

**SUMMARY OF RESULTS FROM 1991 POTATO SEED RESEARCH**

**I. ANALYSIS OF LEAF AREA, TOP DRY WEIGHT AND TUBER WEIGHT FOR DIFFERENT SEED SOURCES.**

Six seed sources (Becker, MN; Greeley, and San Luis Valley, CO; and Outlook, Prince Albert and Saskatoon, Sask.) for the cultivars Norchip, Norland, Russet Burbank and Russet Norkotah were planted April 26 on a sandy loam soil in Weld county. Emergence was May 12-15. Five replications per treatment (four cultivars x six sources) were collected for leaf area and dry weight determinations. This was repeated every two weeks until maximum growth when data were taken every week. The last collection was taken 111 days after planting. Norchip was abandoned from the trial because of very low emergence for the Becker seed source. continuous recordings were taken of canopy temperature, soil temperature, soil moisture and irradiance.

The results are presented in Fig. 1 to 6. We can conclude from these data that seed sources for Russet Burbank leaf area and dry weight of top growth (Fig. 1,4) were significantly different (statistical data were calculated but are not presented) for all but the first and last date of analysis. SLV, PA and Saskatoon sources were similar and produced the highest leaf area. Seed from Becker, Outlook and Greeley were similar and produced the lowest leaf area and top dry weights for most dates. The final harvest of tubers was highest from the cool source seeds, but we caution that plant numbers are insufficient from this trial for reliable data. The replicated yield trials from another experiment are more reliable for yield data. Leaf area indices (Fig. 4) reflect seasonal changes among the seed sources.

The data for Norland and for Norkotah were not significantly different for seed sources on most harvest dates. Norland from the Becker and Greeley seed sources produced less leaf area than SLV at 45 days after planting, but thereafter the differences were insignificant until maximum canopy development when SLV seed plants were lower, but this was not reflected in lower tuber yields (Fig. 2,5).

Russet Norkotah appears to be insensitive to seed production site on the basis of this one years' data. There were no significant differences among seed source for leaf area on any harvest date. One should be cautious in drawing conclusions on limited data, but if this is confirmed it may well be a desirable characteristic in this cultivar.

These data concur with several years of earlier yield data that Russet Burbank is highly influenced by environment and Norland less so.

**II. FOURIER TRANSFORM INFRARED (FTIR) ANALYSIS OF FREEZE DRIED POTATO POWDERS.**

The basic hypothesis of this research is that vibrational spectroscopy, measured by FTIR, of certain biomolecules that are unique to different genotypes can be used as a means of characterizing cultivars and perhaps genetic variants.

We are working under the following assumptions:

1. We can detect a number of similarities in potato powders that are only to be found in potatoes and will be similar for all genotypes that we test. For example potato starch will be uniquely different from wheat or corn starch.

2. We can detect some characteristics that will be different for each genotype we test, and will not vary from season to season or location to location. If this criterion cannot be met the concept will fail.
3. We can detect differences among mutants of cultivars that will be constant from season to season and location to location. This may or may not be possible: so far electrophoretic techniques have not been sensitive enough to accomplish this type of discrimination.
4. We will detect differences that result from location and seasonal effects that will not be stable and will be of no value in characterizing genotypes. Some of these differences may help us to better understand physiological responses such as seed vigor.

During the past few weeks we have accomplished the following:

- Developed a reliable procedure to prepare samples from freeze dried, fine ground and screened potato powders.
- Developed a protocol to derive high quality infrared spectra and a computer based analytical technique.
- Developed a computer library data base and a searching technique for several cultivars and mutants (variants) of Sangre. Representative spectra were collected from 600 cm<sup>-1</sup> to 4000 cm<sup>-1</sup> (Fig. 7).
- Preliminary results suggest that the library of spectra can be used to separate cultivars, but a fully reliable method will require more time to complete (Fig. 8).
- Comparative Data Analysis

Equation used: An industry standard normalized least squares dot product algorithm which generates a hit quality index (HQI) as follows.

$$HQI = \frac{\sqrt{2} \sqrt{1 - (LIB \bullet UK)}}{\sqrt{(LIB \bullet LIB)} * \sqrt{(UK \bullet UK)}}$$

The dot is the product of the two spectra, LIB is the library entry being searched and UK is the unknown spectrum. This formula gives the best match at HQI = 0 (LIB=UK) and the worst match at HQI =  $\sqrt{2}$  (1.414). This means that a comparison is made in a specified region of the spectrum (in the case presented in Fig. 8, between 860 cm<sup>-1</sup> and 2000 cm<sup>-1</sup>). The best three hits listed will begin with the lowest HQI values (best matches). The higher the HQI value the more imperfect the match. The example in Fig. 8 demonstrates an accurate identification of the unknown (Russet Burbank from a completely different sample) from our present library of 12 entries. Norgold and SLV were the next best hits, obviously quite different cultivars.

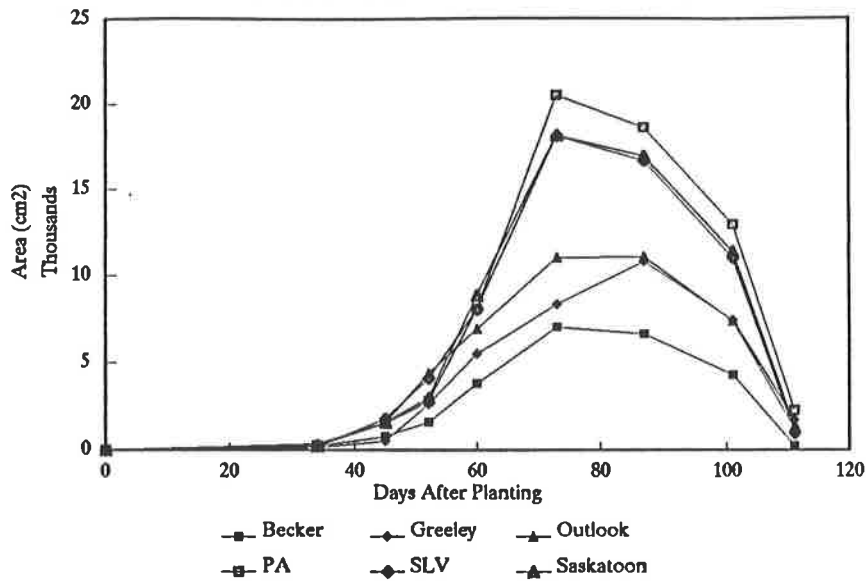
Library of Potato Cultivars and Variants (Absorbance spectra)			
ABN90	Norland, Becker	1990	PP000001
ASLN90	Norland, SLV	1990	PP000002
ASM10	Sangre, variant 10	1991	PP000003
ASM1145	Sangre, variant 11	1991	PP000011
ASWT	Sangre, (normal wild type)	1991	PP000005
ASM14	Sangre, variant 14	1991	PP000006
ARN1	Russet Nugget	1990	PP000009
ANG1	Norgold	1990	PP000010
ARBG	Russet Burbank	1990	PP000012

Present concerns and future goals:

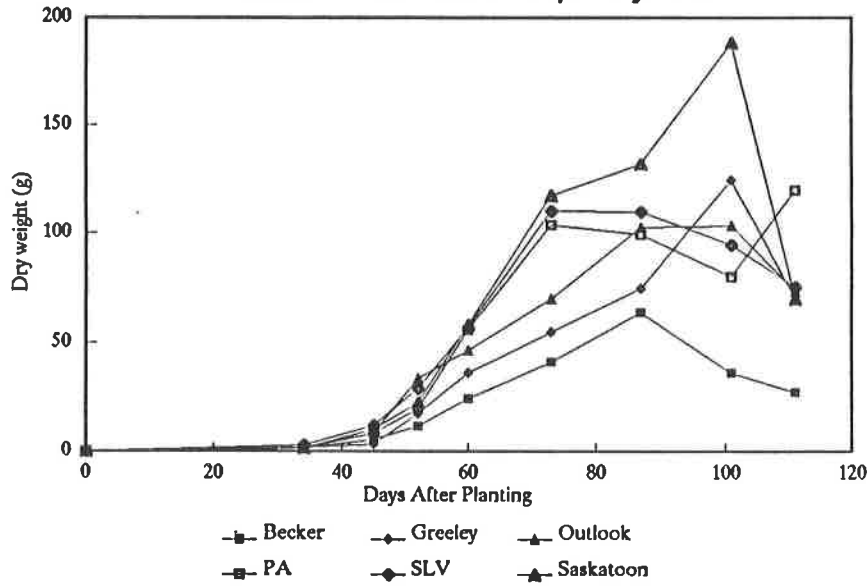
- To resolve questions posed in assumptions 1 to 4
- It is important to improve on techniques associated with sample preparation and application to the crystal prior to analysis.
- We need to test different analytical criteria to evaluate data such as peak position and intensity to determine the most effective approach.
- We should explore alternative methods to isolate specific components such as potato starch and proteins and analyze these fractions to compare with potato powders.

We caution that this approach has not been used before with FTIR and may not succeed. If it does, however, there may be a number of potential advantages over methods such as electrophoresis.

### Russet Burbank leaf area



### Russet Burbank top dry wt.



### Russet Burbank tuber wt.

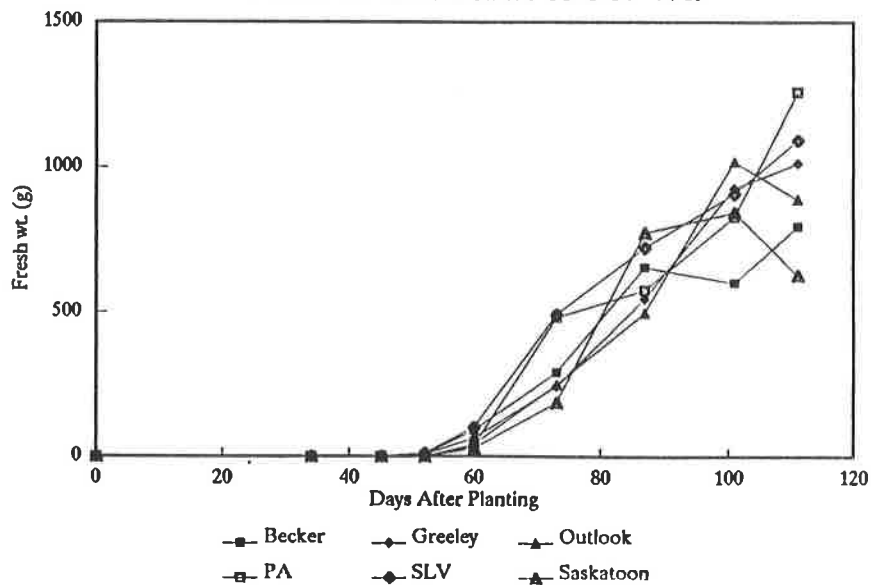


Figure 1.

Leaf area, top dry weight and fresh tuber weight of six seed sources for Russet Burbank grown in Weld county, CO, 1991.

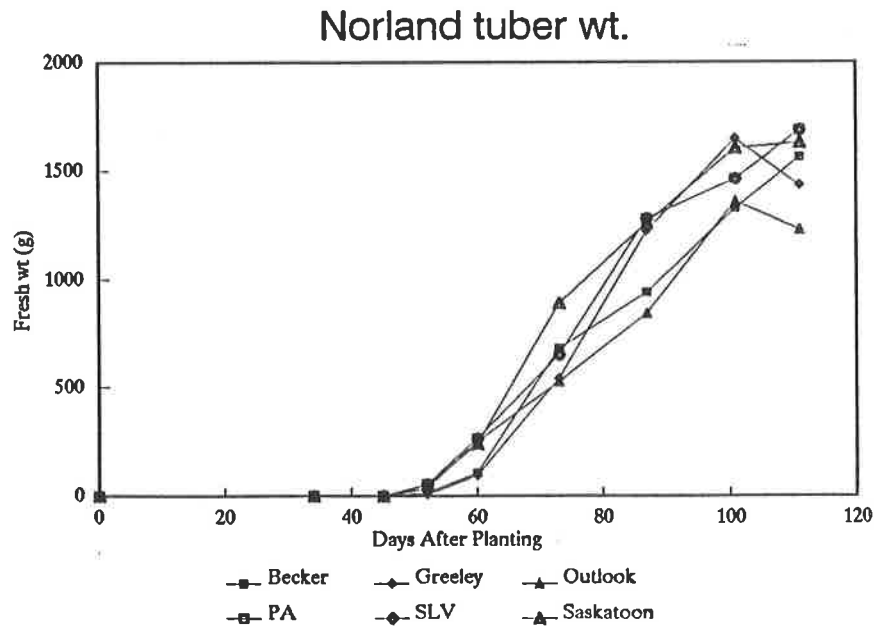
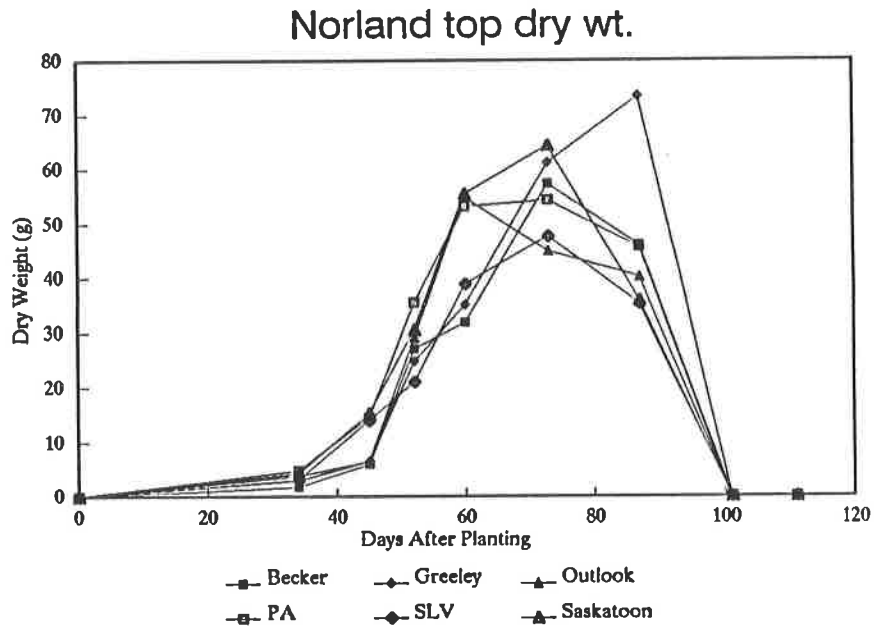
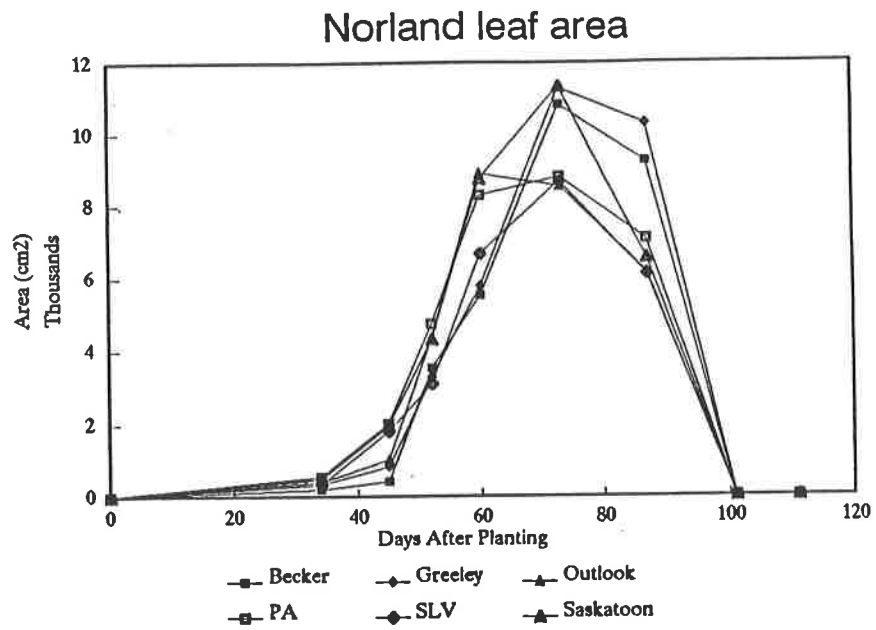


Figure 2. Leaf area, top dry weight and fresh tuber weight of six seed sources for Norland grown in Weld county, CO, 1991.

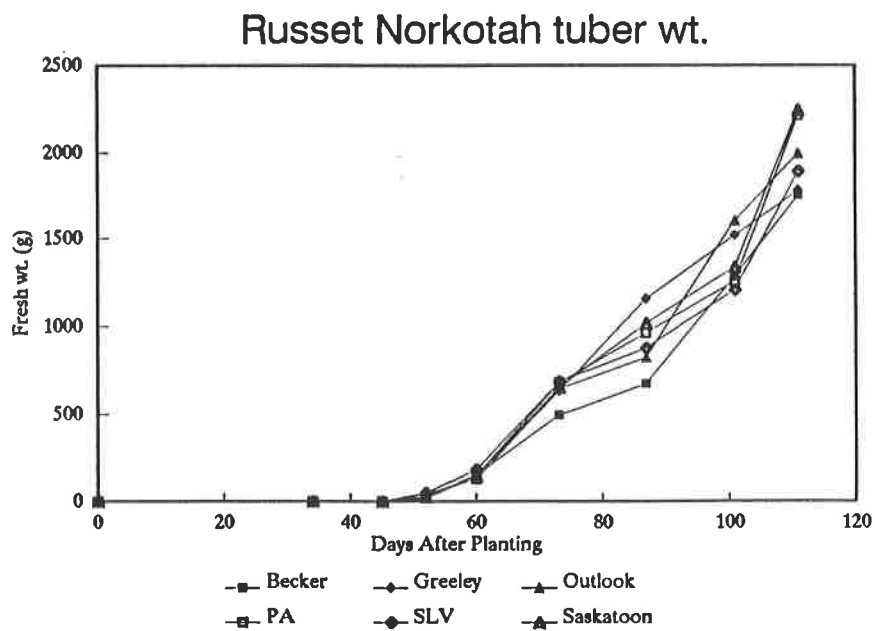
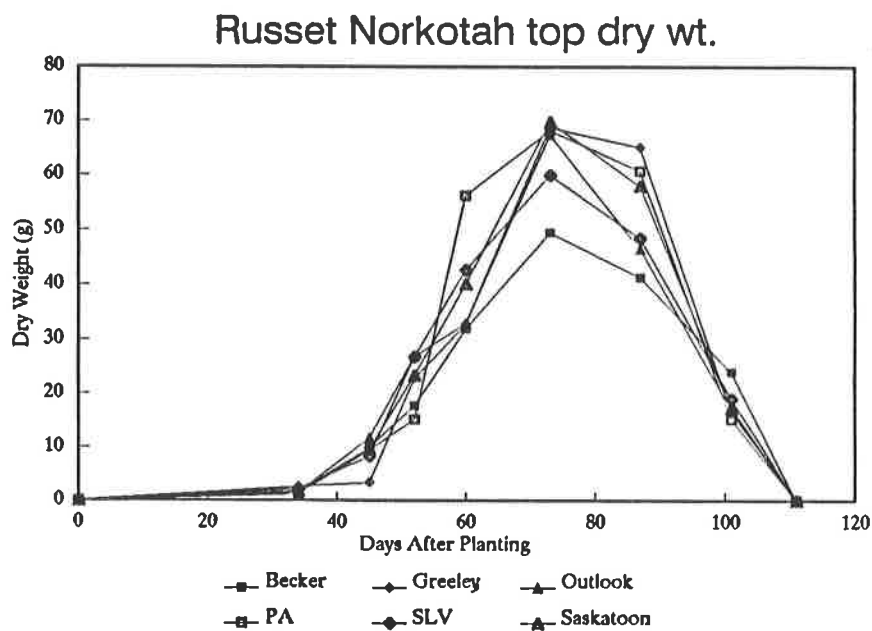
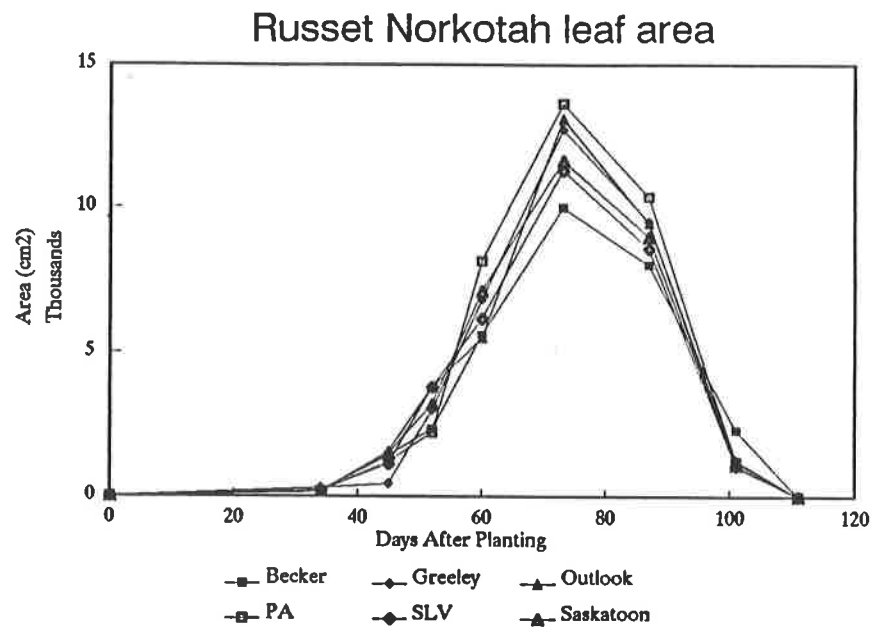


Figure 3. Leaf area, top dry weight and fresh tuber weight of six seed sources for Russet Norkotah grown in Weld county, CO, 1991.

# Burbank Leaf Area Index

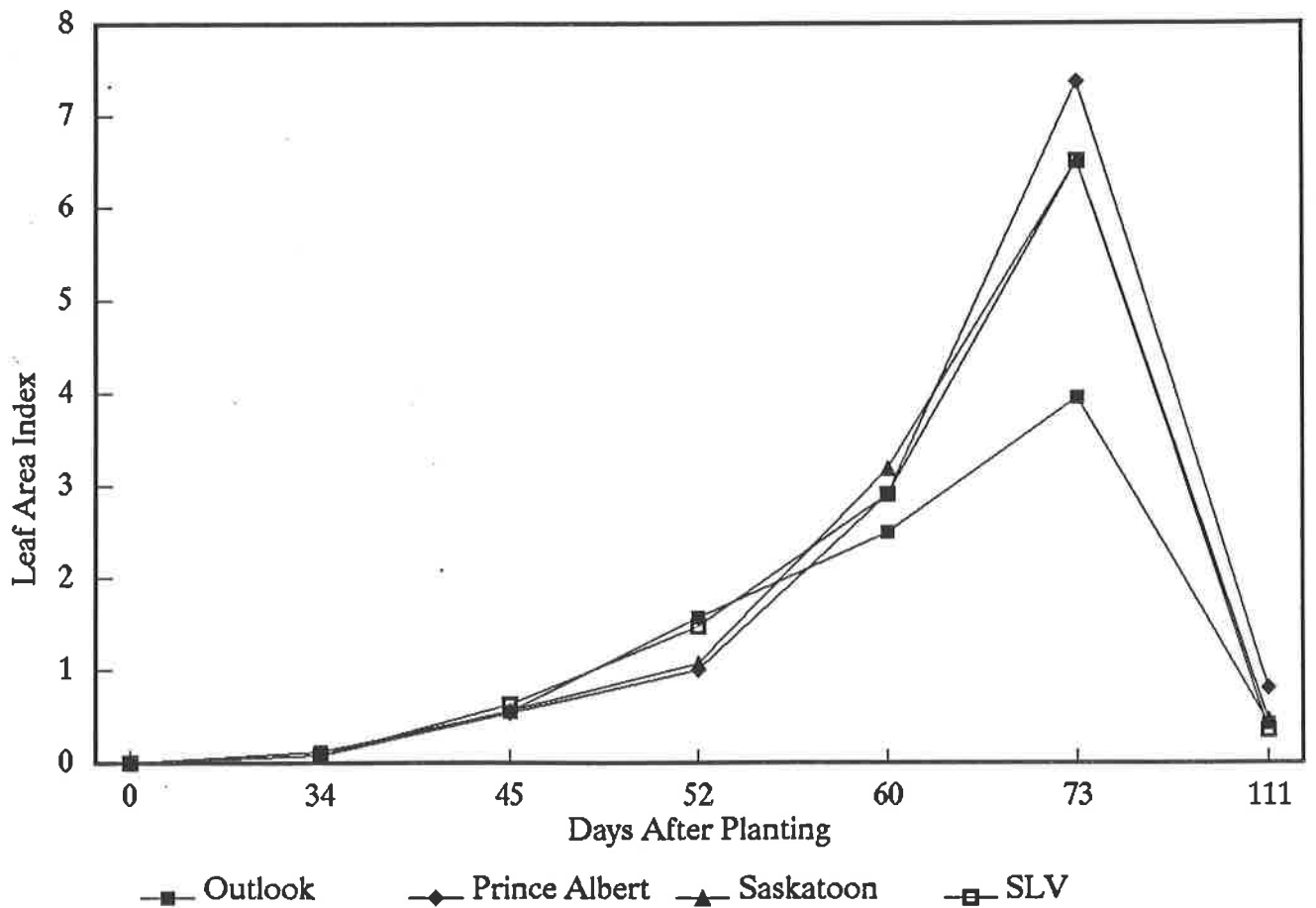
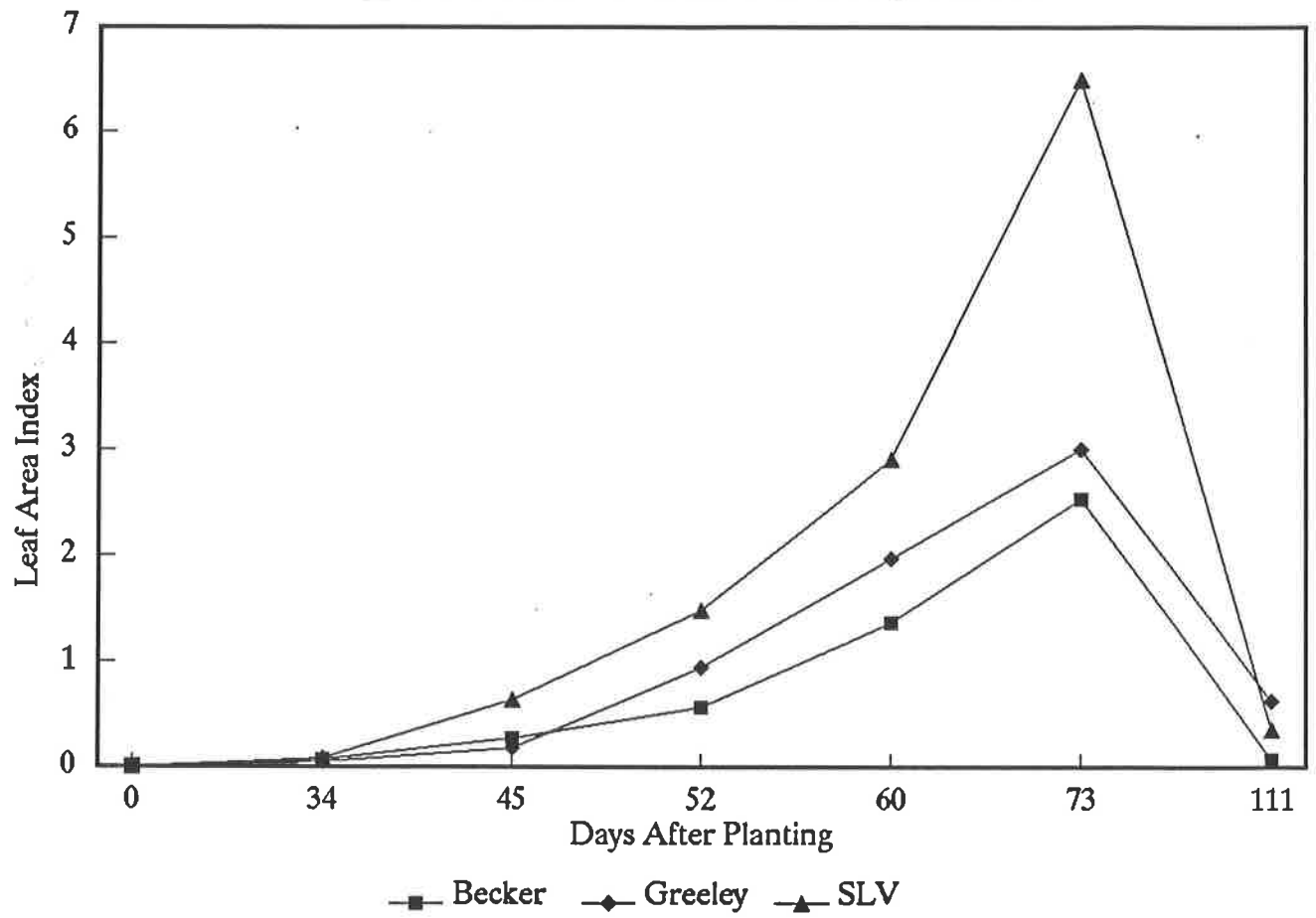


Figure 4. Leaf area index for six seed sources of Russet Burbank grown in Weld county, CO, 1991.

# Norland Leaf Area Index

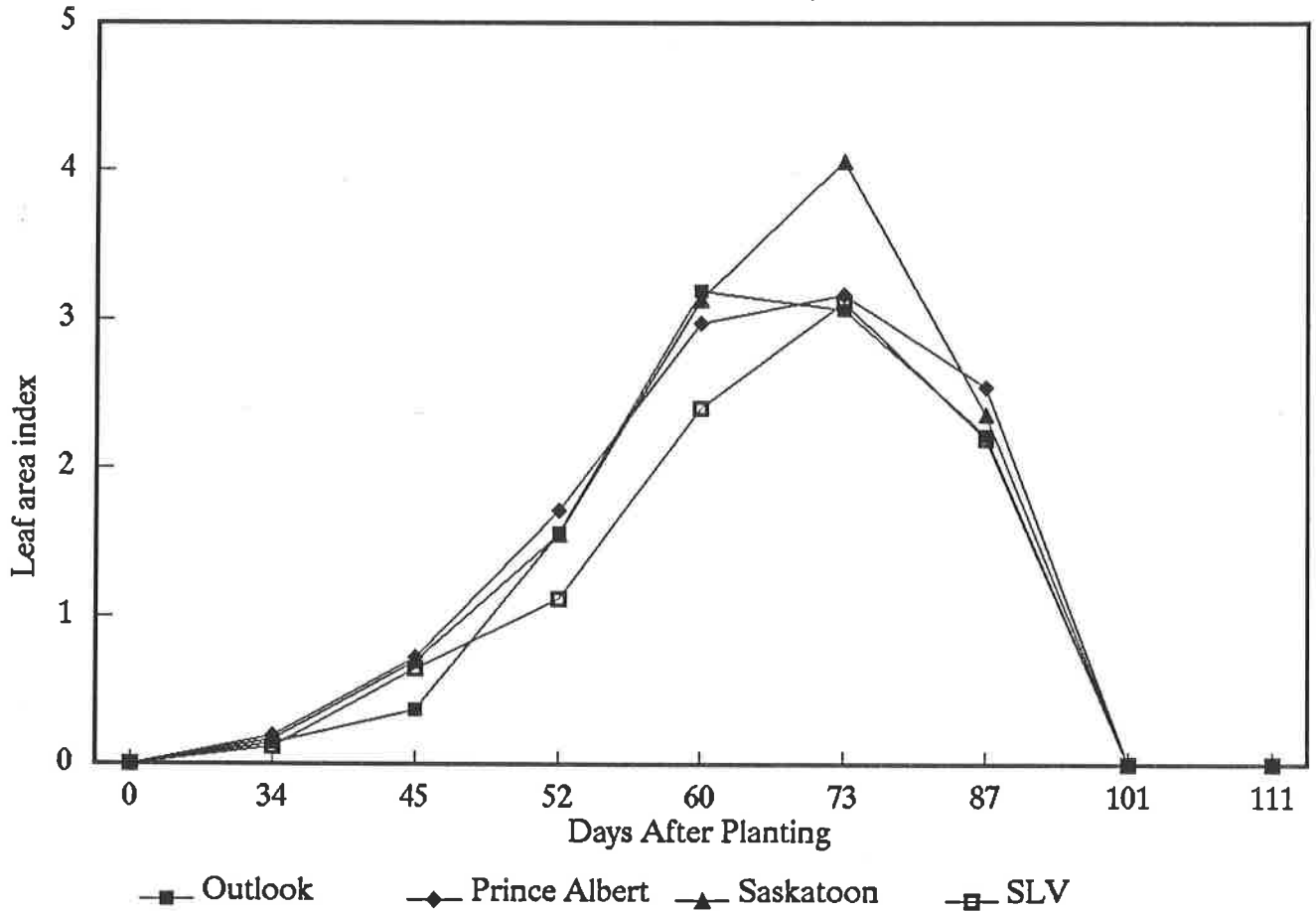
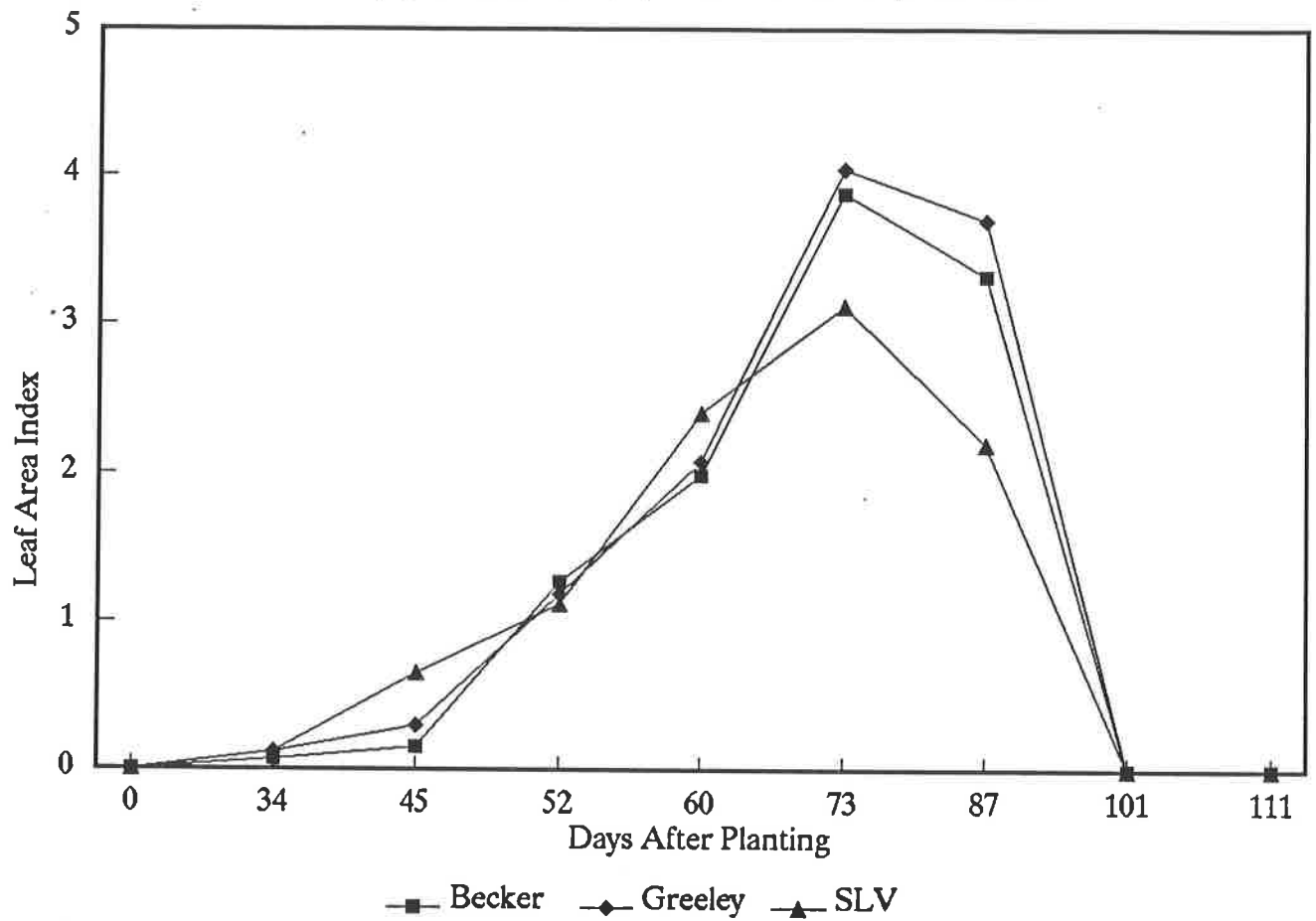


Figure 5. Leaf area index for six seed sources of Norland grown in Weld county, CO, 1991.



# Norkotah Leaf Area Index

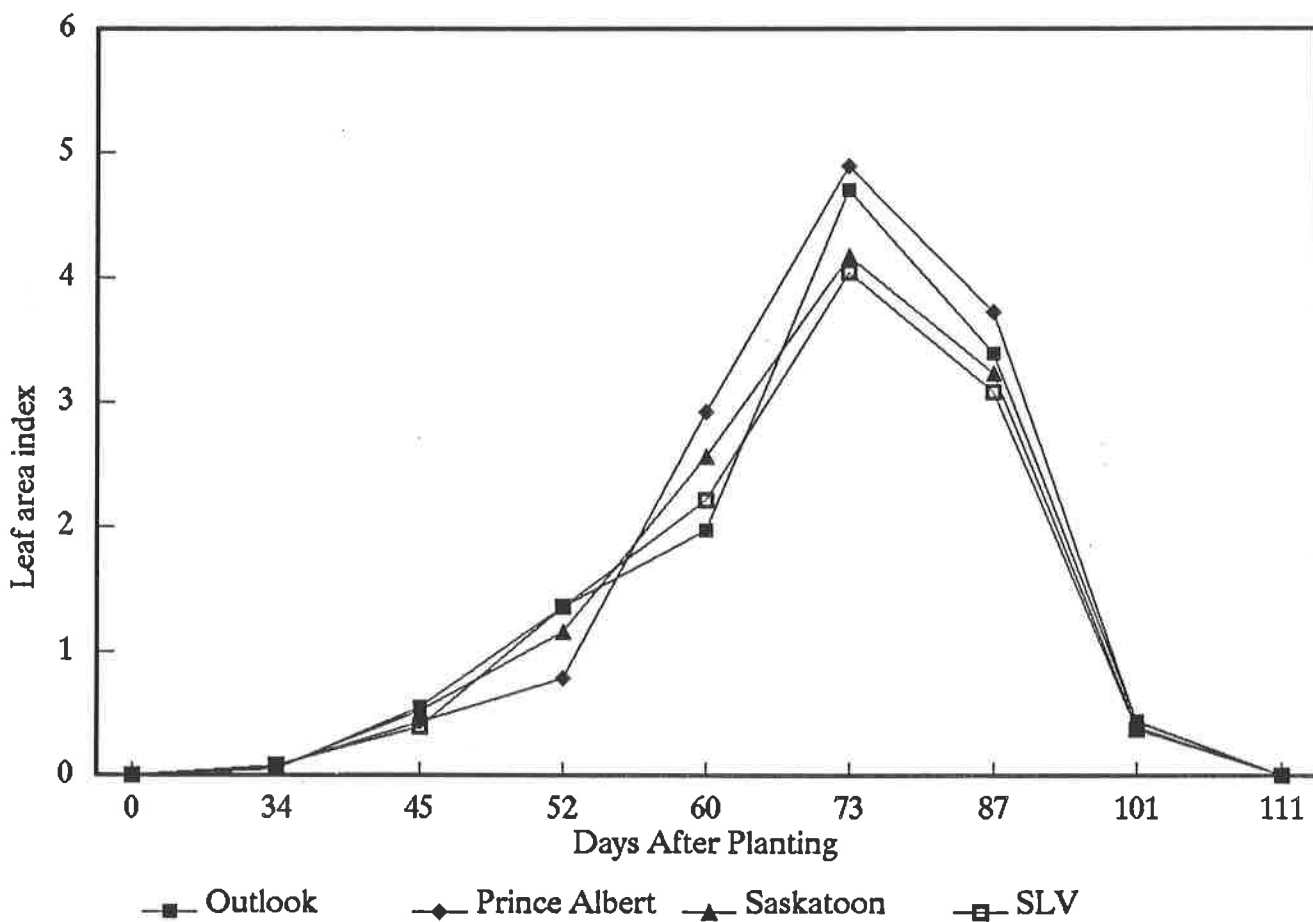
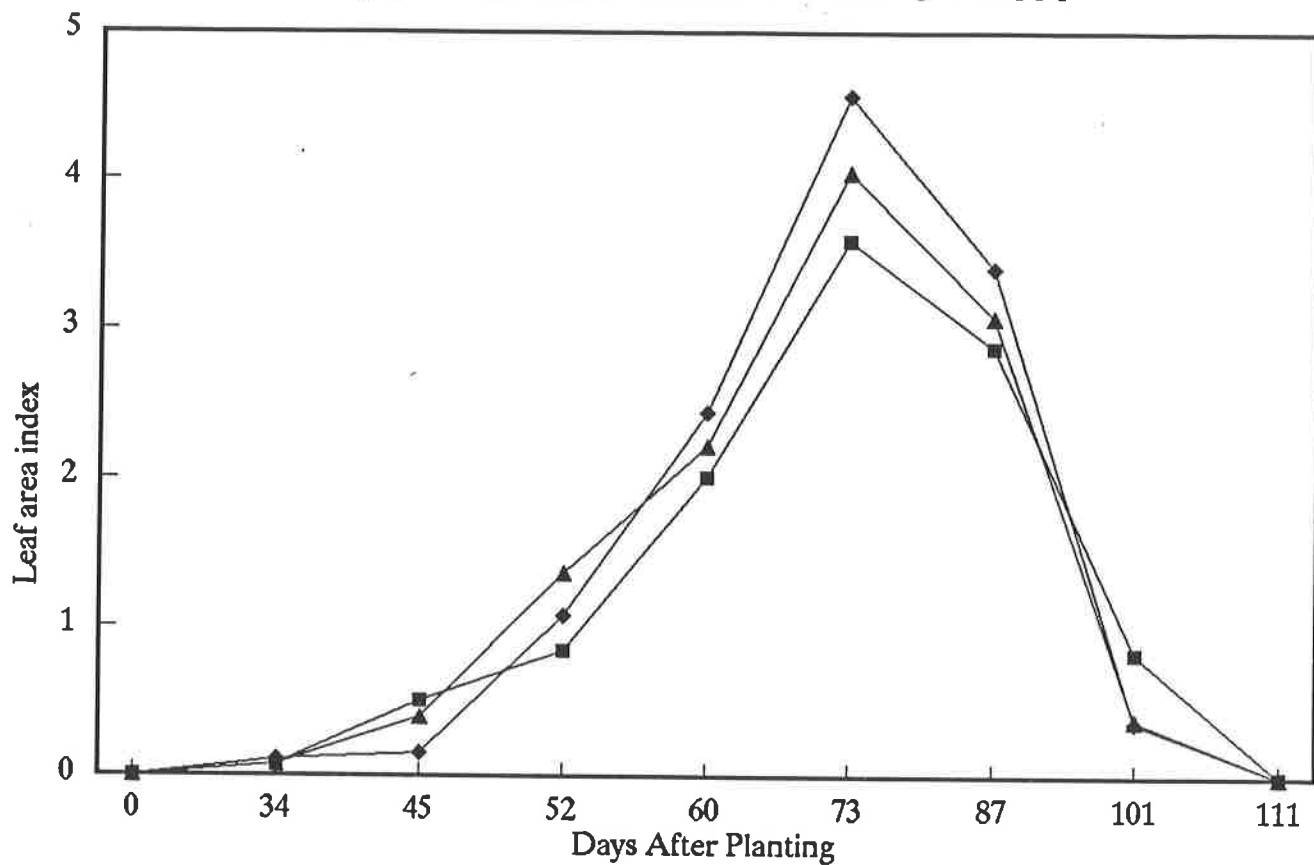


Figure 6. Leaf area index for six seed sources of Russet Norkotah grown in Weld county, CO, 1991.

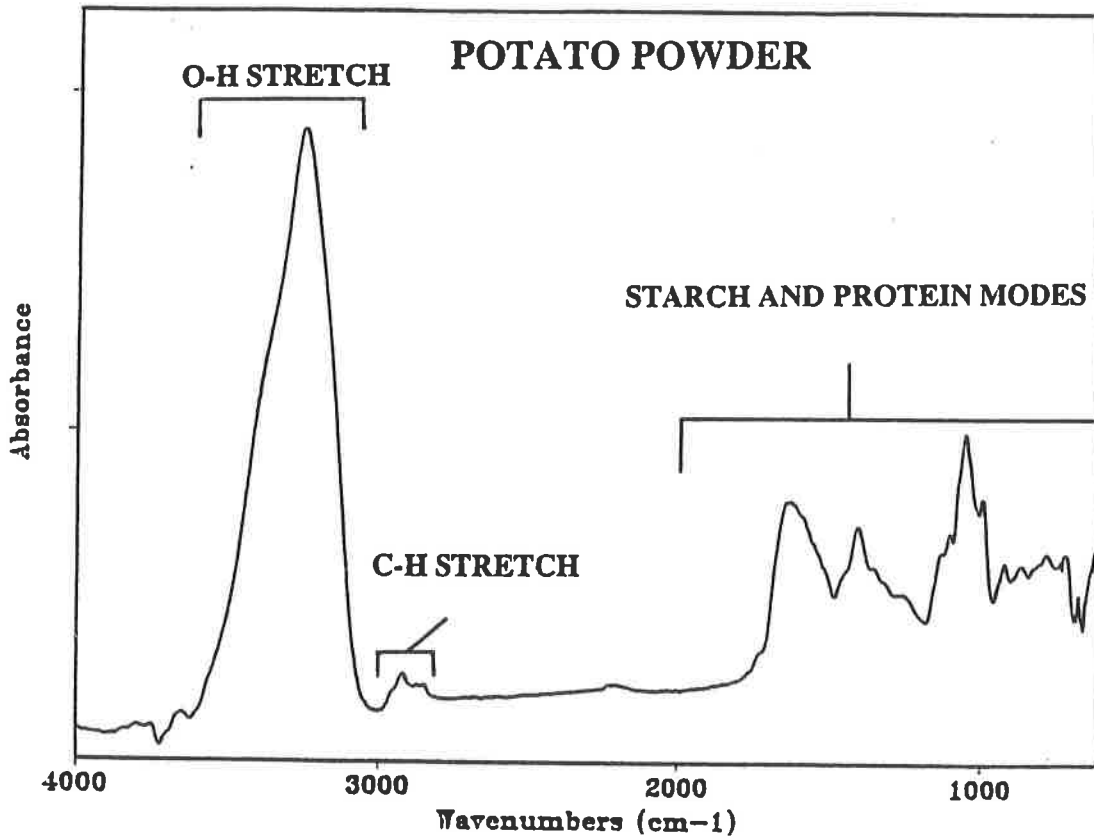
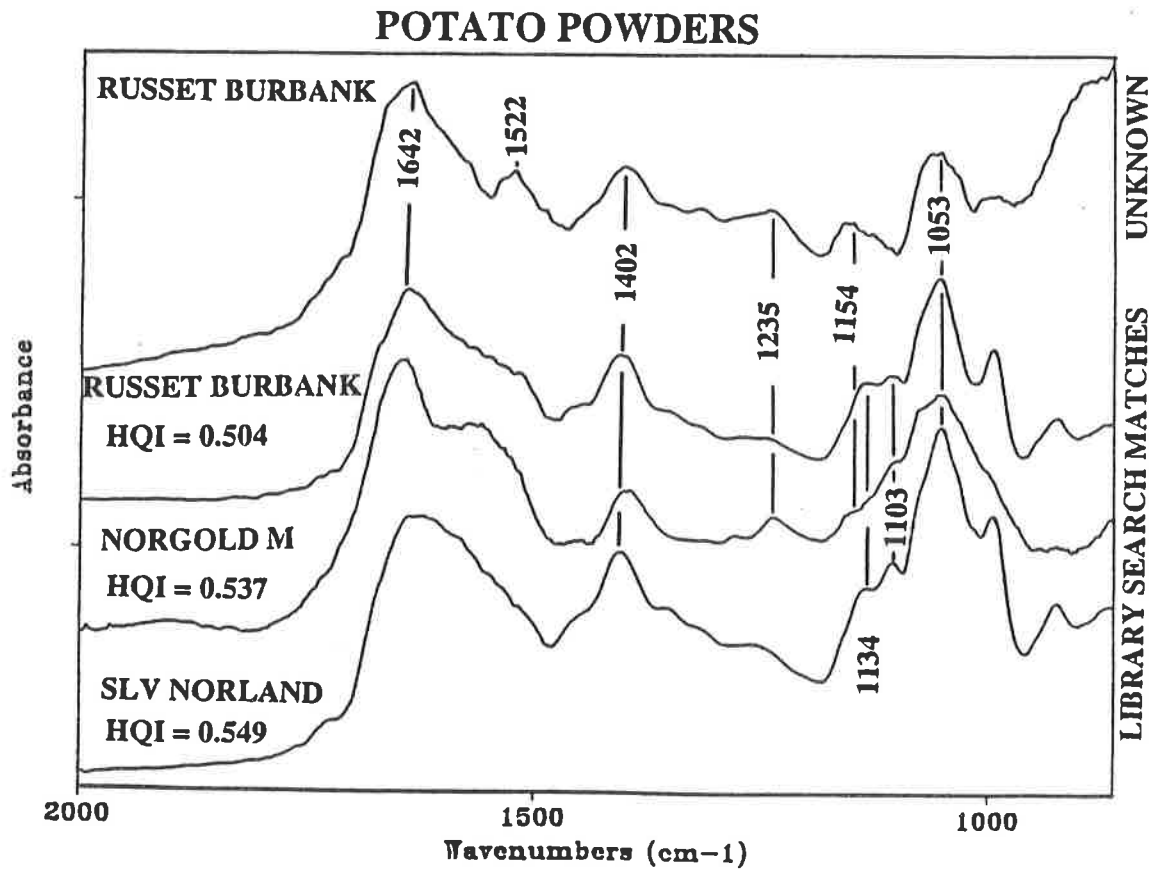


Figure 7. Infrared spectra for a typical potato powder showing modes that were used in comparative identification studies.



Res= 4cm-1

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Figure 8. Spectra from potato powders comparing the unknown (Russet Burbank) to a correct match from the library along with the two next best matches.