Processing potato study tour to North America, July 2002

Stephen Welsh
Tasmanian Farmers &
Graziers Association

Project Number: PT02032

PT02032

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for the potato industry.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of Tasmanian Farmers & Graziers Association.

ISBN 0 7341 1524 5

Published and distributed by:
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Know-how for Horticulture™

McCain Foods (Aust) Pty Ltd

Potato Grower Study Tour Report

USA & Canada

20 July - 17 Aug 2002

Greg Bullock
Steve Cook

Contents

Executive Summary

The interest for a study tour of Canada and USA potato production stemmed from the Tasmanian growers increasing need for information. This hunger for information is a direct result from the success of potato growers discussion groups within Tasmania.

The grower's trip expenses are funded by themselves and HAL project matched voluntary contributions, (45%)

The itinerary had a primary focus to investigate the technical issues of potato production, i.e. Seed handling and cutting, disease management, irrigation scheduling and nutrition management.

The information does not necessarily imply new findings or practises suitable for implementation for Tasmanian potato growers.

Participants

Steven Cook, McCain Foods (Aust) Pty Ltd
Greg Bullock, McCain Foods (Aust) Pty Ltd

Brendon Rockliff, Devonport. Commercial grower
Stephen Dick, Devonport. ``
Colin Lindsay, Cressy. ``
Phillip Beswick, Wynyard. ``
Darrel Lohrey, Wynyard.
Craig Dobson, Wynyard. ``
Craig Medwin, Smithton. ``
Bill Gooch, Frankford. Seed Grower
Rob Wilson, Wynyard. Agronomist, Serve Ag Pty Ltd

The key issues identified for further evaluation for implementation within Tasmania are as follows.

1. Virus Management

Edge effect border crops. An opportunity exists to use a border crop around seed crops that maintain a vegetative growth stage coinciding with periods when risk of infection is highest. The use of systemic aphicides in the seed potatoes and border crop should be considered.

2. Physiological Age of Seed

Post harvest management of seed. The current Tasmanian seed harvest offers bonus payments as an incentive for early harvest only, regardless of the storage timing. Canada/USA growers consider that an early controlled environment storage just as important as time of harvest for maintaining young p age seed.

Controlled environment of seed includes humidification levels, temperature set points and variation within store area and CO2 levels and air purging techniques. The importance of growing conditions for seed and minimising handling / bruising pre-storage were reiterated.

3. Cutting and curing of seed

The group were exposed to the McCain training module on cutting and curing of seed. Importance of the need for a controlled environment conducive to efficient suberisation was the key element, plus other issues on mother tuber size and storage diseases. These subjects will continue the McCain side of the Tasmanian Industry to persevere with acquiring seed lines of a uniform size and quality control benchmarked by the support of an independent certification scheme.

Much attention to detail is applied to minimising damage and bruising of seed prior to storage and cutting. The benefits of applying the same care post cutting should become a priority. Yield losses from cut seed damage and bruising due to the need for wound healing as a result have been quantified in trial work up to 22%. Damage at planting offers an opportunistic site for Fusarium entry and therefore seed piece breakdown. A high percentage of seed piece breakdown can be attributed to damage at plantingof what was well suberised seed.

4. Soil moisture and Irrigation

The benefits of dammer diker use were exhibited. Although this machinery has been used within Tasmania before, the benefits for some soil types may have been over looked. Not all soil types and topography will benefit but should be explored in some Cressy/Longford regions.

Maintaining soil moisture between the precise criteria of 70% minimum and 85% maximum were discussed. The losses in production due to soil moisture being greater than 90% (that commonly occurs within Tasmania) due to anaerobic soil have to be considered.

The use of water to control tuber set and early crop numbers was evaluated. "The greatest gain in yield as a result of timely irrigation will be in the first six weeks (after planting)", was a statement made. Assuming p age, nutrition and environmental influences are not limiting, the first tubers set and "held" will provide the greatest yield with accurate irrigation.

The use of maleic hydrazide to control successive setting was examined and the benefits/shortfalls considered. Product evaluation trials should be considered.

5. Nutrition management

Nitrogen. The benefits of lower basal rates and more regular shortened intervals between side dressings were learnt. No more than 30% of total crop requirement to be applied at planting. Better utilisation of product and benefits of physiological disorders should be achieved by progressive steps in adapting nitrogen applications.

Phosphorus. A need for availability of phosphorus throughout progressive growth stages was demonstrated. Basic plant botany explaining root growth structure should be considered when deciding the formulation and placement of phosphorus for maximum utilisation.

Availability and application equipment need too be researched for suitability to local soils for the utilisation of starter fertiliser and main crop requirement.

Potassium. As inputs increase, if SG's become a problem or the salt index of fertiliser blends becomes a limiting factor for some, the balance between muriated and sulphated potassium should not be overlooked.

6. Disease Control

Added to the previously mentioned virus and storage diseases, is the management of rhizoctonia. The control of rhizoctonia needs to be a wholistic approach including rotations, seed quality and in furrow spray options. The benefits of using rhizoctonia-harbouring crops within the potato rotation eg. Beans, clover, brassica's. need to be considered. Seed quality can be improved by early harvest not only for physiological purposes, but also as a tool for reducing the incidence of seed borne sclerotes. Both of these management practises have been practised in the past (in Tasmania), but as time goes by, their importance has been overlooked.

The latest innovation in rhizoctonia control being trailed both in Australia and North America is the use of in furrow fungicides at planting. The use of in furrow spray applications will be evaluated using products such as Amistar™, Rovral™, and Blocker™ depending on registration permission and Australian product availability.

7. Row width and hill shape

A model of a potato hill demonstrated a 90 tn per hectare potato crop contained within the hill with no greening. As yields increase, size and shape of the hill need to be amended. Changing row width and shape need to be trailed. Compaction in the bottom of the hill needs to be given some thought when trying to reduce green.

The participants thank the management of McCain Foods (Aust) Pty Ltd for allowing such a tour to be realised. It is intended by all the participants that the information bought home will be used to drive our industry in a forward and positive direction.

Program

Monday 22/7/02

am

Met John Walsh - McCain Agronomy
Start potato school training and grower tours

New Brunswick Plant Propagation Centre, Shirlyn Coleman, Senior Plant Development Officer. Department of Agriculture, Fisheries and Aquaculture. (Provincial Gov't).

Centres primarily are responsible for the production of plantlet material and ***micro tubers.***

- Variety Repository 460 public varieties (that have had or may in the future have commercial use).

- New variety Introduction engine for industry.

Canadian Seed Certification Scheme

1. Nuclear Stock) In-vitro production
2. Pre-Elite)
3. Elite 1
4. Elite 2 Scheme governed by National Legislation.
5. Elite 3
6. Elite 4
7. Foundation
8. Certified

$130 cad. Per variety/ year repository fee.

PBR Introduction 1990

Plantlets and Micro tubers @ $0.68 ea. (Cad). > % plantlets. $ loss organisation. Sales supplemented by government monies. (Provincial)

Federal Government – Certification Scheme funding.

Mini tubers produced by seed growers or Provincial Seed Farm. (Bona Cord)

On going Lab Testing Programme
Virus,
Biological
Viroid – potato spindle tuber

Nuclear stock given an independent certification certificate before entering certification scheme for mini-tuber production.

Production Line

- Meristem cutting → Plantlet 6 months
- 1 plantlet → 5 plantlets per month. (i.e. 1:5 ratio per month)

Multiplication media for plantlet production
Initiation media introduced for micro-tuber development

Expensive and inefficient production during winter months. Special orders only.

pm

Potato Research Centre. Paul Milburn, Assistant Director.
Agriculture and Agri-Food Canada. Federal Govt. Institution.

3 Primary Roles

1. Breeding
2. Germplasm
3. Gene Bank

Home of shepody variety. Released ~ 1980.

Biotechnology breeding programme for

- Late blight resistance
- Starch production and reducing sugars
- Common scab resistance (Callum Wilson involved)

Introduced accelerated release programme 5 years ago.

- 80,000 crosses per year
- Crosses → variety evaluation by 6-7 years
- Open to public trial and comment for 2 years dependant on seed availability
- Open to bidding for exclusive private commercial trailing for 3 years
- Available for bidding on a % of variety licence.

East → West Canada = 4000 km. Environmental differences have an affect on clonal performances.

Working on gene and individual clone characteristics so as too predict reaction to clone cross. Not GMO as such, but will be able to introduce gene performance in a traditional way.

East coast Canada – no irrigation, generally 2" – 3 " of water short each year. Problems with hollow and storage wet rots when trying to irrigate.

Dr. Rudra Singh.

Virus Detection by PCR (Similar to DNA) technique. Aiming to develop rapid detection method. Leaf / stem / tuber. 2 or 3 mls of plant sap required.

Biological plant indication is slow and unreliable in the way virus exhibit itself in the plant.

Virus levels will be different at opposite ends of tubers.

Ability of viruses to mutate over years in differing hosts makes detection difficult. Affects on potatoes will change as virus mutates.

Dr Russ King.
Common Scab – Breeding for tuber resistance

Firstly need to identify toxins (genes) produced by s. scabies. Toxin similar to natural herbicide.

Bacteria release toxin to kill stem / tuber cells so as to provide a protein source for survival. Dead cells expressed as scab lesion on tuber. Suspect that the toxins released in common scab infection may be in some cases the same as those released in powdery scab.

Using the identification of toxin to find resistant clones of potato varieties.

Trudy Dalton
Potato Breeding Greenhouse

Producing true seed by pollen cross. Seed germinated to produce plant and hence tuber for multiplication and germ plasm stock.

Tubers taken to field, Benton Seed Farm, for evaluation.

Dr. Yvan Pelletier
Plant breeding for Colorado Potato Beetle Resistance.
Selecting from ~ 200 wild solanaceous plants, pollen crossing in potatoes to find resistant plants to attack. Some plants have a natural toxicity to CPB.
Incorporating plant resistance to blight infection.

CPB has very quick ability to develop insecticide resistance. Currently only one commercial insecticide available. Currently using IPM scouting programme as apposed to blanket spraying. 2 CPB / plant economic threshold.

CPB over-winter in soil by burrowing as adults.

Snow cover acts as a buffer to soil freezing.

Dr. Lien Chow.
Mulching trial to reduce soil moisture evaporation. Looking to improve soil structure by GM crops and tillage practises to retain soil moisture and prevent erosion.

Mulch is holding moisture but slows down soil warming in spring..

Dr. Gilles Boiteau
Developing model to predict CPB flight patterns.

Cone in cage acts as a launching point for beetle to fly.
CPB will walk in preference to flying. Won't fly until temp 20 deg. Celsius. Won't fly in wind.
4 INSTAR stages. Juveniles will damage plants.

Benton Seed Farm
Variety development of stock from potato breeding greenhouse.
Variety development in field selecting for end use quality and field performance, susceptibility to scab, blight etc. Repeated plots.

Strong debate as to wether or not the breeding programme should continue to keep trying to grow the perfect potato or start selecting something that has some good characteristics and learn how to grow it. Presently new varieties are still trying to be selected while using a some - what traditional fertility / water / planting etc regimes.

Same problem occurring at home

Using mineral oil spray for barrier to aphid stylet of PVY transmission.

Common scab incidence, Fusarium rots, l & e blight, verticillium wilt incidence recorded as part of resistance breeding programme.

Regular pathogen testing programme.

Breeding programme also considering D.M distribution throughout tuber. I.e. As tuber is a modified stem, has a tendency for lower D.M in centre of tuber (a want to go hollow).

12" – 14" standard spacing for shepody.

1 mini tuber from breeding greenhouse → selection 3 – 4 tubers → selection of 16 – 20 tubers → 100 hills for adaptation to environment selection → accelerated release programme.

Eye distribution, given little consideration when culling during selection phases.

Hand harvested, no bruising. Developed own spud nicker barrel bruiser. 15 kg sample tumbled for 30 sec.

300-hectare farm. 12 ha of plots per annum. Forestry buffer providing natural barrier.
Ryegrass G.M. crop. Avoid clovers for rhizo and verticillium wilt control. 22 may planting.

1st generation selection all visual.

Tuesday 23/7/02

am

John Walsh, Yves Leclerc. Florenceville Motor Inn.

Overview of the Food Safety Programme and the HACCP issues for raw product production.

Satisfaction of customer concern. Safety of food supply major issue for polled consumers.
Gov't policies as regard to consumer safety.
Responsibility of growers beyond the farm gate.
Production regulated by best management practises. Land/soil management, crop fertility, pest and disease control.

Programme of traceability and trackability introduced two years ago.

Traceability ..... Farm → Processing
Trackability .....Processing → Point of sale

Farm HACCP
- Field
- Harvest
- Storage
- Transport
- Production

Field
- Equipment calibration
- Pesticide use, registration etc.
- Field sanitation

Harvest
- Harvesting equipment possible source of contamination
- Employee training in identifying and actioning contaminates

Storage
- Pesticides – Audit of registered pesticides and record of use
- Lighting – minimising glass as source of contamination
- House keeping. Eg servicing machinery in potato stores, oils on floor is becoming detected in later store potatoes
- Use of food grade paints
- Housing animals in potato stores

Transportation
- Contamination from trailer boards etc.

Production
- Pesticide residue testing - Monthly raw product test

2000/2001 68% free of any detectable residues

1. 2.8% above MRL Thibendazole

2. Detected below MRL's
   28% Chloropropham (CIPC)

6% Thibendazole
2.8% fonifos (insecticide)

For chemical to be active, it will be detectable. Depending on what measure of detection, ppm or ppb.

Record Keeping

Providing an audited paper trail from seed to delivery of raw product

Best Management Practises

- Fertiliser use. Crop use = Application rates
- Crop protection. Maximum control from minimum inputs. Exercising threshold levels & IPM strategies. Pesticide drift.
- Soil and water. Erosion, rotation to assist disease control
- O.H.&S. Protective equipment. Observing re-entry periods

G.M.O. Need to believe in the science, but provide what the customer wants.

Presentation of McCain – seed potato slides.

- Physiological Age
- Cutting and curing

Dormancy break can be detected by changes in tuber sugar levels before any visual signs are evident. Sprouts act as wicks, therefore creating moisture loss from tubers. Moisture loss and damage to sprouts will affect vigour of seed.

Physiological age of tubers affects how and when they will sprout.
Affects on seed P Age

- Storage temperatures (point and fluctuation)
- Harvest temperature and conditions
- Growing conditions (heat, water stress and logging, over night temp's)
- Handling and damage – the less the better

As seed ages with time, all functions of handling, cutting etc, the impact is heightened.

Seed pieces – Apical end will perform differently to that of the stem end. Apical end will have less stems and higher vigour. This is more prounced as mother tuber size increases.
pm

Bona Cord Pre Elite seed farm.

Fredericton Plant prop'n centre 100% sole provider of invitro plantlets and micro tubers.

- 75% plantlets
- 25% micro tubers

1500 ft above sea level, 1000 feet above main commercial area.
Forestry buffer zone of minimum 5km.
Soil freezing winters of down to –40 deg Celsius ambient.

Production of minitubers in glass house → Bona cord and industry use for elite production .

Some hardened plantlets for field planting.

- Use ammonium N.
- Calcium Nitrate
- High P
- High air velocity
- Mini-tubers will out yield field plantlets.
- Low mortality rate of hardened field plantlets
- Solid set irrigation required.
- Small mini-tubers and micro tubers have been green house potted, shot and then field planted.
- Holland mechanical transplanter (USA), 25000 / day

Seasonal greenhouses (non-heated) built to Federal Gov't Regulation for certification.
1st and 2nd Field generations chatted before planting. Aiming to maximise short growing season.
Micro tubers (some) and small mini-tubers potted into 2" cells, hardened to 2" height and then transplanted to field.

Hanging mesh bags used for chitting all generations.

Seed production system – quality compromised by volume in greenhouse. Volume : Profitability

Mini-tubers ex mini-tuber highest producers in glasshouse. 100-day cycle. Early production nutrition : > P, <N.

Invitro – micro tubers, Exvitro – techni tubers.

Continuous Lab testing programme for presence of: PVY, PVYn, PLRV in greenhouse. Post harvest testing for: Bacterial Ring Rot (BRR), PVY, PLRV. 9200 Samples per year.

1 gallon/acre/year mineral oil for PVY protection. (Part control). Oil interferes with stylet action.

Yellow pan traps used to monitor G P Aphid immigration from southern USA. No over wintering in NB. Traps an indicator of presence/absence only.

Computer controlled CA store for pre-elite seed.

75lb bag → $37.50 Elite. 1lb mini-tubers → $26.50. 22 mini-tubers/lb.

Sales contribute too 40% of operating budget.

Wednesday 24/7/02

am

Pres du Lac Hotel, Gilles Moreau and Yves Lerlerc.

Cropmet programme.

Storemet programme.

pm

Farm visit, Enoil Cote

Russet Burbank crop – Shallow root zone and therefore typical root development as a result. Discussed the differences in planting techniques. Our one pass planting and hilling technique as compared to planting into a flat seedbed and hilling twice. Canada applying residual herbicides either prior to first hilling, or between first and second. Either way herbicide is only present on soil surface for a maximum of 4 weeks before soil disturbance.

Looked at hilling machinery being used. Long "mouldboard plough share type" boot appears to be contributing to bottom of hill compaction.

All growers cutting their own seed for disease management. Bacterial ring rot transfer minimisation strategy.

1.

Better Built cutter 16500 lb/hour.
Barrel duster – maxim MZ powder.

Machinery Dealer visit.

Thursday 25/7/02

am

Eyves Leclerc, John Walsh

Disease, Pest management
pm

McCain Research Farm.

Variety trials
Extension projects

Thomas machinery visit

- Skid steer loader assembly line
- Potato harvester manufacturing.

Thomas staff, factory field staff and growers claim that bruise free results are around 90%. If the testing protocol is the same as Smithton plant, considering the amount of stone in the profile, this is an extraordinary result.

Friday 26/7/02

am
McCain potato storage course module

- Storage facilities structure, volume etc
- Quality of tubers for storage
- Humidification – purpose and controlling
- Ventilation – purpose and controlling
- Disease and defect management in storage.

pm

Farm Visit – James Banks

Looked at shepody and russet crops.

Rotating green processing peas, wheat and timothy rye grass. Rotating land parcels with neighbouring farms which complements the needs of both land holders.

Buying in E2 and E3 seed and multiplying for one season as seed for a further one year as commercial production. Productivity gain from value adding.

Again as seen in Grand Falls, seed planted on hardpan, poor root penetration and plants starting to flag after 20 mm rain only 3 days prior. Russet Burbank planted 23rd May.

Shepody paddock on freshly cleared forest ground, digging where planting had not occurred proved depth of soil. Planting and moulding practises had again compacted root zone below and beside the seed piece. Planted 4th June.

Cost of production w-/ o.heads = $1890 / acre.

Avoiding clover in rotation crops minimum 2 years from potatoes as prevention strategy against verticillium wilt.

On farm storage sheds.

- Construction material
- Insulation methods
- Plenum designs
- Pilers and conveyors.

Monday 29/7/02

am

Meet Andrew Ronald - McCain Agronomist, Coaldale, Alberta
Alberta plant

pm

Visit Growers
Ian McGilviray

N-P-K fall application, 125-125-150.
Planting 20-80-0 + Zn. Nitrogen application through pivot application.
Max 40gk N/Week. High rate this season due to leaching from high spring rains. Normally 10-12 kg/week. 1st application prior to row closure.

Concerned with the long-term sustainability of the area due to the increase in availability of tonnage with both Lamb and McCain contracting. New inexperienced growers with inadequate disease management pose the greatest risk to neighbouring growers. Late blight first identified 1992.

Soil ball and ribbon hand test for irrigation scheduling. Both Ian and Andrew Ronald felt that soil moisture monitoring instruments were too point specific for large fields and the variation within. Tasmanian contingent explained the technique used in evaluating soil moisture by hand testing and utilising instrument measuring devices as a management aid, not a decider.

4 year rotation.

Seed from Edmunton, where day length is 1½ hours shorter. Cooler Northern temperatures and shorter days, growers believed in the "Northern Vigour" concept of seed.

After many years of evaluating seed and different handling measures, still at a loss to understanding or trying to predict behavioural patterns related to P age.

Moisture first priority and soil temperature second the most consistent parameters to stem numbers. The lower soil moisture at tuber initiation, the lower or more inconsistent stem numbers. The lower soil temp at tuber initiation, the lower the stem numbers. This is consistent with experiences within Tasmania.

Soil O.M. content ~ 2%

Sand bed machine for stone and clod separation post harvest , prior storage. Air blower creates bed of aerated sand particles that carry over potato tubers. Stone and clod fall through sand bed, therefore separated from tubers. 100% on stone, 95% on clods.

Early blight – possibility that blight problems may eventuate from seed tubers. If blight is occurring in commercial crops early before row closure and microclimate within canopy is conducive for sporulation, blight may be tuber borne.

When analysing Tasmanian seed production system, realistically, groundkeepers are more of a potential host problem.

Dammer Diker used after moulding to prevent run off in furrows and capturing water, therefore increasing wicking into bottom of hill.

Blight control – 7 to 10 day preventative programme. Aerial application. Russet Burbank 36" rows, 12' spacing. Herbicides – Prism, Rimsulfuron.

Kvernland cup planter, operate at 3.5 miles/hr. believed to be more accurate that pick planter. Plant population essential for processing size profile. 2-¼ oz. Seed piece size. Mancozeb / firbark seed treat.

Maxim – variable results in different years. Not the answer to sound rotational practises and good seed quality. Have experienced some set pruning in the past due to rhizo. Numbers all important for yield. Tuber size does not make yield.

Water management in conjunction with soil preparation. Essential to prevent clods so as to increase amount of available water for crop use (and improved harvesting). 18" water for crop season. Some fall irrigation to improve early season moisture. Snow falls unreliable for soil profile wetting. 2" / week @ full canopy. From middle of season start to dry down lower profile. Aim @ 75% field capacity to provide rain buffer to manage rot. Depletion of oxygen at 95 – 100% field capacity becomes yield reducing. Believes that soil moisture technology is too point specific for correct paddock management.

Splitting king tuber @ 30mm dia. Too check for internal defects. Hollow heart appears early in season, rarely seen late season.

Experienced low tuber numbers due to early crop stress periods, (heat, cold, moisture +, -). Early crop management essential to foundation for high yield potential.

Soil and petiole N test every week. Soil N used too forecast petiole trend. Test 1st and 2nd foot. Use benchmark sites relevant to field as opposed to zig zag method across paddock. This will eliminate some of the inconsistency in testing.

Tuber shrink if tops dead and tubers and root system still translocating in dry soils, i.e. Ensure adequate moisture after top kill.

Chris Perry
European dome shape storage shed. ~ 5% shrink.
1 of a few @ 34" rows. 12 ½ " spacing.

Using composted feedlot cattle waste for soil ameliorant. Applied at 5tn/ac. per potato rotation.

Improved soil "health" has delayed tuber initiation period and maturity days. Manipulating seed age to compensate.

Soil *****

Lockwood air cup planter. 95% plant population.

Last N application 90 days after planting. Natural plant maturity helps with stem retention at harvest as compared to top killing. 40lb/ac N fertigated @ 20-25mm king tuber size. Calcium nitrate ?

Chlorinated water in refrigeration system aids in silver scurf control in storage.

Tuesday 30/7/02

am

University Alberta
Vauxhall Research station, subsidiary of Lethbridge Research Station.

Frank ? – Evalaluating variety of green manure crops in potato rotations for benefits in soil structure and disease management. Evaluating direct seed and minimum tillage systems to minimise carbon loss from tillage.
Programme appeared to lack definite outcomes?

Dermot Linch – Breeding programme looking @ tuber early blight resistance as well as foliage blight resistance.
French fry varieties being selected for

- Early maturity
- Storage / process temperatures
- Sprout inhibition in storage

70,000 single hill first crosses.
Ranger russet as parent for early skin set.
CV92056-4 showing good potential for French fry processing.

pm

Clive Schaupmeyer

Discussion on

- Early plant health (10-40 D.A.Plant) as to effect on yield. Greatest crop yield loss at this stage. RB plant may initiate ~ 20 tubers. Depending on plant stress (eg. Moisture), 10-12 tubers will be retained. Greatest potential yield loss due to moisture can occur at tuber initiation period.

- Crop nitrogen requirement – 10 lbs / acre / imp. Ton.

- Harvest date of seed – If harvested after 20 days from top kill, aging will occur. Early harvest greatest control for protection against rhizoctonia sclerotia forming on tubers. Try low rate of diquate to initiate skin set for early harvest.

- The quicker the temperature reduced of seed after top kill, the younger the seed will remain.

- Work being done in the Red River Valley on CO2 accumulation in seed storage. Critical point > 2500 ppm ? Variability in microclimate within cool stores maybe causing differing characteristics in seed performance, i.e. Temperature, oxygen, air exchange rates, humidity.

Lorie Delanoy
Agriculture Canada, Lethbridge research Station

Rhizoctonia control – In furrow spray application.
- 45 degree angle spray nozzle
- 9" spray band applied behind planter boot point.
- Auxistrobin (quadris, amistar)
- Maybe use for both seed and soil borne rhizo, therefore eliminating the need to use maxim as a seed treat.

Wednesday 31/7/02

Debrief at hotel

Thursday 1/8/02

am
Warren ? , Agricultural Engineer, Alberta Dept Ag.
Jeff Bronsch, Irrigation Technologist.

Visit St Mary's Reservoir system.
300 000 Acre foot capacity. 1000 meter above sea level. Snow pack at 2100mts.

System capable of two seasons if starting from full and no recharge period. Below average recharge years = 3 year buffer.

Dam construction – pmf (probable max flood) calculation for spillway design. 80 000 cubic feet per second. Spillway redesigned 1999. Previous spillway of 50 years 50 000 cubic feet per second.

Diversion channel – 100 meters inside wall, 40 meters under water surface. Constructed 1940. 20ft cement plug at head.

Water temperature at dam outlet 38 deg F. 40 – 45 degrees at farm. Water temp increases in channel systems. Cold water application has been an issue when watering in the spring.

Water rights trading allowed for first time last year after drought conditions experienced. Licence belongs to property deeds, not to land owner. No more licences being allocated, current waiting list. As district agricultural industry changes as crops develop, i.e. Alfalfa, sugar beet and potato, demand for water increases. Pressure from suburbia to increase recreational and environmental flows.

Water trading at $125 / ½ acre foot.

pm

Ridge Reservoir diversion channel,
Milk River Reservoir

Monday 5/8/02

am

University of Idaho, Tetonia Seed and Research Farm

Jim Whitmore – Farm @ 6200ft.
Evaluating variety breeding and seed multiplication from Aberdeen breeding programme. Selections also from Oregon, Washington and Idaho programmes.

Laboratory tested plantlets. Stem cutting and developing minitubers in shade house for field production .

Mild winters have increased problems with volunteers. Increase in incidence of PVY post mild winters.

PVY biggest viral problem. Some PLRV.

Green Peach Aphid and Bird Cherry Oat Aphid vectors – Finding that cold tolerant eggs are over wintering in cloke cherries. Urbanisation and associated gardens etc. are increasing pressure for aphid control.

Gem russet most susceptible to PVY on farm. Gem foliage natural attractant for aphid. Potato Aphid and Green Peach Aphid inefficient vectors of PVY, but if population is high enough, there will be some transmission. Local seed growers now refusing to grow out generations of Gem Russet for commercial growers unless commercial growers prepared to forward sign guarantee of acceptance of seed lot due to risk of PVY infection.

PVY & PLRV Control strategy – fallow edge effect with buffer crop (oats ?) and spray programme. Buffer crop provides the soil colour contrast to attract aphid. If aphid feeds in buffer crop charge will be lost, it therefore should be "clean" before migrating into potatoes. Aphidcide not systemic but providing a little peace of mind. Early vine kill to help minimise potential aphid migration

Using diluted sulphuric acid for top kill.

Seed management – Tetonia county area zoned seed certified district. Tetonia 65 frost free days. (from emerge) Research Farm has 8 year rotation. Seed farms in the county 3 – 4 year rotation.
$6.50 – 7.00 / cwt G3.

Idaho
- 40 000 acres of seed
- 400 000 acres of commercial

Breeding programme – historically if variety tuber looks ok, it would be kept regardless of disease susceptibility. Eg. Gem Russet and its susceptibility to PVY. Focus is changing to a more wholistic approach to variety management. Individual management strategies required for new variety potential a problem. Currently all varieties managed as a "russet".
Visit seed growers

Nuclear fields planted with minitubers. % of product sold too seed growers as nuclear generation for multiplication.

Jack Hoopes. Tetonia.

Seed grower
- 1700 acres – 80% Russet Burbank
- 3 year rotation
- Majority seed lots sold as Elite 3 to commercial growers
- Custom seed cutting operation

Plantlets purchased and potted for greenhouse production of minitubers. Using nursery bags and potting mix media. Destroying nursery bags after each crop for sanitation.

Smoke bombing greenhouse for fungicide application. When using over head application of fungicides, underside of leaf coverage poor. Sap test green house plants regularly.

Disease management regime greater on earlier generation crops.

Cut seed suberised prior to distribution to commercial growers. Suberised in 10 – 12 ft stack with ventilation. Cut Russet Burbank seed at or prior to peeping. Maxim for Rhizoctonia. Maximum mother tuber size 12oz. 3 – 10oz majority. Round seed graded out at cutting. $9/cwt E3 russet.
Seed harvested by mid October and cooled down by end of November, 36 – 38 deg F. Good air and humidification to reduce pressure bruise in stack. Humid cells for humidification.
2½ - 3 oz. Cut set size. Minimum 1½ , Maximum 3½oz. 8 – 9" spacing for Russet's. Short growing season – 160 cwt / acre average yield. Vine kill early to minimise virus risk. As other crops in region dry off, aphid population in potatoes increases.

pm

Ashton Seed Co.

Clen and Emma Atchley.

Plantlets from University of Idaho. Participating in Tri-State breeding programme (Washington, Idaho and Oregon)

Umatilla – Storage problems in stacks > 10000 sacks. < 10000 sacks in pile = less problems. Main problem from Fusarium. (High solids ? shatter bruise ? Fusarium) Warm harvest saw less problems.

Chlorine Dioxide for storage rot problems. (Oxidate ?)

90-14-2 as a replacement variety for Gem. Still has some minor problems with susceptibility to PVY, but less than Gem. Stopped growing Gem due to inability to keep out virus. Growing virus sensitive varieties on downwind side of plots or farm for some extra aphid protection.

SR70 Russet type potato showing some very promising characteristics. Should be available for commercial evaluation in 2 years. Bred university Idaho.

Grading pre and post storage. Pre grading has eliminated some problems in storage. Using University of Idaho Mechanical potato to identify impact points on grading tables, transfer belts, bins etc. Do this check on a regular basis. Achieving ~ 5% shrink. Eliminate temperature ASAP to minimise shrink.

Commercial growers specifying young physiological age seed. Participating in Virus winter testing programme. Samples sent to California each winter for grow out trials. Very necessary part of virus management strategy. Eliminates virus infected seed immigrating into commercial fields and being grown out before any visual signs of virus becomes evident.

Storage piles 16-22 ft depth. 38 deg F. at bottom of pile. If temperature at top of pile reaches 42 deg. F. tubers will sprout. Computer controlled temperature management system ensures less than 1/10 deg temperature variation. Computer software package US. $3000

Computer monitoring system for 22 remote pivot sites. Shows degree of rotation, mode of action (i.e. Irrigation, Fungigation, Herbicide application), application rate.

Soil infiltration rate 5 – 6 mm per hour.

Goucho treated soy beans for border crop protection of aphid.

Idaho Crop Improvement Association
Jonathan Whitworth
Dr. Phillip Nolte

Managers for seed certification within Idaho.

- 147 000 tons of seed United States
- 1 400 000 tons of potatoes United States
- 413 000 tons of potatoes Idaho

State Authority of Seed Certification

- 0.2% PLRV
- 1% PVY
- 5% common and powdery scab tolerance
- No standard for rhizoctonia
- 12 Inspectors
- Aphid Trapping Network
- When first green peach aphid is detected, alert is sent around all counties.
- 0 % tolerance to Bacterial Ring Rot. 1 or 2 seed lots condemned each year for BRR.
- BRR can survive on machinery in the absence of potatoes for several years. BRR will not survive in soil media without host plant. Contamination from stores, machinery etc. Sanitation essential for control.
- Manage Post harvest winter grow out testing for virus. Proves to be more economical to grow out lines in summer environment during USA winter, than too sample and plate tuber cutting for virus detection. $60 / lot as compared to $400 / lot. Plants grown only long enough to obtain leaf sample, therefore little tuber set and ability to reuse same sites on a minimal rotation.
- Seed growers too provide storage maps of each generation in storage.
- Tuber inspection for certification at point of sale in spring time.
- Mandatory use of Certified seed for commercial growers introduced in 1997.
- No emphasis placed on PVS. No measurable yield decline, <1%. PVS very difficult too control.
- Yield loss of PVY = 150lbs / ac / % of PVY infection. Decline is fixed line. Not a % drag in yield, assuming that crop is compensating, therefore yield decline is more noticeable in low yield fields.
- Legislation for certified seed production empowers department to enforce virus hygiene within all of county. Eg. Removal of a peach tree in a home garden. Virus management has to be approached as a community.
- Mosaic viruses – insecticide programme proves very inefficient, as transmission occurs in seconds.
- PLRV – 24 hour development period where virus has to pass through the digestive system of the aphid, before returning to the salivary glands. Use of border edge affect crops aim to cause aphid to lose "charge" before entering potatoes.

Tuesday 6/8/02

am

Aberdeen Research Centre

Weed and herbicide trials – Pam Hutchinson
Trial plots for the efficacy of new and old herbicides, alone and in tank mixes.
Outlook, matrix, lexone, stomp. Plots hand seeded with a known given of weed population.
100 % and 0 % hand weeding plots as controls for efficacy and crop affect. All plots 1 % O.M., sandy loam. Suppression of nightshade required as it is a host plant for blight.

Irrigation technology – Dr. Brad King.
Comparing the scientific view that evapotranspiration is the same over an entire well watered field, with the practicalities of soil and crop variations. Reservoir tillage applied to monitoring sites, for if water is running off, accurate monitoring of use and evaporation can not be measured.

Evapotranspiration varies across field as crop row cover does not occur at an even rate, therefore requiring different applications. As sprinkler size changes are note infinitely progressive along the boom of a centre pivot, jumps in size can be 10% above or below the required application.

Campbell Scientific Reflectometer Soil Moisture Probe. (Aust. Distributor – Logan)
TDR probe with a pair of parallel 300mm steel rods. Device can be fixed with down load capacity or portable for random testing.

Decko – capacitance probe, soil texture calibration required. No good in clay loams ?

Compaction of soil horizons changes water holding capacity and therefore calibrations.

pm

Potato breeding Programme – Dennis Corcini

Funk Farms - Monte Funk
County Line Farms, American Falls, Idaho.

5000 acres potatoes in rotation of malting wheat and sugar beet. All crop under irrigation from 250 ft bore water. Jetfill tensiometers as a guide to irrigation scheduling.

Manager's responsibilities are segregated with crop requirements, i.e. one is responsible for all irrigation, another disease and another nutrition.

Liquid phosphorus applied above seed piece at planting. Pre plant NPK = 150,100,105.
Applying 20 units N per week on average. Nutrition management all subject to weekly petiole test results.

In furrow application of quadris @ 6.2oz w/ 10 gall water per acre. 40 psi tee jet with a 5" band.

Seed from Ashton. Cut and suberised 1 month prior to planting. Young P Age seed. Maxim and fir bark treatment. Seed 45 deg at cutting. Soil > 4o deg F. at planting. Aim for 3 – 4 stems, 8 – 10 tubers. 100 – 120 day growing period. 320 cwt / acre average yield.

Rhizoctonia problems increasing. Increase in presence in wheat and beet crops.

Availability of worthy and affordable labour becoming an increasing problem.

Revisiting approach to the importance of soil health to overcome stagnant yields and increasing disease problems. Biological approach to increase enzyme activity in soil.

Soil applied "tea" evolved from brewing process of worm castings.
Custom blending own micro nutrient spray applications in response to petiole tests.

Wednesday 7/8/02

am

Dale & Paul Stuckenholtz Labs – Twin Falls.
General agronomy / nutrition
Soil science

Basis : Plant health => Disease suppression relationship

Law of limiting factors, Genetic and climatic potential of Idaho = **600 cwt/acre**

Less

Seed size and condition	20	
Herbicide toxicity	20	
Irrigation Management	30	
N-P-K	30	
Micro nutrient	10	
Rhizoctonia	20	
Soil variability	40	Responses available to grid sampling
Soil Aeration	20	
Plant population	20	
Fungal Diseases	40	
Equals	**350 cwt /acre**	Average commercial yield

Analogy – Potato plants hidden hunger – Deficiencies limiting production that are not visual !

Management of BALANCED APPLICATION

- Soil testing
- Plant tissue testing

- Precise irrigation
- N-P-K in water
- Starter fertilisers
- Liquid Fertilisers
- Foliar Nutrient Sprays
- Pesticide development
- Humic acids
- Increasing rate of photosynthesis

<13000 ppm K = > incidence of verticillium wilt

Plant use K = 4 units/day
High P → low Zn & Cu availability

Foliar nutrient product selection : Products may contain analysis, but mode of action may differ. Nutrient absorption is enhanced by a small amount of urea nitrogen. 1 – 2 lbs/acre of urea nitrogen is generally adequate.

Nitrogen Management

Low Nitrogen
- Target spot
- Verticillium wilt
- Blackdot

Early season high nitrogen
- Delayed tuber initiation
- Too much vine (disease)
- Lower yield if short season
- Increase hollow heart

Late season high nitrogen
- Delayed maturity
- Low skin set
- Increase bruise
- Low S.G's

Use of foliar nutrients
- Correct or prevent minor nutrient deficiency, @ 1/5th lb.
- Correct hidden hunger
- Increase yield
- Lower disease
- P, Zn, Fe, Mn, Cu ,B most common
- Apply only ones that are deficient
- Apply at coolest part of day. Use 7 – 10 gallons water per acre.
- Enhance absorption with urea

EDTA chelates ok in soil application to limit tie-up, but not in foliar applications as is toxic to plants.

Phosphate prills wax/oil coated – delay period for dissolving and availability of microbes/bacteria to dissolve P. Humic acid will increase rate of breakdown, therefore increasing availability.

Dry granular application in fall, followed by liquid at plant ?

@ pH 6.5, Iron tie-up of P will not occur ???

Early Phosphorus and Late Phosphorus Deficiencies.

Where is plant root development ? Early root growth in top of hill. Low soil temperatures, high ambient temperatures promoting rapid growth create a high demand for P. Late season growth has a lower P demand. If P is in top of mould only 5% of the plant root mass will have access to it. Need to design fertiliser placement to accommodate different growth stages and demands of plant needs.

Hollow Heart Management

1. Uniformity of plant stand
2. Date of planting (earlier = higher risk)
3. Low nitrogen early
4. Maintain potassium levels
5. Less chlorides
6. Vigilant early irrigation
7. Soil aeration
8. Soil temperature at tuber. >50 deg F.
9. Soil texture. >% in heavy soils
10. Calcium. Use of calcium nitrate
11. Boron deficiencies

Scenario – Planting ok, start irrigation, cool weather change, saturated soils, warm weather develops with cool soils, rapid plant growth = Hollow Heart. Apply CaNo3 and foliar P.

Common Scab Prevention

1. High levels of early phosphorus. > 0.2ppm
2. High Fe and Mn
3. High K
4. Soil moisture greater than 70% until tubers greater than 2 oz.

pm

University of Idaho – Kimberley Potato Storage Research Centre (Est. 1990)
Gale Kleinkopf, Tina Brandt, John Klimes.

www.kimberly.uidaho.edu/potatoes/

Facility developed for the evaluation of new variety storage requirements, storage disease management strategies, evaluation of commercial storage products (eg. Alternatives to CIPC), effects of different storage temperatures etc.

9 separate bins @ 60 ton, each with it's own environment control. Organic decay sensors to detect rot.

Although CIPC still remains an effective sprout suppressant, questions are being raised about its continued use in the food chain.

Suggestion that CO2 levels will affect sprouting characteristics, but no work done to support. Interaction with ethylene production questioned. Ethylene sensors costly and inefficient at this stage compared to CO2 meters.

Researching new seed disinfectants as 60 % of world Fusarium strains are resistant to tecto. Problem to overcome with current products, is that when they become inactive upon contact with soil particles.
Disinfectants affect sprouting characteristics, therefore not suitable for seed storages.
Umatilla same as Russet Burbank for Fusarium tolerance in storage. Considering fungaflor as a cut seed treatment for Fusarium control.

Variety evaluation in storage as compared to Russet Burbank as standard.

- Sugar accumulation
- Sprouting dormancy
- Fusarium incidence
- Shrink

Thursday 8/8/02

am
Stay Boise

pm

Friday 9/8/02

am

Drive Boise to Pasco

pm

Nelson Irrigation – Graeme Hutchinson
Tour of manufacturing plant and demonstration of sprinkler and big gun options

Saturday 10/8/02

am
Field Officer – Paul Saito

Baker Farms
2500 acres potatoes. Crop management responsibilities distributed between 4 managers. Each manager is responsible for all crop requirements (irrigation, nutrition, disease) within his control. (As compared to Funk's management distribution).

Stem numbers (2.5 – 4) and vigour, top growth smaller than expected for crop stage and projected yields. 34" rows, 10.5" in the row spacing.

Custom cut seed from Montana.

Deep well irrigation water. Sodium levels high in irrigation water, applications of gypsum as a result.

40% of Nitrogen and Phosphorus and 100 % of Potassium pre-plant. Applying < % of K top dressed, N,P & K through pivot water. Monitoring micro nutrients with leaf testing. Foliar applications as required. Total = 300,300,300.
Monitoring leaf testing until 2 weeks prior to top kill. Aim Nitrogen at 5000 ppm (dry ash) at top kill.

Looking at Neutron and C probes, but considered fairly expensive. Monitoring 1st, 2nd and 3rd foot for irrigation scheduling. Aim at constant 75% field capacity. Respiration rate limited by over wetting soils. Applying in furrow ridomil (pinkroot) and quadris (rhizoctonia). Running profile water level down later in season for blight, sclero and storage rot prevention.
Aim to keep lenticels only just visible.
Hollow heart problems early in season if watering over done. Don't generally have a problem with common scab. Low soil inoculum levels.
Not concerned at a little bloom on crop. If trying to water to stop bloom, problems with pythium, pink rot, and hollow heart develop. Aim to keep a high percentage of crop in the bin. Higher yields are probably achievable, but will be at the expense of higher losses and higher risks. Bloom may not necessarily be from moisture stress, heat ?

Average yield – 30 ton per acre after grade & shrink. Best crop – Ranger Russet @ 39 ton.

Umatilla – susceptible to PLRV within the foliage, but not seeing any tuber net necrosis. Generally better internals. Less water than Russet Burbank. Run nitrogen lower. Responses seen to Calcium Nitrate.

7 – 14 day blight programme.

High incidence of PLRV. Tuber net necrosis seen as a result of primary infections. Plants will exhibit visual signs around six weeks after infection. Aphid scouting programme in region. Aphicide programme to combat.
Fulfil™ - soft on benefitials
Aldicarb™ - in furrow systemic.
Monitor™ - gives 2 weeks systemic protection ? (Don't mix with Bravo)

Soil pH 7 – 7.5.

Reservoir tillage on slopes and flat ground. Rip and Dam Diker pass prior to emergence, when apical shoot from seed piece is no more than 2" long. 10" point on ripper is creating shatter into the bottom and side of hills to remove any compaction created at planting.

Using white mustard as a bio-fumigant for verticillium wilt control. Needs to be green plant directly incorporated straight into moist soil for any fumigation benefits. If plant matures or dries before incorporation, fumigation benefits lost.
Mustard to grow and incorporate = $100/acre, as compared to using Vapam = $150/acre, plus the green manure benefits.

Past problems with early stem death due to sclerotinia,
- PCNB – apply early. 2 applications ?
- Rovral – apply pre-row closure. 2 applications
- Omega

Precision Planted onions
pm

Tour Othello factory

Monday 12/8/02

am
Visit Hutterites – Eli Walman, Farm Manager

20000 acres, 4500 acres Potatoes
18 families, total of 85 people of which 20 work fulltime on colony farm.

Water – Deep well bores >240 0ft. As bore depth increases, sodium content increases. Water temp – 105 deg.F.

Gypsum application for sodium levels

Prior to planting, water priority allocations made to each crop, (beans, beet, maize). Potatoes priority one for water.

Through more educated and measured assessment of soil moisture, and improved pivot irrigator efficiencies, applications reduced from 7 gallons per acre to 5.9 ½ inch applications.

Verticillium wilt – green manure bio-fumigant mustards.
Common Scab – Eliminate raw manures prior to planting

- No decomposing straw in root zone
- Most important, adequate moisture early!

Take delivery of seed in spring. 3 year forwarded arrangement with seed grower. Organised so that seed is no more than peeping upon delivery. Aim to keep seed as young as possible. Plant when soil at 50 deg. F.

Satellite technology being used to manage paddocks by grid references. Fertility and weed control applications as required to each grid as apposed to blanket field applications. Weigh cells on harvesters were measuring yield within grid references. Working towards precise water application as per grid requirement.

Computerised injection system on pivots for herbicide and fungicide application. All pesticide applications made in 100% mode at night.

35 – 38 (US) ton gross paddock average yields.

Trialing humic acid type products too improve soil microbe activity. Products specific to crop, Ag Pro for beans, Reclaim for potatoes. Jury still out on results ?

Norkota Russet – Fresh pack and process versatility
Russet Burbank – Processing, Main storage variety.
Umatilla Russet – Processing
Ranger Russet – Short term stores. Typical ranger problems.

Umatilla – Best yield on farm @ 52 us ton per acre.

- Very good performer but requires different management strategy to burbank. Biggest problem is bruise initiated Fusarium in storage. Fusarium breakdown a problem in seed lines when warming to cut.

Previously harrowed down to manage rhizoctonia. Now hill at planting to warm soil earlier. Seed treatments and wholistic approach to manage rhizo, eg. Pre-water if required rather than water post plant.

Packing shed capacity – 300 ton per day. X-ray machine for detection of hollow heart.

Truck Fleet – 18 prime movers 10 years old.

pm

Steve Holland

Seed – No 1 seed is invaluable.

Early vigour – first sign of potential.

Physiology]
Pathology] Combination of each or stand alone
Genetics]

Need to identify a line of seed that performs in your district.

Seed from > day length > ? vigour
PS > sugars > carb > starch + energy (vigour)
Reason for southern vigour.

> Size > bruise. 95% if all seed decay will eventuate from bruise site. 8 bruise sites on a seed piece from cutting to planting. Depending on pathogens present and temperature. Lowest cut size for early plant. > size > late plant, eg. Plant two cut seed before three cut.

Rhizoctonia

Maxim – contact product as compared to systemic eg. TOPS.

Corners of seed piece where damage occurs and protectant is 'rubbed' off seed – non protected sites.

Pithium – Ridomil OK – in furrow spray application.

Maxim better than tops for soil borne Rhizo.

Rhizo @ stem base of s/piece – seed borne.

Rhizo @ half stem and stolons – soil borne. 80-90% problem for NW USA.

Blocker (AMVAC) – (PCNB old) carcinogenic product. Was best for Rhizo control. Now new production process, safe. Available for use in USA. Good on sclero.

Amistar has broader spectrum but probably not as good as control.

Maxim has a degradation with H2O and pH levels. Late germination of some sclerotia spores may still attack.

Rovral 8/10, Blocker 9.5/10. Roval being applied in water for sclerotina. Sunlight kills sclero a ratio of canopy growth. Rotation of beans for sclero.

Sclero and Rhizo mould @ base of stem very similar.
If tissue clean under mould – Rhizo
If tissue slimy under mould – Sclero

Seed Physiology

Starts the last month of growth of seed crop. Affects vigour, shrink etc. Unloading trucks outside. Exhaust fumes from trucks – CO2, creates anaerobic condition > sugar problems. Disease prevention prior to storage **.

Seed harvest < 65% soil capacity > bruise and shrink.

% of shrink in seed is a correlation of % of performance drop.
CO2 > will age seed. Oxygen depletion will vary vigour/p.age. Temperature control + or -1/2 deg.F will not affect aging. Greater the variation = increase rate of aging.

Whole seed of 2oz will out perform 3oz cut seed piece, due to damage sites.
Drops sites in seed – critical to bruise. Eg loading over sides of trailers. Need to boom elevate into trailers for seed.

0, 4, 8 bruise test – hand applied.
21% yield reduction, pathogens etc.

Seed size ? > yield ?

Stem end and rose end variations in vigour through mother tubers.

Tighter stem number range with whole seed. Single cut 95%. Therefore better market yield %. Seed up to 5oz ok. Whole seed to 3oz.
7 buds/eye of potatoes.
Shepody – low stems/hill from large mother tuber.

Aging techniques – stem removal – physical shock
Temperature variations – physiological shock.

Physiological shock delays suberisation + sprouting.

+ - ½ F pulp temperature variation > ages.

Longer Season > larger hills

Pre-sprouting – removes energy
Primary bud – strongest shoot.

Temperature variation most effective way to age seed and retain vigour.

½ eyes on tuber green point peeping > 2 ½ stems
2-3 eye below whorl peeping for whole seed. May as well store in soil as store in shed. 180 day growing days > 3 ½ stems, 18-20 tubers + days to grow out.

Any signs of wilting > no growth. Stomates close > 30 minutes. No PS

Erwinia, Pithium, Fusarium, Pathogens cannot penetrate potato skin. Wound healing @ 95% RH – 56F. Oxygen requirement critical. Cutting exposes internal tissue to disease susceptibility.

No periderm development < 9C.

Root zone = drip line of plant. Hilling of K into Hill will not make K available for late plant bulking.??? Trial results shown 62% yield variance.

4-7tn/acre @ 20 tn/acre average – pre-spread ? vs. band+

Geotropism of potato root development > neutral.

Fert

Placement Timing Formulation

MOP – potato has very low requirement for chlorine.
Chlorine translocated through plant. CL- ions concentrate stops osmosis of water. Sulphate > Chloride 6 tn differences
K 3 ½ lbs/day requirement of soluble.

No internodal roots
Higher temp > nodes
Starter fertiliser – 4" out and 2" up from seed piece for early root development.
3" to close (too hot) – 5" 50% efficiency

Liquid – most efficient fert for entire plant growth
+ 1 gall/ac humic acid
10.34.0
1 gall/acre for each ton of yield + at 2n chelate per acre.

Plants – leaves from plants less than 3-4" plant height are immature and no PS (Roots not working @ this stage) All energy from seed.

Roots – 80% of feeding and drinking occur in the last 20% of root length, i.e. root hairs. Therefore feeding position changes as plant roots grow.

Humic acid – potassium hydroxide extraction. Better than sodium hydroxide extraction.

KOH – potassium hydroxide – magic formulation for unknown reason. Chelates prevent tie up.

Red ball flow gauge for liquid fert lines.

First 12 days after emergence – potential to double growth with early vigour in this period with liquid starters.

No roots below seed piece. Branches go down a little but remain geotropic neutral.

Roots pruned by remoulding will drop tubers/stolons @ that node. Plants greater than 6" high no moulding.

All P & K @ pre-plant apply 110% for potential good year.

Poly P fertilisers move < 1/8" – not available for plant use.
Ortho P only available for plants

Microbe > poly – ortho breakdown

< 10,000 ppm N senesesence is induced

P – battery for growth – P should be flat line – not taper off.

K demand during vegetative growth, flattens off while plants 'coast' and then > when tuber bulking.

Equilibrium of available K > several months.

WHY OUR P DROPS ?!!!

WIPF – water injected P fertiliser – Ortho formulation.

The flatter and wider hill, warming increased due to less shading on back of hill.

40, 36, 20 ton hill capacity without green, dependant on shape of hill.

When stem first exposed to light, no tubers above that point – no benefit of remould. Trigger for leaf development.

Don't bury any green foliage > start of Erwinia!!!

Wider hill better than taller hill. Potential crop starts at emergence. Case for 34" rows??
Better water and heat capture.

Water @ 65-85% field capacity.
>85% lack of oxygen limits root performance, rots etc

Die check water infiltration water can.

Furrow compaction can cause greening by 'pushing' tubers up as bulking

Dam diker improved yields on flat ground.

Primary set – stresses ? number 4-6/stem RB

Secondary set – may be P availability 3-4/stem shep

More primary's held, less 2nd set.

Dry fertiliser salt index

Acid soils – no acid fert

Portage video ???

Population important not row space?? Infiltration etc

Seed piece size (potential yield) and spacing

Rate of bulking curve-linear, lack of leaves & p/s rate

Earlier kill time after planting. Longer time required for skin set.

Canopy p/s factory. Excessive canopy shading becomes an issue.

Heat necrosis spots – flush of growth in tops, energy from tubers. Similar to HH tops want more than plant can provide. N, water, heat etc OM release

Ca & Bo inconsistent in HH control. Weather pattern more significant.

Only apply 30% of N requirement prior to row closure. 'Slow down' growth rate to manage HH. Don't want over acceleration growth rate. Even keel metabolism.

Soil N drops 30% in 7 days, petioles will drop in 7 days. Spoon feed N frequently to maximise affect. Same as water. Using urea – need to plan further ahead.

N – ¼ lb/ac/day at end of season.

50lbs/ac Soil N will be adequate for growth if constant availability.

Probably not losing some of 1st set, but a check of some kind is inducing 2nd set.

For seed growers – moderate aging and even nutrition and water management should close up size distribution profile.

Turgidity of seed won't cause a problem for shatter if temp is OK.

Shatter more temp related than turgidity.

Sunlight degrades seed quality and dehydration from wind.

Altitude in seed growing region makes no difference to seed performance.

Latitude has major difference.
Idaho, Wash, Edmonton, Alaska, Trial
Alaska seed – plants 8" when Idaho emerge
?SGs
?Sugars > earlier emergence

Genetics more influence than nutrition on TI
TI definition – swelling behind hooks.

Seed killed too early may lack vigour due to lack of time for (starch?) formation.

Block shape – genetics.
Less susceptible to bruise.
Malec Hydrazide stops cell division – cell enlargement knobs form from eyes.

Enzymes that cause cell division, accumulate in the eyes. When stress occurs, cells in eye want to divide first, knobs.

Alpha Helix – eye distribution same as petiole

Dull knives > jagged edge > more surface area. May = 20 % yield loss

If seed is cracked @ cutting passed the vascular ring, energy store for eye is lost/lessened.

Sucrose>excess>storage>carb>starch

Fructose Glucose Plant use for energy

Fructose + glucose in tuber } converted back to starch
Dormancy break
Starch > fructose + glucose

Best control of seed size is spacing

Trialed – 400 sensors in a room proved temp variations in a room

+ 18F 40-80F growth rate doubles

Young and old p.age emerge rate

Maturity has an influence. Immature seed > short dormancy

Induced senescence will translocate tops to tubers and increase maturity

If crop healthy @ vine kill, range of maturity in seed lot will be less as opposed to ½ dead and top kill

10 day emergence diff in cut set size and cuts i.e. 2cut 3 cut

wholes and halves very similar in stem and emerge rates. Control of stem numbers lost in large mother tubers due to cutting profile.
2 cut = 2.5 stem] if everything else equal
3 cut = 4 stem

differentl cuts roll differently in planter boot – poor cv's

variable stem count – how do you manage nutrition for one plant with 2 stems/12 tubers and 4 stems/16 tubers

1 ¾ > 5oz seed range 30% price premium. Worthy investment

Aerial photo for crop progress – satellite imagery ? Progressive photos will high light differences in crop conditions before they are visible by walking the crop ?

Petioles from stems with flowers will always read lower. As flowers have no chlorophyll and photosynthesis action, translocation ? different in these stems.

Petiole test between 6 and 10 am. Petiole sap results will be altered by the direction in which petioles are stripped. "Strings" taken with leaf tissue will dilute sample.
Sample 4th leaf, ie. Whorl, 1st, 2nd, 3rd, 4th.

Maxim does not increase stem numbers. What occurs is that the inhibition of rhizoctonia to prune stems / stolons by the action of the maxim, appears to give more stems. Stems are characterised by variety and physiological state.

Shepody – Greatest increase in stems/hill will be achieved by smaller seed size. 10 ounce seed pieces will give 15% blind sets.

Evaluate early crop emergence. Why are there some plants double the size of others at 2 weeks after emergence ?

- Seed health
- Seed size
- Soil

Variations can be 3 to 8 pound per hill. Variations across a field may be 10 fold.

Tuesday 13/8/02

am

Review

Pm
Clear Water Industries
Drip Irrigation – Brief discussion on drip irrigation practises in region. Placing tape between two rows. Slope limited to about 4%.

Prosser Research Station
Dr Robert Thorton

Importance of phosphorus management during crop life. Some early dying can be attributed to falling P levels, more so than N. Although P demand is high during early crop establishment, requirement through entire crop life tends to be overlooked. Washington soils have a P fixation problem due to high Na and Mg levels. Applications of foliar P may prove beneficial.

Dale Westerman –USDA, Kimberly. Working on phosphorus demands.

MH30 helpful, but not the total answer to controlling volunteers. Timing of application variable with different varieties. Used widely in the fresh market industry to control shape. Has been known to contribute to problems with dry matter levels.

Lower translocation rates to smaller tubers. Typical russet application timing on a plant with 10-12 tubers, is when the smallest tuber is about 2" or 2 ounces. Will lessen second set. Rate – 2.5 kg/Ha active ???? Check MRL'S

Starane - problem with the window of opportunity for application due to the long emergence period of volunteers.

Seed cutting for stem numbers – pre dormancy cutting will give more consistent results than spring cutting. Importance of handling and cutting for strong plant stand and early vigour stressed. Russet Burbank, stem numbers greater than 4 will be non – contributing to yield increases.

Quality of Shepody seed a problem from large mother tubers, mainly due to blind sets. Calices found on the edge of blind shepody seed pieces, is "energy" that would normally go into producing stem growth.

Nutrition – Most of K pre-spread and 30 % of N at planting. N better utilised applied during crop growth starting at 4 to 5 weeks. 1ST nitrogen application before first petiole at 6 to 7 weeks. Aim to keep P maintained throughout crop life tapering to 1000 ppm at harvest.