EXPERIMENTAL CULTIVATION OF POTATO (SOLANUM TUBEROSUM) IN PERMAFROST REGIONS IN THE CANADIAN ARCTIC, ELLESMERE ISLAND (79°N), N.W.T.

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Originating in the Andes of South America, the potato has been successfully grown in all continents from tropical to sub-arctic regions. Documented attempts of growing potatoes in cold regions point to a great potential of the staple if adequate but inexpensive technology is applied.

In 1982 and 1983 a pioneer project in growing 6 potato varieties of early-maturing, short-season selections of (Yukon Gold, Superior, Serrana Jemseg, Campbell-13 and F72217), was in progress at Alexandra Fiord Lowland (78°58'N, 78°55' W), Ellesmere Island, Canada. The primary objective of this study was to determine whether potatoes grown in the High Arctic are biologically and economically feasible as a crop using limited technology.

The plants were grown a) directly in the open cultivated tundra soil; in soil beds covered by clear plastic mulch and windbreak (1982, 1983); in black plastic 20 ℓ horticultural soil bags (1983) and b) in soil beds (1982) and soil bags (1983) placed in specially designed small unheated dome-shaped greenhouses ("Igloos") which acted like solar cells. These greenhouses were light, reusable and easily assembled and disassembled on site from pre-fabricated parts.

The mulch plots (surface soil) and greenhouse (surface soil and air) temperatures were up to 15°C higher than the control plots. However, the soil below 10 cm was still relatively cool, decreasing in temperature towards the permafrost table at 50 cm, only slightly deeper than in the tundra control site. In 1982 this situation unfavourably affected growth and yield of the tubers because the potatoes were planted directly in the ground. In 1983 this problem was to a high degree eliminated by growing the potatoes in black plastic soil bags placed on the ground which allowed the incoming radiant energy to heat the black bags and warm air to circulate between the bags. This kept the soil mean temperature in a favourable temperature range 11°C (at -10 cm) to 15°C (at surface) which resulted in higher tuber production.

In 1983 one greenhouse was experimentally insulated with

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styrofoam at a depth of 25 cm to reduce conductive heat loss to the permafrost. Here the soil bed was substantially warmer 12°C (at -25 cm) to 21°C (at surface) compared to 5°C (-25 cm) (1°C at -10 cm) and 16°C (at surface) in the non-insulated greenhouses. Direct planting of Yukon Gold variety in this insulated "Igloo" resulted in a 68 to 80% increase of tuber yield over the yield of directly planted Yukon Gold in non-insulated "Igloos".

In the open, non-mulched plots, the Yukon Gold plants survived but brought negligible yields. In the plastic mulch-protected soil the potato plants did well with a 1:4.5 tuber return. In the green houses using the black soil bags the tubers yield averaged 1:7.

A further objective of this study was to determine the effect of the 24-hour Arctic day on the tuberization success of each tested variety. The total standing crop (d.wt. of shoots, roots and tubers) of potato plants grown under the 24-hour natural photoperiod was compared to the standing crop of plants grown under an artificially induced 18-hour photoperiod (the greenhouses were covered for 6h at night). Preliminary results indicate that biomass production was lower in the 18h photoperiod pointing to a need of the additional energy for photosynthesis.

A bulking rate study at regular intervals over the growing season (growth responses) of each variety (temparature, day length, light intensity) indicated that varieties F72217, Campbell-13 and Jemseg were more successful in terms of tuber yields under the continuous photoperiod. Varieties Superior and Yukon Gold were more responsive to the induced 18h photoperiod with increased stem elongation and number of tubers, however with decreased total yields.

The Southern Argentina selection, Serrana variety has proven to be the most hardy, cold-tolerant and disease resistant of the tested varieties. The success of this cold-hardened variety supports the idea that wild potato strains may be even more suitable for experimenting in the extreme Arctic environment than are the recommended cold-resistant Canadian cultivars.

The prospects of growing potatoes in the remote north are feasible. With simple inexpensive technology, a meaningful crop of tubers may be produced over the short arctic summer season. This has a significant practical value since the air freight of imported potatoes exceed up to 20 times their retail value on the southern market.

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