions. The model, with a modest amount of additional effort could be used by Dr. David Holm to evaluate potential performance of advanced seedlings in the potato breeding program. The next stage of application would likely involve development of cultivar specific management profiles for new varieties--or older ones. As additional experience is gained the model will eventually become available for grower use.

Summary Comments:

The long term benefit of this study to the SLV potato industry involves a new approach to learning about specific differences of field growth of potato varieties. The techniques will enable researchers to accurately evaluate the potential adaptability of both early and late maturing potatoes for use by SLV growers. The comparison of growth patterns for Sangre and Nugget provides detailed information to verify why a variety like Sangre is better adapted than Nugget to the short season SLV environment. Earlier tuberization and more rapid tuber bulking permit it to reach maximum yields and yet allow time for skin set prior to harvest. However, Nugget has many attributes that justify it's development and commercial use in the SLV. The very fact that Nugget is currently being grown for commercial production testifies to the fact that a late maturing potato has a place in a short season production area. However, we need a good understanding of growth patterns in order to develop crop management that will minimize inherent risks associated with such varieties.

Another important "take home" lesson from this study is that early season crop management should be re-emphasized!! This includes things such as seed selection, pre-plant seed handling, planting and early season fertility/irrigation. We also need to learn how to better stimulate earlier tuberization in varieties such as Nugget in order to take advantage of a tremendous top growth that really doesn't get "put to work" in tuber production as early as it should.

3/12/93

David

Here is the budget
starting April, hopefully.

1 Salary 4 months @ 1363 5452

2 Soil and plant sample analysis 800

3 Travel to SLV 1000

\$ 7252

1 Continue model validation at CSU.

Activate soil/plant N + irrigation

subroutines, I will install SUTESTOR for David's

use. Consultations with David on model.

2 CSU soils lab for analysis of
plant and soil samples. We do

our own soil moisture determinations

3 Two trips for 2 to 3 people for
program installation and soil and
plant sampling.

Thanks
Frank

Fig. 1

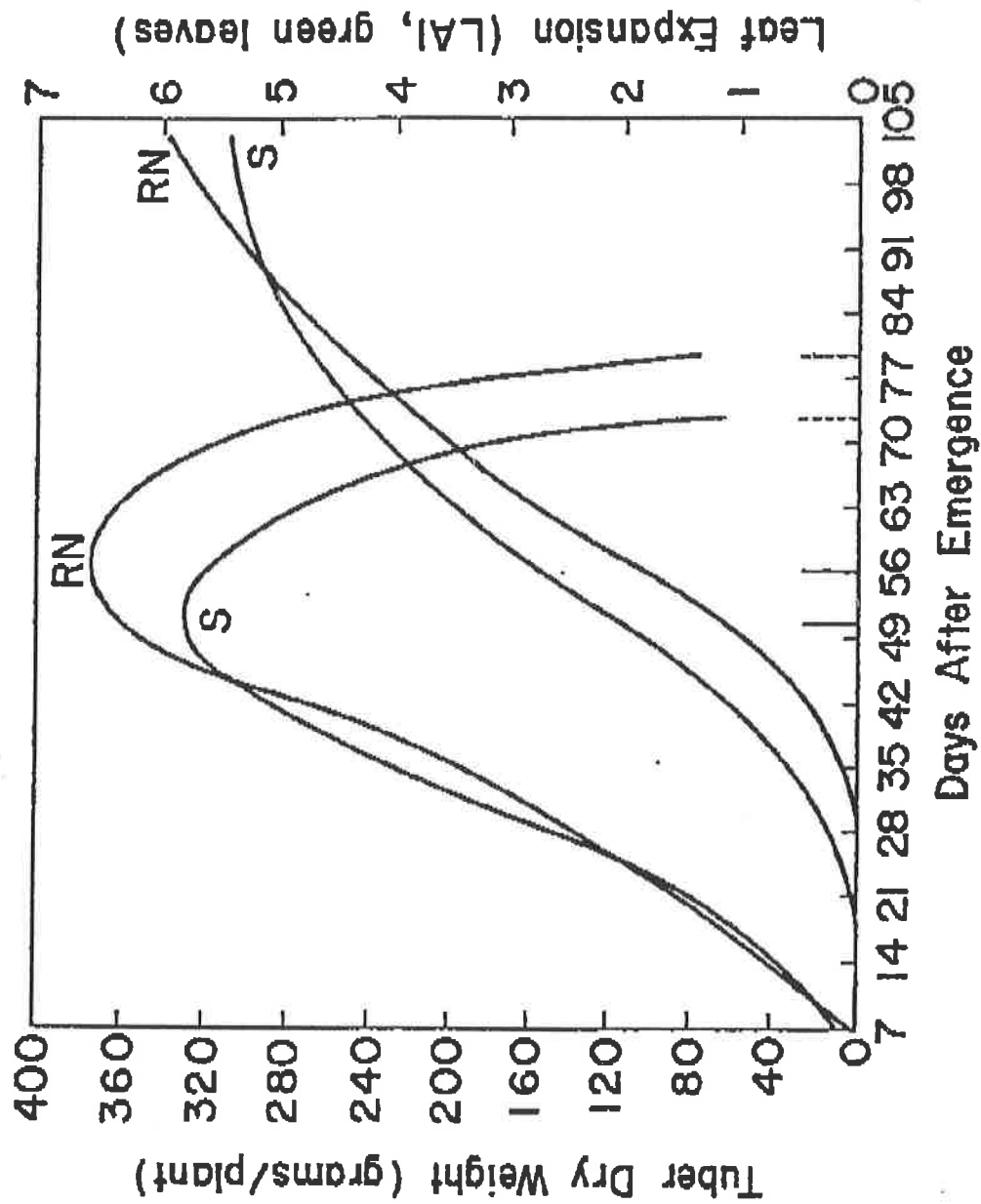


Fig. 2

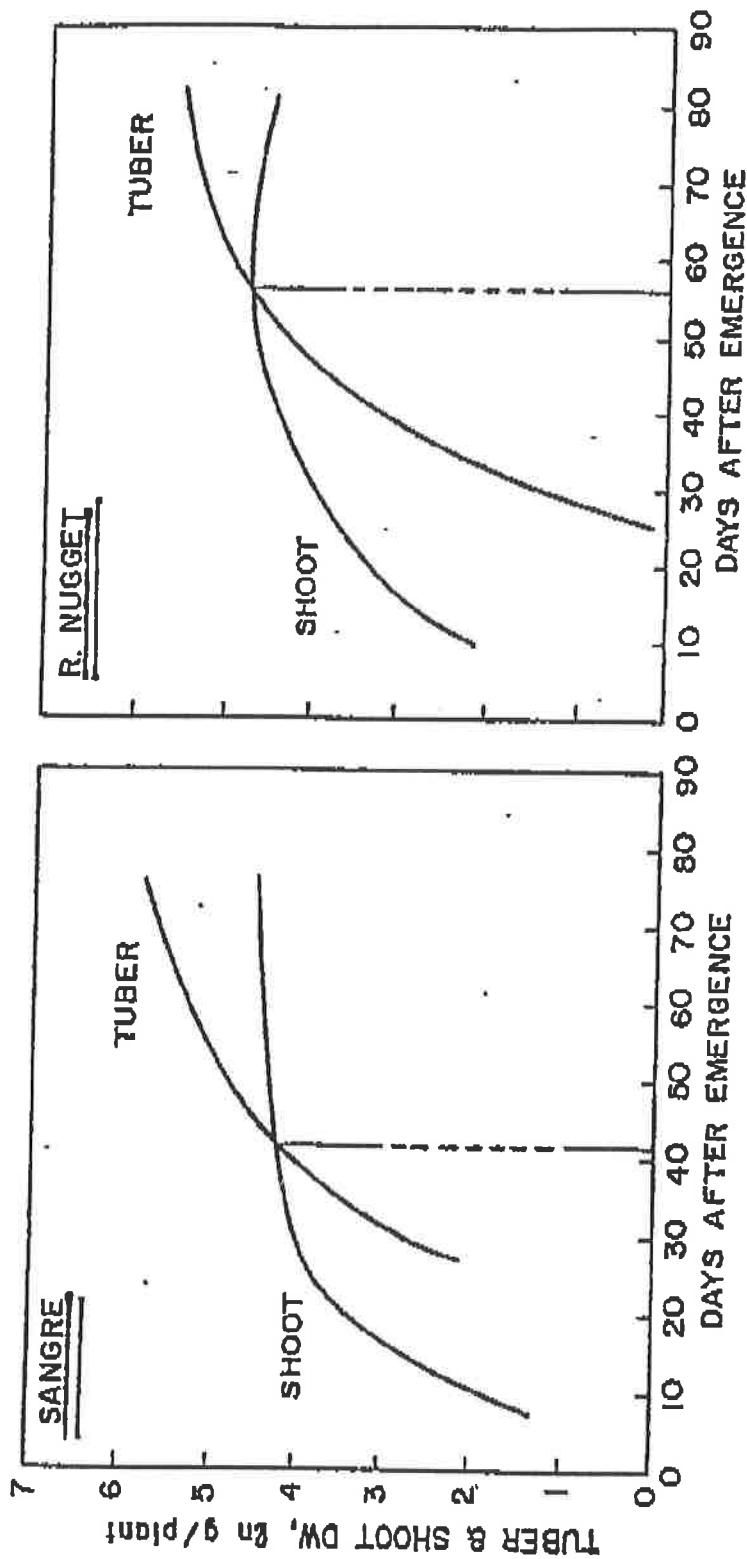


Fig. 3

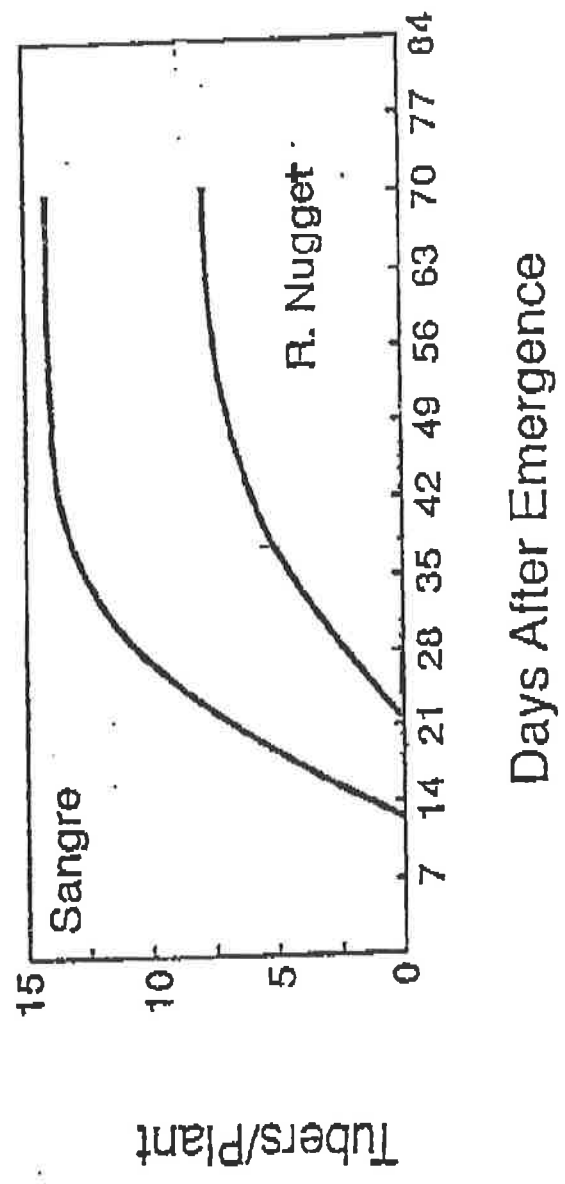


Fig. 4

CULTIVAR CLASS

- DETERMINANT & EARLY
- NONDETERMINANT & LATE

Fig. 5

**SIMULATION MODELS ARE
USED TO EVALUATE POTENTIAL CHANGES
IN MANAGEMENT INCLUDING IRRIGATION
& FERTILITY AND/OR CULTIVAR ADAPTION**

Fig. 6

**"THINGS SHOULD BE MADE
AS SIMPLE AS POSSIBLE
BUT NO SIMPLER"**

**ALBERT EINSTEIN
1879-1955**

Fig. 7

WE HAVE ESTABLISHED
COEFFICIENTS FOR
SANGRE & R NUGGET
THEREFORE

	S									RN								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
<u>DETERMINANCY</u>																		
<u>TUBERIZATION</u>																		
<u>BULKING RATE</u>																		
<u>L EXPANSION RATE</u>																		

Fig. 8

**SUDHIR RUNS
SUBSTOR ON:**

- **DESKTOP**
- **CPU:486**
- **HARD DISK: 130 Mb**
- **RAM: 8 Mb**
- **MONITOR: SVGA**
- **DOS: 5.1; 5.25 OR 3.5"**
- **MATH CO-PROCESSOR**