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A REVIEW OF BLACKCURRANT CULTURE TECHNOLOGY

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Abstract

As consumers increasingly prioritize health and wellness, the nutritional profile of blackcurrants, with its mix of vitamins, antioxidants, and anti-inflammatory properties, positions them as a valuable addition to a balanced and nutrient-rich diet. Blackcurrants are valued for multiple reasons, with distinct attributes that contribute significantly to their prominence. They are recognized for early fruit-bearing, consistently high yields, and adaptability to diverse climatic and soil conditions. These attributes enhance the economic viability of cultivating blackcurrants, contributing to their widespread popularity among fruit growers. This review aims to provide a screening of the cultivation technologies for the blackcurrant crop, focusing on specific characteristics such as planting, soil management, fertilization, irrigation, pruning, disease and pest management. This paper can be a useful tool for anyone interested in blackcurrant crop technology.

Key words*: disease, fertilization, irrigation, pruning, soil management.*

INTRODUCTION

The blackcurrant, also known as *Ribes nigrum*, is a medium-sized woody shrub that thrives in colder climates, due to its ability to withstand harsh winters, and is valued for its juicy and aromatic berries (Woznicki et al., 2016), although, in certain regions, blackcurrants are grown specifically for their buds, from which a valuable essential oil can be extracted. Due to its high cost, this oil is typically reserved for use in luxury perfumes (De Toro, 1994). The small fruits of the blackcurrant are utilized fresh, can be preserved by freezing, and serve as a valuable raw material for the food and confectionery industries, utilized in the production of juices, wines, jams, jellies, teas, and various other food products and ingredients (Sazonova, 2015; Mattila et al., 2016; Sazonov et al., 2020).

Blackcurrants are relatively easy to propagate and cultivate, with considerations of economic viability also playing a crucial role in these decisions (De Toro, 1994).

Researchers and farmers have crafted precise production systems for numerous temperate horticultural crops worldwide. These systems excel in utilizing labor and chemical inputs effectively. They allow for crops to be cultivated over extended seasons and stored for prolonged periods. Cultivars tailored to particular growing regions have been bred, and pest management strategies have been seamlessly integrated into production methods. Farmers have experienced enhanced efficiency, at least in the short term. Meanwhile, consumers have enjoyed long-term advantages such as reduced prices and a consistent supply (Pritts, 2002).

Furthermore, to advance crop quality and performance, numerous blackcurrant breeding programs have been established across various research institutions globally. These breeding initiatives are widespread and conducted in countries such as New Zealand, Denmark, France, Germany, Japan, the Netherlands, Norway, Poland, Ukraine, the United Kingdom, the United States, Finland, Canada, Sweden, Estonia, Latvia, Lithuania, Romania, Russia, and Serbia. Each of these nations is dedicated to improving blackcurrant varieties through selective breeding methods, focusing on enhancing traits such as yield, resistance to key pests and diseases, and fruit quality suitable for processing, freezing, and fresh

markets (Cortez et al., 2019). Moreover, there is an emphasis on developing cultivars adapted to local soil and weather conditions, as well as mechanical fruit harvesting (Pluta and Zurawicz, 2002b).
This study aims to offer an overview of cultivation techniques for blackcurrant crops.

MATERIALS AND METHODS

This review examines the current state of cultivation technologies for blackcurrant crops, covering key aspects such as planting, soil management, fertilization, irrigation, pruning, and disease and pest management. The goal is to offer insights into the current state of cultivation practices for blackcurrant crops.

RESULTS AND DISCUSSIONS

Planting

Blackcurrant cultivation occupies a relatively modest geographical area, yet it is a crop of considerable economic importance, being increasingly acknowledged for its rich content of vitamin C and anthocyanins (Vagiri et al., 2012). Particularly in Europe, the primary region for blackcurrant cultivation, production is on the rise, and there is a growing interest in extending cultivation to regions and countries where *R. nigrum* is not presently cultivated (Mitchell et al., 2011). Blackcurrants are relatively straightforward to grow, thriving once they've taken root, easily outcompeting weeds. Typically, they're planted in either autumn or spring. Being deciduous, their growth cycle is mainly regulated by light and temperature. Although they endure low temperatures well during dormancy, they're sensitive to spring frosts, particularly during flowering. Yet, some varieties boast genetic resilience against frost damage. If the aim is to prioritize vigorous vegetative growth over fruit production, the risk of frost damage decreases (De Toro, 1994). Blackcurrant has a relatively high chilling requirement and is one of the fruit crops that is potentially at risk in parts of Europe due to the lack of winter chilling forecast in projections of future climatic conditions (Atkinson et al., 2013; Jones et al., 2012). During winter, the buds of numerous temperate woody plants, such as blackcurrant, experience a dormancy cycle to avoid premature bud bursts during brief periods of warmer weather and the ensuing damage to shoots as colder conditions return. This cycle is triggered by a reduction in day length and/or a decrease in temperature (Heide, 1974; Fennell and Hoover, 1991; Olsen, 2010).
The timing of phenological events is crucial for perennial fruit crops, particularly in selecting suitable cultivars for specific regions. If a cultivar fails to respond adequately to environmental conditions, it can result in significant consequences such as reduced annual growth, lower fruit yield, and even plant mortality (Chung et al., 2013).
Cultivating blackcurrants requires substantial labor and resource investment. Establishing and maintaining a blackcurrant crop demands significant time and energy, both human and mechanical. Employing mechanized methods notably decreases the time and effort needed for diverse agricultural tasks, thereby crucially enhancing efficiency and profitability for farmers (Yläranta and Ryynänen, 1981).
Before planting, soil preparation is crucial to eradicate perennial weeds (Karlsson, 1985). Traditionally, blackcurrants are spaced 0.5 to 2.0 meters apart between plants and 2.4 to 4.0 meters apart between rows, facilitating mechanical weed control (De Toro, 1994). This spacing also needs to ensure the formation of compact rows, preventing gaps between plants or overlap of branches among adjacent plants (in cases of insufficient spacing between plants within a row) (Asănică, 2017).In a study conducted by Rousseau and Roy in 2002, different plant spacings of 55, 70, 85, and 100 cm were compared for both cultivars 'Ben Alder' and 'Ben Lomond'. Results showed that for 'Ben Alder', the yield per bush remained consistent across different plant spacings, while for 'Ben Lomond', the yield improved with increased plant spacing. However, the mean weights of fruit did not show significant variation among these spacings, with 'Ben Alder' averaging 105 g and 'Ben Lomond' averaging 163 g. While studies indicate higher fruit and wood production per unit area with increased plant density, the economic implications of denser plantings must be considered. Although the literature suggests that the highest wood and bud yields occur at very high plant densities, this entails significant

establishment costs. Therefore, under commercial conditions, it may be wiser to accept lower yields to minimize plantation costs and enhance long-term profitability (De Toro, 1994).

Soil Management

The importance of soil cultivation in blackcurrant crops is to ensure adequate water and air penetration at the root system level. It involves activities such as weed control, soil aeration, and refining to maintain suitable soil moisture conditions for the plants. These tasks begin immediately after planting and continue throughout the growing season to encourage healthy growth and minimize weed competition. Similar to many other fruit crops, blackcurrants thrive in soils with a favorable texture, such as loam or clay loam. Sandy soils typically have limited water retention capacity, while heavy clay soils can impede the development of their delicate root system (Karlsson, 1985).

Special care should be taken to ensure that tools are used at an appropriate depth to avoid damaging the roots. The number of hoeing per row is typically reduced to 1-2 per year when herbicide application is also employed (Mladin and Mladin, 1992).

Between the rows, the soil can be maintained as bare soil or as grassed (lawn), with regular mowing of the grass. Along the row, mulching can be applied, covering a width of 1.0-1.3 meters with materials like straw, grass, and green plants. Periodically, usually every 2-3 years, the mulch is incorporated into the soil in autumn through deep plowing, enriching the soil with organic matter. Additionally, mulch helps retain moisture in the soil, improve its structure, and delay weed emergence. If possible, black plastic film (P.V.C.) can also be used for soil mulching (Mladin and Mladin, 1992).

Larsson et al. (1997) conducted a study investigating soil microbial parameters in blackcurrant fields under different mulches and cover crops. They found that wood chip mulching boosted basal respiration rates but caused nitrogen deficiency in the bushes despite the initial nitrogen supply. This highlights the importance of assessing microbial parameters for sustainable growing systems and identifying environmental stressors.

In a study by Paunović et al. (2017), three soil management systems (continuous tillage, sawdust mulch, and black polyethylene foil mulch) were compared alongside four blackcurrant cultivars ('Ben Lomond', 'Titania', 'Čačanska crna', and 'Tiben'). Soil management system x cultivar Interactions were noted between soil management systems and cultivars regarding generative potential and physical properties of the cluster and fruit. However, no significant interactions were observed for fruit chemical traits, except for soluble solids content. In another investigation, Paunović et al. (2020) assessed the effects of sawdust and black foil mulches on soil properties, growth, and yield of blackcurrant (*Ribes nigrum* L.) over three years, including a bare soil control group. Sawdust mulch notably increased nutrient content and microbial activity while moderating soil temperature and moisture levels, ultimately leading to improved growth and yield of blackcurrants compared to bare soil and foil mulch treatments.

Additionally, Laugale et al. (2019) conducted a study in Latvia comparing two growing practices: one involving the application of pine bark mulch and the other without mulching, where herbicides were applied in rows across seven blackcurrant cultivars. The study found no significant differences in blackcurrant phenological development, productivity, or fruit size between the two growing practices. However, the use of pine bark mulch led to reduced weed growth and less damage from leaf spot diseases and aphids compared to growing without mulch.

The adequate growth of root systems and the dynamics within the rhizosphere, involving symbiotic mycorrhizal fungi and rhizosphere bacteria, are crucial for the healthy development of plants in both natural environments and agricultural settings such as orchards and berry fruit plantations (Sas-Paszt and Mercik, 2004; Sas-Paszt and Żurawicz, 2004, 2005). In a 2013 study led by Derkowska and colleagues, the impact of mycorrhization and mulching on arbuscular mycorrhizal fungi colonization in 'Ojebyn' and 'Tiben' blackcurrant bushes was investigated. Root samples were collected from various experimental combinations (control, peat substrate, bark, sawdust, manure, compost, mycorrhizal substrate, and straw) to assess mycorrhizal frequency. The results indicated that the highest values of mycorrhizal frequency and intensity were recorded in the roots of 'Tiben' bushes inoculated with the mycorrhizal substrate (F = 37.78%, M = 0.38%) and those mulched with sawdust (F = 21.11%, M = 0.21%).

Fertilization

In modern, environmentally friendly farming, it's important to optimize nutrient uptake from both organic (like natural mulches) and organo-mineral fertilizers while minimizing mineral fertilizer and chemical pesticide use to maintain ecological balance. To achieve high yields sustainably, traditional intensive farming methods, relying heavily on mineral fertilizers and pesticides, can be replaced with organic practices like using manure, straw, and natural bioproducts such as biofertilizers and composts enriched with beneficial microorganisms (Mladin and Mladin, 1992). Research on organic farming methods aims to produce high-quality crops while safeguarding the environment and human health (Derkowska et al., 2013).

Natural mulches serve as a mineral source (including C, N, and P) for plants following the mineralization of organic matter, with soil macro- and microorganisms deriving energy and essential minerals from organic matter, thus enhancing soil biological activity (Esperschütz et al., 2007). Moreover, humus compounds in mulches significantly affect crop physiology, influencing processes such as water balance, respiration, and photosynthesis (Ngosong et al., 2010).

Although blackcurrants are less demanding in soil fertilization, systematic application of organic and chemical fertilizers leads to large and consistent fruit yields of exceptional quality year after year, significantly extending the economic exploitation period of plantations. Fertilizers are applied judiciously based on the soil's nutrient content and the plants' nutritional requirements. Like other fruit shrub species, blackcurrants require higher potassium and phosphorus levels from the beginning of flowering until fruit ripening, while nitrogen is most critical in the early stages of vegetation for plant growth (De Toro, 1994).

The enhancement of depleted humus and nutrient levels in the soil involves incorporating manure along with variable amounts of nitrogen, phosphorus, and potassium, adjusted according to the soil's nutrient composition. Research has established fertilization ratios for different species and groups of species, with a specific N:P:K ratio of 2:1:3 recommended for blackcurrants. The choice of fertilizer depends on the soil's pH, with acidic fertilizers like ammonium sulfate, superphosphate, and potassium sulfate used for alkaline soils, and basic fertilizers preferred for acidic soils. Manure and less soluble fertilizers are applied in autumn and incorporated into the soil through plowing (Mladin and Mladin, 1992).

Chemical fertilizers can be applied singly or in various mixtures, and nitrogen-based fertilizers are typically applied at the start of vegetation in March. A second fertilization may be done in June if nitrogen deficiency is observed, with nitrogen fertilizers spread evenly along rows or around plants and incorporated into the soil (Mladin and Mladin, 1992).

In recent times, there has been an increasing focus on enhancing plant nutrition through foliar fertilizers. This method is viewed as a promising and environmentally friendly approach to boost crop yield and nutrient utilization efficiency. The targeted application of foliar fertilizer tailored to each variety holds significant promise for maximizing specific yield potential and overall profitability (Vâtcă et al., 2020a).

Foliar fertilizers containing macro and micronutrients are used during spraying against diseases and pests, typically before flowering, 1-2 weeks after flowering, and/or during fruit growth and maturation. These fertilizers address deficiencies observed in plant leaves and other parts, providing nutrients like boron, zinc, iron, and manganese (Mladin and Mladin, 1992). In a recent study, Vâtcă et al., (2020b) tested the specific reaction of three blackcurrant varieties to foliar fertilizers to obtain two growth models. The conclusion was that each variety has a specific response to fertilizers.

Soil cultivation and nitrogen provision are crucial aspects of organic farming, especially when organic fertilizers are required. However, obtaining organic manure from other organic farms can be difficult in practice. Consequently, cover crops are seen as a practical alternative nitrogen source, providing a potential option for organic fertilization on farms focusing on organic blackcurrant production (Lindhart, 2002).

Lindhart (2002) used various mulching methods in an unsprayed field trial to assess their impact on organic blackcurrant production about soil cultivation and nitrogen supply. Mechanical weed control was performed along the bush rows, and cover crops such as vetch (*Vicia sativa*), rye (*Secale cereale*), perennial white clover (*Trifolium repens*), and ryegrass (*Lolium perenne*) were utilized in the trial. Throughout the experimental process, each of the cover crops supplied an adequate amount of nitrogen.

A study by Polunina et al. (2023) investigated the impact of fertilization and plant care on the productivity of a particular blackcurrant variety. The findings demonstrated that optimal conditions, including mineral fertilization, Riverm 5% foliar application, clean fallow, and straw mulching, contributed to improved cluster development. Additionally, combining Riverm 5% foliar application with mineral fertilization resulted in increased blackcurrant yield while Medelyaeva et al. (2023) conducted a study in the Tambov region on leached chernozems, examining the impact of foliar feeding with Aquarium 6 at a concentration of 0.5%, trace elements at a concentration of 0.1%, and urea at a concentration of 1% on the spread of pests and diseases in blackcurrant plantings. The findings indicate a positive effect of these treatments on reducing the number of kidney mites and the development of powdery mildew compared to the control group.

Irrigation

In its natural environment, the blackcurrant plant thrives as an understory shrub, often found beneath taller trees or in partially shaded sections of forests. This habitat offers the plant partial shade and sufficient moisture. The findings indicate that blackcurrant plants inherently possess a low tolerance to drought conditions (Woznicki et al., 2016). In regions with insufficient rainfall, irrigation becomes essential for successful crop growth. The frequency of irrigation sessions varies based on factors like resource availability, soil moisture levels, root system development, growth stages, and specific requirements of the plant species. For blackcurrants, maintaining soil moisture levels at 70-80% throughout the growing season is crucial for optimal growth and fruiting. Additional watering is required at key stages such as inflorescence emergence, end of flowering, start of fruit development, fruit ripening, and post-harvest irrigation to support bud formation and winter preparation.

In the context of blackcurrant cultivation, irrigation technology encompasses the precise application of water, both in terms of quantity and timing, utilizing sophisticated systems and techniques. This approach is crucial for ensuring the optimal growth and development of blackcurrant plants throughout their lifecycle. Irrigation methods can vary depending on resource availability, with options including sprinkler, micro-sprinkler, or drip systems tailored to the specific needs of the crop (Mladin and Mladin, 1992).

Advanced irrigation systems, such as drip irrigation or micro-sprinklers, are commonly employed in blackcurrant cultivation to deliver water directly to the root zone of plants. This targeted application minimizes water wastage through evaporation or runoff and promotes efficient water uptake by the plants. They also enable precise control over the application of water. This level of control is instrumental in mitigating the risks associated with over- or under-watering, which can have detrimental effects on plant health and yield.

In 2002, Rolbiecki et al. published a study aimed at evaluating the effects of drip and micro-sprinkler irrigation on the growth and yield of blackcurrants in light soil. Their findings highlighted the critical role of water in determining yield and quality, with irrigation significantly improving growth and berry production. The study conclusively demonstrated that successful blackcurrant cultivation in such soil and climate conditions requires irrigation.

Trickle irrigation systems have evolved and become available in various types since their introduction. Although these systems find applications in diverse crops, they are notably advantageous and frequently employed in perennial crops. This assertion is corroborated by studies conducted by Karmeli and Keller in 1975, as well as by Nes et al. in 2002.

Additionally, high-density plantations typically have greater water requirements compared to those with normal density (De Toro, 1994).

One advancement in irrigation technology is the use of soil moisture sensors, which provide real-time data on soil moisture levels, allowing farmers to adjust irrigation schedules accordingly to prevent water stress and avoid overwatering. Modern irrigation controllers can also utilize weather data to automatically adjust irrigation schedules based on local climate conditions, further optimizing water usage (Muneeb et al., 2023).

Fertigation technology, where fertilizers are injected directly into the irrigation system, has become increasingly common in blackcurrant cultivation. This method ensures that plants receive essential nutrients directly at the root level, minimizing waste and runoff while promoting efficient nutrient utilization and environmental sustainability (Muneeb et al., 2023).

The potential of implementing automation through an Internet of Things (IoT) system to enhance traditional surface irrigation systems. Automated systems can operate with minimal manual intervention, utilizing timers, sensors, computers, or mechanical devices to streamline functionality and address issues such as labor demands and water application inefficiencies.

Numerous studies have indicated that implementing automation in irrigation projects, utilizing advanced technologies like intelligent irrigation controllers and wireless sensor networks, can result in substantial water savings, potentially up to 38% (Al-Ghobari et al., 2017; Bowlekar et al., 2019). Various types of soil moisture sensors including tensiometers, gypsum blocks, granular matrix sensors, time-domain reflectometers, and dielectric probes, are available for measuring soil moisture levels, which can be used manually or integrated into automatic irrigation control systems via an IoT system to optimize water application. (Bowlekar et al., 2019; Hardie, 2020; Vera et al., 2021; Pramanik et al., 2022). The sensors detect the advancement of water and provide a signal to halt the flow accordingly.

Pruning

Blackcurrant belongs to the group of fruit shrubs composed of woody plant species that form numerous stems of varying vigor, originating from the root collar area, and giving the appearance of a more or less compact bush. The classic training system for fruit shrubs typically involves using bush-type training forms, which do not require support or trellising of the plant growth. This system has the advantage of lower establishment and maintenance costs (Asănică, 2017).

New crown designs have been implemented for fruit bushes to meet the demands of intensification and enhance fruit quality. The development of these new crown structures represents a significant advancement in modern horticulture. In this regard, Stanislav Strbac applied and tested the vertical cordon training system for black and red currants in Norway (Asănică, 2017).

The first 2-3 years after establishing the plantations involve a series of activities focused on promoting rapid plant development and achieving early yields.

Increased production during the initial years of cropping could potentially be achieved through the implementation of management practices that influence the quantity and length of shoots generated in the first season (Rhodes, 1986).

To facilitate maintenance and harvesting, a flattened bush form is adopted for the plants.

Various activities are carried out during plant management, aligned with the chosen cultivation approach and the biological needs of the fruit bushes to ensure proper growth and fruit production. Pruning systems include formation pruning, fruiting pruning, and rejuvenation pruning.

a) ***Formation pruning***: For species grown as bushes, formation pruning begins at planting by shortening stems to 10-12 cm. After the first year, 3-5 growths are stopped at each plant and shortened to 30-40 cm. After three years, in autumn or spring, 8-14 growths of different ages are left at each bush, eliminating weak, thin, broken, or diseased ones. By the fourth year, the bush is considered formed, consisting of 15-20 stems of varying ages, well-positioned to allow light penetration and facilitate soil maintenance.

b) ***Fruiting pruning***: Conducted during the fruiting period, it aims to maintain a balance between growth and fruiting processes. Aged stems (over 4-5 years old) are removed and replaced with new growth, while small growth stems, broken or diseased branches and those growing towards the row interval are suppressed. Balancing young and old wood is essential for optimal production.

c) ***Regeneration pruning***: Applied when plants decline to prolong their economic fruiting lifespan. For bush-shaped plants, all stems over one year old at the base are removed, and the remaining stems are pruned to 4-6 buds. Weak growth and poorly positioned stems within the bush are eliminated. Fertilization with farmyard manure, superphosphate, and potassium salt is recommended along with regeneration pruning. Nitrogen-based fertilizers are applied during the vegetation period of the following year. Pruning is done using sharp tree pruning shears and wounds larger than 23 cm in diameter are coated with mastic or oil-based paint to promote rapid healing (Mladin and Mladin, 1992).

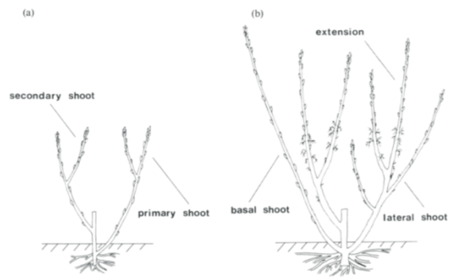
Song et al. (2000) recommend a specific pruning regimen for blackberry plants. Initially, after planting, they suggest cutting the shoots at the base, leaving 5-7 buds untouched. In the second spring 4-5 shoots should be headed back, leaving 25% of the length of the shoot. Finally, after the third year of growth, it advises thinning out the old fruiting branches to maintain plant health and encourage new growth. A study conducted in Lithuania by Sasnauskas and Buskienė (2006), examined the effects of pruning on four blackcurrant cultivars. Pruning induced shoot growth and significantly boosted growth vigor by 40-70% compared to unpruned controls. Pruning at a height of 15-20 cm above the soil led to a yield increase of 16-50% compared to unpruned controls. The average fruit weight after pruning increased by 30%.

To reduce the time spent on maintenance pruning, one effective option is to utilize various pruning devices, as demonstrated in the study by Dalman in 1993. In this study, a pruning device mounted on the side of a tractor for removing bending branches significantly decreased the need for manual pruning with hand tools. Furthermore, it was found that the need for manual pruning was minimal when mechanical pruning was performed every autumn, and old and injured branches were pruned by hand every third autumn. These findings suggest that regular use of mechanical pruning devices can significantly reduce manual effort and streamline the maintenance process in blackcurrant plantations (Dalman, 1993).

Rhodes (1986), conducted a comprehensive three-year study in Canterbury, focusing on the growth and fruit yield of blackcurrant plants propagated from unrooted cuttings. During the first season, buds sprouted into primary shoots, some of which developed into secondary shoots (Figure 1a).

In the subsequent season, both primary and secondary shoots bore fruit, leading to their classification as primary and secondary canes. This period witnessed the extension of these canes and the emergence of lateral shoots from axillary buds, alongside the appearance of basal shoots (Figure 1b).

Moving into the third season, shoots from the previous year bore fruit, now classified as extension, lateral, and basal canes. The growth patterns observed were akin to those witnessed in the second season.



Source: Rhodes, 1986

Figure 1. Blackcurrant plant at (a) the end of the first season after planting, and (b) the end of the second season, after the first harvest of fruit

Disease and Pest Management

Several pests affecting blackcurrants are caused by insects, fungi, or viruses. Around 14 different viruses or virus-like diseases have been reported in *Ribes* species worldwide (Jones, 1992; 1995a). Some of these are confined to particular regions and appear sporadically in crops or limited areas. Among them, Blackcurrant Reversion Disease (BRD) and its vector gall mite (*Cecidophyopsis ribis*) are the most serious pests threatening blackcurrant production (Pluta et al., 2002a), particularly noteworthy for their widespread occurrence and economic impact. BRD is prevalent worldwide, where blackcurrants are grown commercially (Bremer, 1983; Ravkin and Chertovski, 1989; Wood, 1991; Trajkovski and Anderson, 1992; Jones 1992; 2002). The disease has been known for nearly a century. However, the causal virus was identified only a few years ago (Jones et al., 1995b; Lemmetty et al., 1997, 1998).

The symptoms include changes in the appearance of leaves and flowers, as well as a reduction in flower fertility, which can lead to significant losses in production. Due to the significant damage caused by the gall mite vector, which induces galling and sterility of buds on blackcurrant plants (Adams and Thresh, 1987), cultivation of blackcurrants has completely ceased in certain regions of New Zealand and Europe (Jones, 2002)

Gooseberry Vein Banding Disease (GVBD) is another widespread issue, affecting various *Ribes* species and cultivars worldwide, representing a significant virus-like disease in these plants. It is considered the second most prominent virus-like disease, with Blackcurrant Reversion Disease (BRD) being the most significant. GVBD is characterized by noticeable chlorosis along the leaf lamina near the main veins in *Ribes* plants. Additionally, it is known to lead to substantial decreases in plant vigor and yield. This viral disease is likely transmitted by aphids and results in significant declines in plant growth and yield. Control measures include using healthy planting material, removing infected plants, and managing aphid populations to prevent disease spread (Jones et al., 2001).

The identification and characterization of viruses and the development of a sensitive PCR assay have enabled detection within 2 days, making it useful for plant introduction and quarantine programs. This technology also offers new opportunities to study epidemiology, virus-vector relationships, resistance identification in *Ribes* germplasm, and inheritance mode, potentially improving crop control measures (Jones, 2002).

Insects such as slowbugs (*Plesiocoris rugicollis*), hymenoptera (*Pachynematus pumilio*), moths (*Euhyponomeutoides albithoracellus*), *Lampronia capitella*, *Synanthedon tipuliformis*, *Resseliella ribis*, and the aphid (*Hyperomyzus lactucae*), which overwinter in various parts of the plant, are expected to have their life cycles interrupted by annual shoot-cutting.

However, pests and viruses spread by mites are not easily controlled by yearly shoot-cutting. Fungi, whose spores overwinter on fallen leaves or other plant debris, present a different challenge. Fungi may proliferate under favorable conditions, especially in high-density and well-fertilized cultivation. *Sphaerotheca mors-uvae*, causing powdery mildew, is a significant fungal disease, thriving in dry weather; its spores overwinter in fallen leaves and buds, though some varieties exhibit resistance.

Blackcurrants may exhibit susceptibility to white pine blister rust (*Cronartium ribicola*) and leaf spot infections (*Gloeosporidiella ribis*), which occur annually and can lead to significant leaf drop by September. Additionally, severe infections of American gooseberry mildew (*Sphaerotheca mors-uvae*) can adversely affect yields, resulting in minimal shoot growth. (Lindhart, 2002)

Other fungi such as leaf spot (*Septoria ribis*), *Puccinia caricina*, and grey mold (*Botrytis cinerea*) also pose challenges, particularly in low-density cultivation. *Septoria ribis* infections are prevalent among currant species (Parikka et al., 2002). These diseases are typically managed through chemical control methods in spring, involving one spray before flowering and another within a week after flowering (Tapio, 1972). The interval between sprays may vary, with several weeks between applications depending on weather conditions, although later treatments are not recommended (Parikka et al., 2002).

CONCLUSIONS

The scientific evidence underscores the significant advantages of blackcurrant cultivation technologies, which have been demonstrated to offer a range of benefits. The increased mechanization of the cultivation process translates to heightened efficiency and reduced labor costs.

The adoption of various soil management technologies, alongside reduced water and pesticide usage through modern applications, contributes to aligning with sustainable agricultural practices and environmental conservation efforts.

Their versatility and resilience, characterized by early fruiting, high yields, and adaptability to varying environmental conditions, contribute to their widespread popularity among growers and expand cultivation options across different regions.

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