Organic Potatoes and Conventional Potatoes

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Interest in organic foods is increasing at a moment when humanity is facing a range of health challenges including the concern that some conventionally produced foods may pose possible adverse effects on human and livestock health. Consumers are showing increasing interest in organically grown potatoes due to their nutritional quality and health protection value.

organic conventional potato quality disease

1. Introduction

Potato (*Solanum tuberosum* L.) is the fourth-largest crop produced worldwide after rice, wheat, and maize at a total annual production of 370, 504, 766, and 1150 million tons for potato, rice, wheat and maize, respectively [1]. Potato is adapted to a large range of geographical environments and climates [2].

Different factors affect the quality of the potato tubers. Nitrogen availability to potato plants is critical to plant growth and development, tuber yield, and quality. Nitrogen form and source are one of the main differences between conventional and organic potato production [3][4][5][6][7]. In addition, to control the numerous potential diseases and stabilize yield in potatoes, commercial growers apply a strict package of pesticides and high rate of nitrogen fertilizer [8][6][9][10][11]. Some undesirable residues can be accumulated in the potato tubers [12] and the soil [13] under conventional farming that can potentially affect human and animal health [14], and organic foods are therefore generally assessed as being healthier and of better taste than conventionally grown crops [15][16].

2. Weed and Pest Management in Potato

Commercial potato growers follow rigorous herbicide application schedules throughout the conventional potato growing season and apply different pesticides. While conventional potato often starts by soil fumigation, organic potato often relies on the biofumigation provided by cover crops such as those of the Brassicacea family. Boydston [17] reported that weeds should be managed in a holistic, intentional, and proactive manner if no herbicide is considered. Under organic farming, crop rotation, cover crop selection, planting pattern and timing in addition to healthy and appropriate seed material are the main aspects to be considered for successful weed management.

3. Nutrient Management

Both organic and conventional systems have adopted cover cropping to improve soil organic matter content and improve soil quality. Bio-fertilizers derived from microorganisms are an alternative to chemical and organic fertilizers. Bio-fertilizers derived from microorganisms are an alternative to chemical and organic fertilizers.

4. Potato Disease Occurrence and Intensity

Disease management is a serious challenge and threat to organic potato management and disease pressure depends on crop physiology and nutrient availability that confers plant tolerance to disease stressors [18][19][20][21][22]. Late blight, caused by *Phytophthora infestans*, is commonly thought to be the factor most limiting yield under organic practices [23]. Common scab (caused by *Streptomyces scabies*), silver scurf (caused by *Helminthosporium solani*), and soft rot (caused by *Pectobatcerium* sp. and *Dickeya* sp.) may be detrimental to organic production systems. Organic farming relies on the agricultural practices to reduce and/or control diseases instead of applying chemical pesticides (Table 1). Larkin and Halloran [24] indicated that disease levels and crop production are influenced by crop management practices. Crop rotation plays a tremendous role in maintaining potato disease incidence at controllable levels. Through a process known as biofumigation, plants within the Brassicacae family produce glucosinolates, which break down into volatile compounds that are toxic to several plant pathogens [25][26][27][28][29][30][31][32].

5. Total Tuber Yield and Marketable Yield

Potato under organic production is subjected to different pests, diseases and limited available nutrients and consequently produces lower tuber yield compared to the conventionally grown potato (Table 1 and Table 2) [5][23][33][34][35][36][37][38][39]. Synthetic fertilizers, pesticides, and other non-organic inputs are not allowed under organic production, which infers challenges in nutrient and pest management under organic farming than conventional systems with lower marketable potato tuber yield in organic production [23][40][41][42]. In various studies, the yield of organically grown potato tubers is lower compared to the yield of the conventionally grown potato by 5–40% [8][43][44][45][46][47][48].

6. Tuber Specific Gravity and Dry Matter Content

Lombardo et al. [48] and Herencia et al. [49] reported higher dry matter content in organically fertilized potatoes, and other studies have also shown higher dry matter content in organically grown potatoes compared to conventional production systems [50][6][51][52]. However, Woese et al. [53] found no difference in potato dry matter content between the organically and conventionally grown potatoes.

7. Sugar and Starch Contents of Potato Tubers

Dramićanin et al. [54] found that starch content in the potato tubers may be considered an important indicator of the type of production, botanical origin, and ripening time and the sugar macro- and micro-components such as fructose, glucose, saccharose, sorbitol, trehalose, arabinose, turanose, and maltose were the main factors for the differentiation of production types, production years, and botanical origin of potato. An increase in total sugars was noted for organic potatoes when compared to conventional potatoes [55][56][57].

8. Nitrate Content of Potato Tubers

Lombardo et al. [6] found that the nitrate content in organically grown tubers was 34% less than in conventionally grown potatoes. Similarly, studies have shown lower amounts of dry matter [50][58], vitamin C [56], total amino acids [8], and total protein in organic potatoes [8][59].

In contrast, Divís et al. [60] reported that mean contents of crude protein and in protein content in dry matter were significantly higher in organically grown potato tubers than in tubers from conventional practice. They found that potato genotype or cultivar was the factor with the highest direct effect on crude protein and protein contents in the potato tubers.

9. Bioactive Compounds and Antioxidants Content in Potato Tubers

Brazinskiene et al. [61] found that the farming system had no significant effect on phenolic acid concentrations in the potato tubers while Keutgen et al. [62] found higher contents of phenolic compounds, flavonoids, and ascorbic acid in organically grown potato tubers than the conventionally grown potato tubers. Romero-Pérez et al. [63] found that flavonoids in plants are strongly impacted by genotype, the agroclimatic conditions, and the cultivation system. Interestingly, Lachman et al. [64] and Vaitkevičienė et al. [65] derived from their study that the colored-flesh potato genotypes have a greater impact on the anthocyanins content than the agricultural production system and they are not detected in white- or yellow-flesh potato tubers [65][66][67].

10. Mineral and Vitamin Contents

Lombardo et al. [68] investigated early potato tuber mineral contents under organic and conventional farming and found that the potato tubers contained more phosphorus (2.8 vs. 2.3 g kg^{-1} of dry matter) and a comparable quantity of both magnesium and copper (on average 250 and 2.6 mg kg^{-1} of dry matter, respectively) under organic farming than the conventional farming. Wszelaki et al. [55] found tuber skin and flesh to have significantly higher concentration in potassium, magnesium, phosphorus, sulfur, and copper under organic management than conventional practices, while iron and manganese contents were higher in the skin of conventionally grown potatoes.

Contradictory data have also been reported between the organically grown and conventionally grown potato with respect to vitamin C content [69][70][71]. Warman and Havard [69] found that there was no significant difference in vitamin C content of the potato tubers grown under organic and conventional practices. Conversely, other studies have reported higher vitamin C content in the organic potato tubers than in the conventional potato tubers [58][56][72].

11. Sensory Characteristics of Potato Tubers

Lombardo et al. [6] found that potato cultivars Ditta and Nicola were well suited to boiling with a delicate taste, firmness, and absence of blackening. Moreover, potato cultivars Arinda, Ditta, and Nicola grown organically had a better sensory performance after frying (strong taste and crisp flesh) than the conventionally grown potato. There was no significant difference in farming systems with regards to consistency, typical taste after boiling [6][56][73], or typical taste after frying; however, organically grown potato tuber showed higher crispiness and lower browning index [6]. Woese et al. [53] found no clear and consistent statements about the high sensorial quality of organic potatoes vs. conventional potatoes from different studies on the organoleptic quality in organic practices compared to the conventional practices.

Potato threshold concentration in solanine of 140 µg g^{-1} causes bitter taste, and solanine concentration greater than 200 µg g^{-1} creates a burning sensation in the throat and on the tongue [74]. Gilsenan et al. [16] found that the conventional potatoes had a lower dry matter content and a slightly softer texture than the organic potatoes. The conventional baked potato was also slightly softer, less adhesive, and wetter than the organic baked potato, but there was no significant difference between the organic and conventional baked potato samples for the sensory attributes of appearance, aroma, texture, and taste acceptability [16]. Brazinskiene et al. [61] reported that odor and taste intensity of the potato samples were not affected by farming practices.

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