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PHYSIOLOGICAL DISORDERS OF POTATO: THEIR SYMPTOMS, CAUSES AND MANAGEMENT

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Abstract

Physiological disorders in white or Irish potato tubers refer to non-infectious abnormalities that arise due to environmental or nutritional imbalances, rather than being caused by pathogens, insects or animals. These disorders typically result from abiotic stress factors such as extreme temperatures, inconsistent moisture levels, or improper nutrient supply during the growth cycle. In this study, several tuber-related issues were identified, including black heart, brown core, cold injury, greening, cracking due to rapid growth and premature sprouting. Each of these conditions affects the quality, appearance and marketability of the potatoes, often leading to significant post-harvest losses. This article provides comprehensive review to mitigate these disorders. It is essential to adopt proper agronomic practices, including balanced fertilization, timely irrigation and careful handling during harvest and storage. Implementing these strategies can help maintain tuber health, improve yield quality, and reduce economic losses for farmers and producers.

Introduction

Potato Botanically known as *Solanum tuberosum*, is a globally cultivated crop that plays a vital role in ensuring both food and nutritional security. It belongs to family Solanaceae and believed to have originated in the cool highland regions of the Andes in South America (Masarirambi et al., 2012). Spanish explorers are credited with introducing it to Europe, from where it eventually spread across the globe, including to Africa. Potatoes thrive in cooler climates and are classified as cool-season perennials in their native habitat. They are sensitive to frost, with optimal growth occurring between 10°C and 15°C (Yamaguchi, 1983). Characterized by a shallow root system, potatoes are heavy feeders and continue absorbing nutrients until maturity (Nxumalo et al., 2017).

However, during cultivation, tubers are prone to various physiological disorders that can significantly impact both yield and quality. "Disorders such as black heart, brown core, hollow heart, greening, frost damage, cracking, and sprouting are common and often stem from environmental stressors or micronutrient imbalances". These issues are typically triggered by erratic weather conditions or deficiencies in essential minerals (Fang et al., 2024).

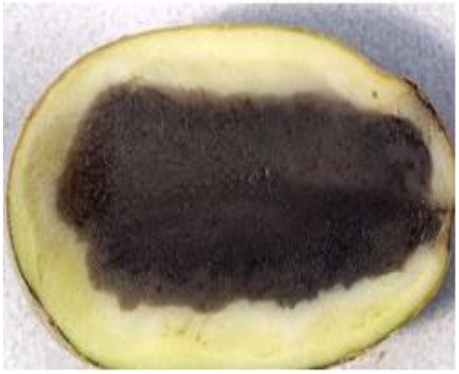
For sustainable potato farming, it is crucial to understand the underlying causes, symptoms, and management practices associated with these disorders. This article offers a comprehensive overview of key and emerging physiological challenges in potato production, along with strategies for effective mitigation.

Physiological Disorders of Potato

1. **Black heart**

Infected plant part: Internal Tissue of Potato Tubers

Symptom: The tuber interior turns greyish-black to black with sharply demarcated areas of affected tissue that are firm and leathery.



Causes: Black heart develops when tuber tissues are deprived of oxygen or exposed to excess carbon dioxide, leading to internal tissue death, particularly when oxygen deficiency coincides with high temperatures. It may arise in the field after heavy rains followed by hot weather that reduces soil aeration. The condition also occurs when harvested tubers are left exposed on the ground for prolonged periods or when sown seed pieces remain in open furrows too long before being covered, especially during hot spells.

Management

- Do not leave harvested tubers exposed to sunlight on trailers or covered tightly under tarpaulins.
- Provide adequate ventilation during storage and transport to prevent gas buildup.
- Avoid planting in or harvesting from poorly drained fields when heavy rains are expected.
- Collect lifted tubers promptly after harvesting.
- Cover seed pieces in furrows immediately after planting to minimize exposure to heat and lack of oxygen.

2. Hollow heart and Brown core

Plant part affected – Internal parts of tuber

Symptoms: Cavities in the tuber may form in a longitudinal or diagonal direction and often exhibit irregular shapes.

Causes: Brown core occurs in tubers that are very small and exposed to low temperatures (below 15°C), particularly during the early stages of tuber formation until they grow to about 50 grams (Wien, 1997). During this period, the cells may die, become brown and tear apart easily.

Management

- Choose cultivars that show greater resistance to it.
- Prevent excessive watering.
- Maintain an adequate plant population density.
- If brown center frequently appears in early plantings, delay planting until temperatures rise slightly.
- By careful management of irrigation and fertilization.

3. Greening

Plant part affected -Tubers-external parts

Symptoms: The tissue just beneath the skin may turn green, with varying degrees of intensity, and this condition can sometimes be associated with sunburn.

Causes: When tubers are exposed to sunlight or artificial lighting, they leads to development of solanine—a toxic compound (solanine)—leading to a condition known as greening.

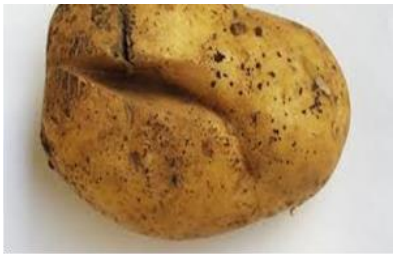
Management

- Select cultivars that tend to grow deeper in the soil.
- Limit nitrogen use, especially for varieties that produce long stolons.
- Ensure the soil is well-prepared before planting.
- Use irrigation during dry spells to prevent soil cracking.
- After the foliage dies back, ridge the soil to cover any exposed tubers.
- Keep harvested tubers out of prolonged light exposure.
- If potatoes will be exposed to light for several days, use packaging that blocks light effectively—brown paper offers better protection than white paper.

4. Cracking/ Growth cracks

Affected plant part- Tubers-external

Symptoms: Growth cracks typically run along the length of the tuber and can differ in both depth and size.



Causes: Growth cracks develop due to fluctuations in soil moisture levels. Tubers are especially prone to cracking when a dry spell is followed by heavy rainfall or excessive irrigation, leading to rapid moisture absorption, accelerated growth, and a sudden increase in size. Factors such as irregular plant spacing, excessive nitrogen fertilization, and imbalanced nutrients also contribute to this issue. Applying large doses of nitrogen all at once after tuber formation further increases the likelihood of cracking.

Management

1. If growth cracks frequently cause economic losses, avoid cultivars prone to cracking.
2. Maintain uniform growing conditions with even plant spacing.
3. Proper irrigation scheduling.
4. Balanced fertilization.

5. Frost Injury

Plant part infected: Internal part of tubers

Symptoms: When tubers are exposed to low temperature (around 2˚C - 0˚C) for less period of time leads to development of grey or reddish spots in tissue. After that, this tissue turns into dark grey or black colour.

Causes: When tubers are exposed to temperatures at or below roughly 2°C.

Management:

- Do not leave tubers in the field overnight when low temperatures are forecast.
- Avoid shallow-setting cultivars in areas that get cold near the end of the season.
- Avoid storage of seed potatoes on the cultivated site unless suitable controlled conditions are available.
- If on-farm storage is unavoidable, separate stacks by covering them with grass or hessian bags; preferably keep them in a ventilated storeroom with temperature control.
- Cover seed potato consignments during winter transport and move them during daylight hours only.
- Provide reliable temperature control for cold storage to prevent damage.

6. Sprouting

Infected part of plant: Tubers-external part

Symptoms: Potatoes commonly begin to sprout at harvest, particularly when tubers have remained in the soil for extended periods.

Causes: High temperatures before harvest encourage sprouting. in the field usually signals that the variety is poorly suited to the local cultivation practices (Sonnewald & Sonnewald, 2014).

Management:

- Evaluate new cultivars in the production area for a minimum of three years using standard cultivation practices to identify those that are not fully adapted.

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