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FACT SHEET

Potato Production

Scientific name: *Solanum tuberosum* Family: Solanaceae

1.0 The potato plant

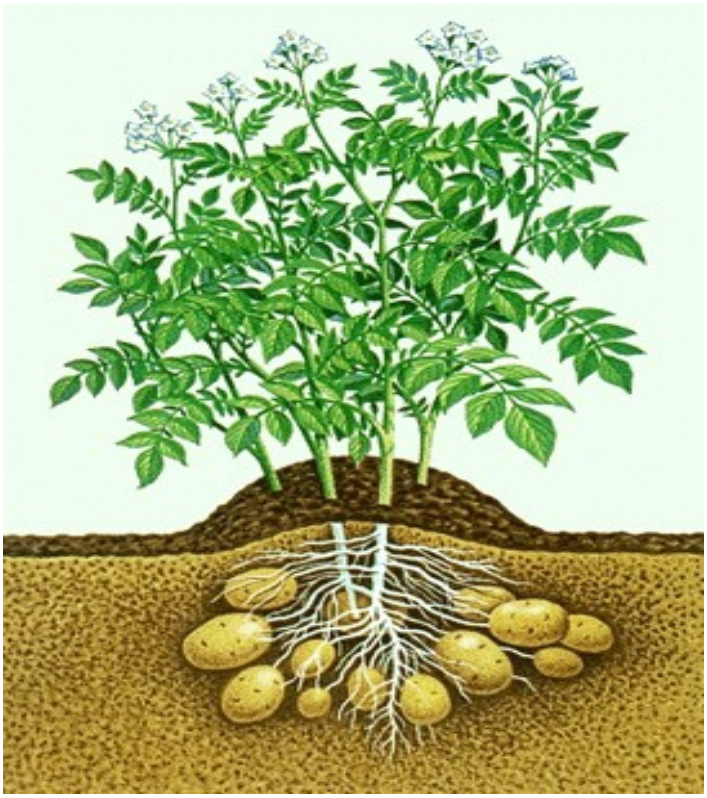

Figure : Structure of a Potato plant

A potato plant (*Solanum tuberosum)* is a low-growing, branching perennial plant with weak stems. it is a herbaceous annual plant that grows up to 100 cm tall and produces a tuber which is commonly known as potato. Potatoes are rich in starch and is ranked fourth after maize, wheat and rice. The crop belongs to the Solanaceae - or "nightshade"- family of flowering plants, and shares the genus *Solanum* with at least 1,000 other species, including tomato, eggplant and tobacco.

2.0 Cultivars: Most common varieties grown in Zimbabwe include BPI, Amythest, Mont Claire, Opal, Emerald and Jacaranda. The yield of these varieties in winter and summer are evaluated below.

Variety	Summer		First Winter		Second winter
	Yield (t/ha)	Days to Maturity	Yield	Days to Maturity	Yield
Garnet	23.2	98	28.4	120	25.8
Pimpernel	12.4	98	-	-	12.4
Amethyst	19.5	97	11.8	108	15.7
BPI	22.3	-	20.8	108	21.5
Jasper	12.2	-	28.5	127	20.4

3.0 Soil and Land Preparation

Most soils are suitable for potato production, but medium textured loamy soils with good organic matter are best. Deep ploughing (600 mm depth) is recommended, with discing and harrowing done to create a fine tilth. The soils should be fine, loose and without compacted layers that hinder root penetration. Clods and stones should be avoided as they reduce root contact with soils and cause tuber deformation. Heavy clays and some micaceous soils should be avoided especially when they dry off because they produce misshapen tubers. Soils must be well drained, especially for the summer crop when rainfall is high. Well aerated soils ensure sufficient oxygen for root, stolon and tuber growth. Optimum pH is 5.0-5.5. Liming should not be done immediately before planting because the resultant high pH levels can predispose the crop to common scab.

4.0 Sprouting of Potatoes

Potato seed is normally supplied in 30 kg pockets containing sizes from 25 mm to 56 mm in diameter and an average of 400 tubers are found in a pocket. Fig 2: Sprouted potatoes

Sprouting is the development of shoots in potatoes. Each tuber has from two to as many as 10 buds (or "eyes"), arranged in a spiral pattern around its surface. The buds generate shoots that grow into new plants when conditions are favourable. Pre-sprouting of tubers helps to increase the number of main stem, and consequently the crop's final yield. Sprouting also ensures quick, uniform and full germination.

Sprouting is done by storing the tubers in diffuse light. Tubers smaller than 25 mm should not be used for seed.

Farmers may sprout the tubers by chitting trays or by force sprouting method. These methods are explained below.

4.1 Chitting Trays

Potato tubers are exposed to sunlight but protected from strong sun. Apply suitable pesticides to the tubers to protect them from tuber moth, and newly developing sprouts from aphids. If cut tubers are used, cure them for 10-14 days at 7-8 ^{0}c and 100 % relative humidity. Dipping of tubers in fungicide drench is recommended.

4.2 Forced sprouting

This can be done when dealing with large potato quantities. The method involves use of heat or acetylene.

- Heat: cover potatoes in tarpaulin in moderate sunshine. Temperature of 30-35 ^{0}c will initiate sprouting.
- Acetyline: 0.1 % of acetylene gas in an airtight room between 21-27 ^{0}c will initiate sprouting. 30 g of calcium carbide will generate sufficient gas for 2 m^3.
- Immerse the tubers in an acetylene solution for 4-6 hours. The mixture should be 45 liters of water to 230 g of calcium carbide added slowly.
- Giberelic acid can also be applied to stimulate sprouting in potatoes.

Planting of Potatoes in the field

Sprouted Potato tubers

10cm

15 cm

120 cm

Figure 3: Planting and spacing of potatoes

Newly-sprouted seed between 5 and 15 mm long is suitable for planting. During planting, potato tubers are mechanically or manually placed in the rows, 20 cm to 30 cm apart, with a row to row spacing maintained at between 60 to 120 cm. Spacing is influenced by seed size and soil fertility. Tubers can be planted 7 cm-10cm deep under irrigation farming and can be slightly deeper up to 15 cm when dryland farming is employed. Soon after planting, a ridger is run to cover the potato tubers by throwing the soil from both the sides and ridges pressed. The first irrigation must be applied to a depth of 600mm.

5.0 Planting times

a. **Summer Crops**

The potato summer crop is planted in November and harvested before the end of the rainy season. Crops suffer from disease pressure, but germination is good. Prolonged rains may pose problems at harvesting due to increased sprouting.

b. **First Winter Crop**

The first winter crop is planted between February and April so that it matures before the frost period. Later planting in lowveld is recommended to take advantage of cooler weather. Both crops are affected by late blight, therefore growing resistant varieties is recommended.

c. **Second Winter Crop**

The second winter crop is planted between late July and early August after the risk of frost has passed. The crop is usually free from late blight.

6.0 Irrigation

Figure 4 Irrigation of potatoes using a watering can (source: FAO fact sheet, Land and Water division)

Pre-plant irrigation is important to ensure uniform germination. First irrigation must be applied to a depth of 600mm. A second irrigation is given about a week later. Subsequent irrigation is applied when required. Light and frequent irrigations are better than heavy, less frequent irrigations. The critical stages requiring water are stolon formation, tuber initiation and development. Stop irrigation about 10 days before harvest to allow for firming of tubers.

7.0 Fertilization

A basal application of compound S at a rate of 1300-2100 kg/ha or Compound C at a rate of 1300 to 1500 kg/ha is recommended. Top dressing of AN at a rate of 290 kg/ha should be applied once, 3 weeks after emergence. In addition, top dressing of 400-500 kg/ha of Sulphate of Potash, splitting it into two equal applications, one at flowering and the other two weeks after flowering. The top dressing of AN should be applied between rows or per plant before the final earthing up. A table below shows nutrient requirement as recommended by (AGRITEX).

Plant Nutrient (kg/ha)		**Soil Nutrient status**	
	Good nutrient soils	**Medium nutrient soils**	**Poor nutrient soils**
Nitrogen	Up to 70	70-110	110-160
Phosphorus	Up to 350	350-400	400-450
Potash	Up to 70	70-100	100-150

NB: All P and K must be applied at planting. P increases yield by increasing the number of medium sized tubers.

K increases the number of large sized tubers. 30 t/ha of organic manure supplies adequate P and K needed by the crop.

Half to two third N is applied at planting and the remainder, 2-3 weeks after emergence

Fertilizer must be banded slightly below and at the side of the seed to avoid contact with the seed.

8.0 Earthing up

The Earthing up in potatoes is an important agronomic process. It involves drawing mounds of soil up around the plant to prevent new tubers from growing and turning green and poisonous. Also many times more potatoes will form from the buried stems. It also helps to prevent greening, tuber moth and blight infection. Potatoes are a shallow rooted crop; hence care is needed to avoid excessive cultivation. After applying the top dressing, potatoes should be ridged up to 20-30 cm high. The first ridging will be the first weed control. The second ridging should be done after potato tubers have started to break the soil. Earthing up should be done and completed by the time when the crop is 25 cm tall.

9.0 Tuber development in potatoes

Figure 5: Tuber development in potatoes

As the potato plant grows, its compound leaves manufacture starch that is transferred to the ends of its underground stems known as stolons. The stems will thicken to form a few or as many as 20 tubers close to the soil surface. The number of tubers that actually reach maturity depends on available moisture and soil nutrients. Tubers may vary in shape and size, and normally weigh up to 300 g each.

10.0 Weed Winter Crop

Weeds can cause significant yield loss. They compete with crop for water, nutrients, light and growing space. They also habour pests and pathogens. Weed, control is by use of cultural, chemical and mechanical means. Commonly used herbicides includes: Topogard (Tebutryne), Dual, Sencor and EPTC.

11.0 Haulm Destruction

At the end of the growing season, the plant's leaves and stems die down to the soil level and its new tubers detach from their stolons. The crop will be ready for harvesting when 95 % of the leaves have died off. In some cases and in seed production, the crop canopy is destroyed prematualy for early harvesting or seed production or when severe attack of late blight is feared. Where chemical destruction is employed, it is advisable to lift the crop within 10 days to avoid attack by black scurff.

12.0 Yield and Lifting

Potatoes are harvested when the potato skin has hardened sufficiently to reduce physical damage during lifting. Expected yield ranges from 17-20 tons/ha in summer, winter crop ranges from 25-40 tons.

13.0 Potato Pest

13.1 Nematodes

There are three important nematodes species that affects potatoes. These species are: Meloidogyne spp, Pratylenchus spp and Radopholus similis. Control is by fumigation where possible. Rotation with grass species that is resistant to nematodes eg Katambora, Rhodes, Sabi and Panucum is a recommended control method.

13.2 Potato tuber moth

The tuber moth larvae make tunnels in plant tissue, there by cutting off nutrients flow and causing the plant to wilt and dry off. Control is by cultural methods which includes ridging the plants up to 250 mm. chemical methods involves Azodrin 40, at 15 ml/ 10 litres of water, when symptoms apper. Or navacron 40 at 50 ml per 10 litres of water.

13.3 Aphids

Aphids are small greenish sucking pests which causes symptoms of wilting and curling of leaves. Control is by spraying Azodrin 40 at 15 ml/10 litres of water. Other chemicals such as thionex, and Malation may also be used.

13.4 Cutworms (Agrotis spp)

The pest is very serious at the beginning of the emergence of young stems. The larvae chew the plant at surface level, and they appear as plump darkish greasy grey caterpillars that normally feed at night. Chemical control is by use of karate, carbaryl 85 %, Thiodan 50 WP.

14.0 Disease control

14.1 Late Blight (Phytophtora infestans)

Occurs when the relative humidity is more than 70 % and temperature is around 22- 25 ^{0}C. The disease spreads very quickly during the wet season. The symptoms include brown patches at the end of leaves with white mycelium on under side and brown spots on stems. Control is by spraying with dithane M45 and Ridomil MZ 72 combined. Two sprays of dithane alternated with two sprays of Ridomil MZ 72 at 50 g / 10 litres of water is recommended.

14.2 Early Blight

The disease slow spreading at temperature around 25 ^{0}C. Bottom leaves show dark brown to black spots with typical concentric rings. Control is by using the same chemicals that are used in controlling late blight.

14.3 Common Scab (Streptomyces scabies)

Signs and symptoms appear as rough circular black scabby lesions which can enlarge and cover considerable part of the tuber. It is associated with soils that have high degree of aeration caused by underploughing of high undecomposed organic matter and high temperatures. No chemical control is available. Avoid liming the field during the period when the crop is to be grown.

15.0 Storage of Harvested Potatoes

The purpose of potato storage is to maintain tuber quality and provide a uniform flow of tubers to fresh market and processing plants throughout the year. Good storage should prevent excessive dehydration, decay and sprouting. It should also prevent high sugar concentrations which result in dark colored fried products. A potato storage structure should have adequate insulation, outside waterproofing, inside vapor proofing, ventilation, air distribution, adequate humidification, and properly designed controls for precisely maintaining the storage atmosphere.

Temperature, humidity, and air movement are the most important environmental factors affecting storability. Temperature requirements are determined by the intended use of the potatoes. Tubers should always be kept in the dark since very small amounts of light will gradually cause greening. Lights should not be used more than absolutely necessary. Surface greening is due to chlorophyll formation and is harmless. However, its presence in potatoes is undesirable because of marketing restrictions and the fact that at times an alkaloid called solanine increases with the chlorophyll. Solanine and other glycoalkaloids cause potatoes to have a bitter, undesirable flavor. Greening develops slowly in the light at 4 ^{0}C or below but develops rapidly at 20 ^{0}C.

Potatoes are usually held in bulk piles 2.4 m to 6 m deep. Some are stored in pallet boxes for short periods. Pressure bruise and internal black spot are substantially lower with pallet storage but decay is often increased because of poor air circulation within boxes. Long-term pallet storage is not recommended. Because of the large number of cultivars grown, only general storage recommendations can be given here. Growing and harvesting conditions influence the behavior of potatoes in storage (See "Storing Problem Potatoes," below).

Early harvested potatoes are usually stored only briefly if at all. Such tubers are quite perishable and damage easily because of immature skins. Early potatoes free from serious bruising and decay can sometimes be held 4 to 5 months at 4 ^{0}C for table use if they are cured 4 or 5 days at 12^{0}C to 18 ^{0}C to heal wounds before storage. However, early crops should usually be sold immediately because of poor storability and typically high early season prices.

Part of Oregon's early crop potatoes are chipped directly form the field. Holding these potatoes in cold storage even at moderate temperatures of 10 ^{0}C to 12.5 ^{0}C for only a few days can cause excessive reducing sugar and undesirable dark chips.

Most late potatoes are stored. Storage temperature depends on crop use (see text below). A relative humidity of 90 to 95% is typically recommended regardless of temperature regimes. Most of the crop is held in non- refrigerated, common, and air ventilated farm storages. In general, comments offered below relate specifically to common storage.

15.1 Curing and Wound Healing

Immediately after harvest, healthy potatoes should typically be cured by holding at 10 ^{0}C to 15.5^{0}C and high relative humidity with good air movement for 10 to 14 days to permit suberization and wound periderm formation (healing of cuts and bruises). Although wound periderm formation is most rapid at about 21 ^{0}C, lower temperatures are recommended to reduce decay. Curing reduces subsequent weight loss and decay by preventing the entry of *Fusarium,* soft rot and other decay organisms. The relative humidity should be about 95%.

15.2 Final Holding Conditions

For table potato, Storage at about 4 ^{0}C to 5 ^{0}C, with 95% relative humidity is recommended. For seed potatoes storage at 3 ^{0}C to 4 ^{0}C is considered optimum for maximum storage life because sprout growth is absent or negligible, decay and shrinkage are low, and other losses are usually minimized. At temperatures below 3 ^{0}C, potatoes are chilled and tend to become too sweet for most uses. Storage at 0 ^{0}C for 20 weeks or longer causes some cultivars to show mahogany browning, a symptom of chilling injury. Potatoes are easily damaged by freezing; therefore, low temperature storage permits little leeway if air circulation is inadequate to maintain uniform temperatures throughout the storage.

15.4.3 Sprout Control

Potatoes usually do not sprout until 2 to 3 months after harvest even at 10^{0}C to 15^{0}C. However, after 2 to 3 months of storage, sprouting can be expected in potatoes stored as cold as 4 ^{0}C and much more so at 10 ^{0}C. Although limited sprouting does not seriously damage potatoes for food purposes, badly sprouted tubers shrivel and are difficult to market.

15.4.4 Storing Problems in Potatoes

Blighted, frozen, wet or otherwise compromised potatoes call for extraordinary storage measures. Common storage rules must sometimes be bypassed in order to save the crop. The following suggestions may help you make the best of a bad storage situation.

- Market straight from the field if feasible; if not, sell at the earliest reasonable opportunity.
- Avoid problems by harvesting dry, sound potatoes with a pulp temperature between 7 ^{0}C and about 18 ^{0}C.
- For frozen or blighted potatoes, if possible wait a few days for symptoms to fully develop before harvest.
- Leave rotten, frozen potatoes and debris in the field insofar as possible. This may call for additional people on the harvester.
- Sort into storage. Provide sufficient light, people and time to do the job properly.
- Have your storage ready (and at the proper temperature) with the air delivery and control systems in good order. Be certain you provide adequate flow rates in all areas of the storage. Add

portable systems to otherwise airless storages. Good air movement is absolutely essential for storing problem potatoes.

- Omit the traditional curing period. Since problem potatoes are usually wet and infected with decay organisms, your goal is to cool and dry the crop as quickly as possible.
- Run fans continuously until the crop is dry and decay is under control. Bear in mind that running fans does not necessarily call for ventilation. Recirculate air through the potatoes at all times during the problem period, even when you are not pulling in outside air.
- Keep the pile as shallow as possible to promote air movement and easy removal of problem hotspots. Rotting potatoes and dirt sometimes form barriers to air movement.
- Monitor the storage daily. Thermometers suspended at various depths in the pile provide a good indication of the average temperature. Infrared "guns" are helpful in locating hot spots before they begin to sink and spread.
- Do not expose cold potatoes to warm outside air. A layer of free water will condense on the tubers. Water on the tubers tends to suffocate the tubers while at the same time favoring soft rot bacteria.
- Do not expose tubers to air at or below freezing.
- When unloading the storage, do not wash dry seed potatoes unless they are covered with dried slime. Washing will probably help wet, slimy seed. If you do wash seed, use sprays as opposed to a dip tank. Try to use multiple nozzles so that all surfaces are washed clean. Misting washed potatoes with a 10% sodium hypochlorite solution is recommended (check the labeling for your area). Add one gallon of bleach to 9 gallons of water and mix well before applying in a well ventilated area. Problem seed which requires washing should be planted as soon as possible provided soil conditions are suitable.

16.0 Marketing of Potatoes

Organization	Buyer	Tel. No	E-mail
FAVCO	Mr. EDzepasi Mr. M. Murungwani	0912 125 948 023 758 506	ernest@favco.co.zw
Interfresh	Mr. Silas Mutota	0913 473 948 758520/30	silasm@interfresh.co.zw
Classic Supermarket	Mr. Fortune Mbanje	253267 704220	----------
Spar Fife Avenue	Mr Marko Thawale Ms Pamela	0912 2284 417 0912 392 676	----------
Courtney Hotel	Mr. Reginald Gumbo	073-2491/2	~~gumbor@exhort.co.zw~~

		011 622 906 0912 513 415	rgumbo@cottco.co.zw
Cairns Foods Ltd	Mr. M Hlungwani	620410/9 011738 874	hlungwani@@cairnsfoods.co.zw