AGRI
INMA

Sustainable Agriculture and Environmental Protection
Vol. 6 / No. 1 / 2025

Review

A COMPARATIVE EVALUATION OF ORGANIC AND CHEMICAL FERTILIZATION EFFECTS ON SHRUB FRUIT PRODUCTIVITY

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Keywords: *aquaponic installations, recirculation systems, wastewater treatment, water filtering,*

Abstract: Soil is an essential but finite resource for plant growth and performance. It deteriorates rapidly in intensively used agricultural areas, but its evolution and recovery are extremely slow. As a result, the deficit of nutrients and organic matter in agricultural systems is at a critical level. Excessive application of mineral fertilizers to provide plants with macronutrients (N, P, K) and micronutrients (Fe, Cu, Mn, Zn,) can be problematic, given that these products may include harmful substances, are often expensive and can have a negative impact on the environment. The amount of organic waste generated in urban and industrial environments is also constantly increasing worldwide, which has led to the development of ecological solutions to manage this waste, such as composting. Thus, the need to balance economic and environmental aspects has led to an increased use of recycled waste, which is transformed into organic fertilizers, capable of satisfying plant needs by releasing nutrients, while contributing to improving soil quality. This paper presents a parallel between the application of organic substances as a feasible option instead of chemical fertilizers, in fruit shrub crops by examining their impact on soil fertility, plant nutritional health, and production yield.

1. Introduction

In recent decades, due to the continuous development of the world population and the increasing demand for food, intensive agriculture has been adopted. Thus, the excessive use of chemicals for soil fertilization and increased production has adversely affected the maintenance of soil health and crop yield [1]. In this sense, contemporary horticulture must be re-evaluated, and diversify its methods, by including opportunities and technological innovations from various fields. These could include, for example, the biotechnology-based industry, in an approach focused on the circular economy [2]. One of the challenges of sustainable agriculture is to reduce the large amounts of fertilizers used without negatively affecting the nutritional needs of plants and without compromising crop production and the quality of plant products. In particular, the excessive use of chemical fertilizers has caused soil degradation (e.g., increased salinity or acidification), pollution of surface and groundwater, and an increase in greenhouse gas emissions [3]. In addition to the effects of inorganic substances on the chemical composition of the soil and certain environmental aspects related to climate change, the decrease in the activity of microorganisms must also be analysed [4]. As in other branches of agriculture, an ecological approach is needed in fruit tree crops, by introducing organic substances to support the maintenance of soil health, implicitly the development of crops and the quality of fruits. Among the best-known fruit trees, there are blackberries, blueberries, raspberries. These fruits are increasingly appreciated by consumers, due to their beneficial effects on human health, supported by numerous scientific evidence.

Consumer awareness of the importance of protecting the environment, but also of food quality, has determined an upward trend in organic production. Due to this trend, most research has focused on the effects of organic production [5]. The use of fertilizers at key moments in the development of plant products is essential for increasing production. Other important aspects are related to the ideal amount and method of application (directly in the soil, foliar, by spraying), thus influencing the rate of absorption of fertilizers by plants. [1,6]. Chemical fertilizers are used for their ability to act quickly and influence soil properties, fruit quality, but also their nutrient composition [7]. Although they have a number of benefits in agriculture, without controlled management, excessive application of chemical fertilizers can have numerous negative effects. In addition to reducing sustainable crop productivity, the reduction of friendly predators can increase the risk of residual accumulation in the soil and groundwater contamination [8, 9].

For example, studies have shown that simply increasing the application of nitrogen-based fertilizer (which is the most important nutrient) not only does not generate significant economic benefits, but also causes imbalances in plant nutrition [10]. In order to maintain soil fertility and crop development, while protecting the environment, attention has been directed towards addressing organic alternatives. Numerous studies present the benefits of applying organic fertilizers, suggesting a consistent reduction in soil-borne diseases, increased plant defence mechanisms, and an increase in both the diversity of microorganisms and biological activity in the soil [11]. Common organic sources of nitrogen range from agricultural waste to manure, which is a relatively cheap and abundant source of nitrogen [12]. Among the significant benefits of organic fertilizers are the growth of beneficial microorganisms in the soil and the improvement of its physical characteristics and fertility, but the major disadvantage remains the inability to quickly respond to the nutritional needs of plants for nitrogen, due to the slow rate of nitrogen mineralization [13].

2. Chemical Fertilizers

The continuous increase in the consumption of nutrient-rich fruits has led to the intensification of crops to meet market demands.

Blueberries, rich in antioxidants, are appreciated by consumers due to their beneficial effects on human health. It has been shown that fertilization is necessary in blueberry cultivation to ensure adequate productivity [14]. Scientific research supports that chemical fertilizers obtain the highest values on the nutritional (high content of N, P, K) and productive parameters of blueberries [15]. The main effects and interactions between fertilizers used in the soil (nitrogen, phosphorus and potassium) and the optimal level of fertilizer application for the vegetative and crop stages, leaf nutrients and berry yield of wild blueberry (Vaccinium angustifolium Ait.) were investigated. The results of the study emphasize the importance of applying balanced fertilization, with the optimal fertilizer doses being presented in Table 1.

Table 1

Appropriate fertilizer application rates for the vegetative and crop stages of wild blueberry [6].

Application period			
Fertilizer applied	**Pre-emergence of shoots in the growing year Kg/ha^{-1}**	**The leaves of the vegetative year %**	**The leaves of the crop year %**
N	30	1,8-2,03%	1,5-1,7%

P	45	0,155-0,160%	0,158-0,164%
K	30	0,53-0,55%	0,535-0,545%
Ca	-	0,44-0,46%	0,465-0,495%
Mg	-	0,115-0,13%	0,115-0,125%
B	-	24-26 ppm	18-22 ppm

Another study suggests that foliar applications of Ca and B did not lead to significant increases in fruit quality, yield estimates, or fruit firmness (such as berry firmness and weight) during treatments in northern blueberry (Vaccinium corymbosum L.) [16]. In Canada, the long-term effects of annual nitrogen (N) applications at different rates by broadcast (BROAD) and fertigation (FERT) techniques on soil properties and blueberry yield were evaluated. From the results presented, it can be concluded that fertilizing mature plants with ammonium sulfate above the suggested rate is not a sustainable choice for blueberry cultivation, by decreasing production and increasing soil electrical conductivity (EC) beyond acceptable limits, Table 2.

Table 2

Total berry yield (kg ha−1) with annual N applications by fertigation (FERT50, 50%; FERT-100, 100%; FERT-150, 150%; FERT-200, 200%) and broadcast (BROAD50, 50%; BROAD-100, 100%; BROAD-150, 150%; BROAD-200, 200%) methods for blueberries (Vaccinium corymbosum) during two production periods (2010–2012 and 2013–2015) [8].

First period	2010	2011	2012	Second period	2013	2014	2015
CONT[a]	2375	6351	9563	CONT	14696	21826	20613
FERT-50	2765	7722	13786	FERT-100	20746	24672	32444
FERT-100	2825	8340	13380	FERT-150	20397	23369	27211
FERT-150	3146	9431	14908	FERT-200	20019	23492	22873
BROAD-50	2552	6779	11694	BROAD-100	19461	23501	30503
BROAD-100	2442	7194	11629	BROAD-150	20615	24860	29620
BROAD-150	2598	8029	14040	BROAD-200	21345	25441	29908
SEM[b]	*453*	*1309*	*1331*		*1459*	*1721*	*1557*
P values	*0.667*[c]	*0.305*	*0.005*		*0.001*	*0.447*	< 0.001

[a] CONT: control (0 kg N ha^{-1}).
[b] SEM: standard error of the mean.
[c] Probability values

The aim of a study was to determine the main effects and interactions of N-P-K fertilizers applied to the soil on the development, growth and production of wild berries. The results obtained recommended the use of 35 kg ha -1 N, 40 kg ha -1 P and 30 kg ha -1 K at the beginning of shoot germination each year for low bush blueberries in Scotland. The proposed rates improved the number of flower buds, berries per stem and berry productivity, without causing excessive stem growth (stem lengths over 20 cm are considered excessive and lead to low harvest efficiency) [17]. Inorganic nitrogen fertilizers are commonly found in commercial blueberry plantations. However, this form of nitrogen can stimulate excessive growth of various weed species, which can ultimately reduce the benefits obtained from fertilization. Therefore, a low crop density is recommended to maximize fruit production and below 25 plants m-2 to optimize the efficiency of inorganic N fertilization [18].

Understanding the annual accumulation of nutrients and the rapid absorption phases facilitates a more efficient management of fertilization programs. Thus, red raspberry (Rubus idaeus) and blackberry (Rubus ssp. rubus) plantations were analysed to find out the required nutrient supply and the efficiency of fertilizer absorption. In addition to N, the other nutrient largely removed during fruit harvesting and pruning is K (Tables 3 and 4).

(Table 3)

Removal of nutrients in summer-bearing 'Meeker' red raspberry and 'Black Diamond' and 'Marion' trailingblackberry from pruning of senescent floricanes in August or September (raspberry) or mid-August (blackberry), and for leafsenescence on primocanes in autumn (raspberry only)[19].

Crop and activity	Macronutrients (lb/acre)^z						Micronutrients (oz/acre)^z				
	N	P	K	Ca	Mg	S	B	Cu	Mn	Zn	Fe
Summer-bearing raspberry Floricane pruning											
August	17.3	1.2	9.4	15.3	3.1	0.9	1.7	0.2	2.1	0.5	—
September	11.8	0.9	6.5	12.7	2.4	0.8	1.0	0.2	2.1	0.4	—
Leaf senescence	9.5	0.7	4.2	5.0	2.1	0.4	0.8	0.1	1.2	0.1	—
Trailing blackberry Floricane pruning											
'Black Diamond'	27.4	4.2	35.8	25.4	4.2	1.8	0.1	0.02	1.1	0.2	0.7
'Marion'	35.7	4.8	36.8	35.1	7.7	2.4	0.3	0.02	1.3	0.2	0.9

^{z}1lb/acre=1.1209kg·ha^{-1}, 1 oz/acre = 7 0.0532 g·ha^{-1}, N = nitrogen, P = phosphorus, K = potassium, Ca = calcium, Mg = magnesium, S = sulfur,B = boron, Cu = copper, Mn =manganese, Zn = zinc, Fe = iron.

Table 4

Removal of nutrients per ton (fresh weight) of harvested fruit in summer-bearing 'Meeker' red raspberry and 'BlackDiamond' and 'Marion' trailing blackberry [19].

Crop	Macronutrients (lb/ton)^z						Micronutrients (oz/ton)^z					
	N	P	K	Ca	Mg	S	B	Cu	Mn	Zn	Fe	Al
Summer-bearing raspberry	3.49	0.47	3.04	0.32	0.37	0.17	0.15	0.03	0.11	0.07	—	—
Trailing blackberry												
'Black Diamond'	2.89	0.53	3.01	0.45	0.27	0.20	0.05	0.02	0.19	0.06	0.15	0.40
'Marion'	2.87	0.63	3.02	0.73	0.37	0.19	0.05	0.03	0.23	0.08	0.19	0.43

^{z}1 lb/ton = 0.5000 kg·Mg^{-1}, 1 oz/ton = 31.2500 g·Mg^{-1}, N = nitrogen, P = phosphorus, K = potassium, Ca = calcium, Mg = magnesium, S = sulfur, B = boron, Cu = copper,Mn = manganese, Zn = zinc, Fe = iron, Al = aluminum.

Fertilization at different rates of N can affect the concentration of other nutrients not only in the leaves but also in other parts of the plant. Monitoring plant development and nutrient levels is suggested to adjust fertilization plans [19]. The response of 'Meeker' red raspberries grown in Washington, USA, to different rates of N fertilizer was evaluated to inform future nutrient management guidelines. Urea treatments (46% nitrogen (N)) were applied to the surface of raised beds of 'Meeker' raspberry plots established at controls, low, medium and high rates (0, 34, 67 and 101 kg N ha −1 , respectively) in 2019 and 2020, Table 5.

Table 5

Berry weight, average plant yield and total yield of Florican red raspberry 'Meeker' fertilized with different rates of nitrogen (N) fertilizer, 2020 [20].

Treatment	Berry Weight (g)	Average Plant Yield (kg Plant^{-1})	Total Yield (kg Plant^{-1})
N fertilizer rate (A)			
Control (0 kg N ha^{-1})	3.02 ^{z}	0.311	0.933
Low (34 kg N ha^{-1})	3.03	0.385	1.15
Medium (67 kg N ha^{-1})	3.10	0.325	0.977
High (101 kg N ha^{-1})	3.10	0.349	1.05
Harvest time (B)			
Early	3.35 a	0.212 c	- ^{y}
Middle	3.08 b	0.542 a	-
Late	2.75 c	0.274 b	-
Significance ^{x}			
N fertilizer rate (A)	0.78	0.85	0.85
Harvest time (B)	<0.0001	<0.0001	-
Interaction A × B	0.55	0.85	-

z Data are shown as means; means followed by a different letter within a group are significantly different at p ≤ 0.05 using a comparison of means with a Tukey's honestly significant difference test. y (-) Not applicable as total yield was calculated over the entire harvest season. x Significance was determined at p < 0.05.

The lack of a N fertilizer response for most of the measured variables led to the rejection of the experimental hypothesis that plants receiving higher N fertilizer rates exhibit improved performance [20]. Following a comprehensive evaluation of principal component analysis and multifactorial analysis of variance, the best fertilization combination for high-yielding and good-quality blueberries was found to be N1P2K2 (F2). That is, the best fertilization effect was that including N 100 g/plant, P2O5 25 g/plant, K2O 50 g/plant applied as ammonium sulfate (472 g/plant). g/plant), superphosphate (41 g/plant), and potassium sulfate (79 g/plant), respectively [21].

3. Common organic sources of nitrogen

The main sources of nitrogen for organic farming are compost, green manures, natural fertilizers and residues from biological processes, so the total release of nitrogen in plant-available forms is related to the mineralization capacity of the soil together with nutrient factors (energy, C and N content, among others) and soil factors (temperature, moisture, oxygen, acidity), as reported by several authors [22]. Common organic sources of nitrogen range from cover crops to manure (or manure-derived products) and fish by-products, vegetable hydrolysate (e.g. corn liquor), molasses, vegetable and animal by-products (e.g. vegetable-based meals such as soybean meal and animal-based meals such as feathers, bones). Although manure is an abundant and inexpensive source of nitrogen, USDA organic regulations permit the use of manure only with a pre-harvest restriction (90 days for blackberries) [12, 23].

Fertilization of blueberries has been the subject of much research. Blueberries prefer acidic, well-drained, moist, humus-rich soils that are lower in nutrients than other fruit species [24]. The literature shows that adding composted yard waste to mulch increased soil and leaf potassium (K) but had little effect on plant nitrogen (N). However, when this compost was used as a pre-plant amendment, soil pH increased to levels above the recommended range for blueberries [25]. It has been hypothesized that composted wood chips (CRW) is an effective alternative organic fertilizer for blueberry plants when weeds are present, as ericaceous shrub species are generally more efficient in using organic nitrogen than herbaceous weed species [18]. A long-term (10-year) study presents the influence of the choice of organic production system on yield and costs and economic profitability of highbush blueberry (Vaccinium corymbosum L.). Thus, treatments included planting method (flat or raised beds), fertilizer source (granular feather meal or fish solubles) and rate ('low' and 'high' rates of 29 and 57 kg ha -1 N during establishment, gradually increased as the planting matured to 73 and 140 kg ha -1 N, respectively), mulch (sawdust, composted yard waste covered with sawdust (compost + sawdust), or black woven polyethylene ground cover (weed mat)], and cultivar ('Duke' and 'Liberty'), Table 6.

Table 6

Results of analysis of variance for the impact of year (2008–16; n = 9 for yield; n = 7 for fruit quality variables), planting method (raised bed or flat ground; n = 2), fertilizer source and rate (feather meal or fish solubles at low or high rate of nitrogen; n = 4), mulch (sawdust, yard debris compost topped with sawdust, weed mat; n = 3) and cultivar (Duke, Liberty; n = 2). Actual P value provided unless nonsignificant [26].

Treatment	Yield (kg/plant)	Berry wt^z (g)	Berry diam (mm)	TSS^y (%)	Firmness (g·mm^{-1} deflection)
Year (yr)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Planting Method (PM)	<0.0001	<0.0001	0.001	<0.0001	NS
Yr · PM	<0.0001	0.0027	NS^x	NS	NS
Fertilizer (Fert)	<0.0001	0.0031	0.002	<0.0001	<0.0001
Yr · Fert	<0.0001	0.0113	0.0001	NS	<0.0001
PM · Fert	NS	NS	NS	0.0477	NS
Yr · PM · Fert	NS	NS	NS	0.0131	0.0404
Mulch	<0.0001	0.0095	NS	NS	0.0088
Yr · Mulch	0.0042	NS	NS	<0.0001	<0.0001

PM · Mulch	0.001	NS	NS	NS	NS
Yr · PM · Mulch	0.0116	NS	NS	NS	NS
Fert · Mulch	<0.0001	NS	NS	NS	NS
Yr · Fert · Mulch	0.0014	NS	NS	NS	0.0455
PM · Fert · Mulch	NS	NS	NS	NS	NS
Yr · PM · Fert · Mulch	NS	NS	NS	0.0308	NS
Cultivar (cv.)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Yr · cv.	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PM · cv.	<0.0001	NS	NS	<0.0001	NS
Yr · PM · cv.	0.012	NS	0.0027	NS	NS
Fert · cv.	<0.0001	0.0002	0.0002	<0.0001	<0.0001
Yr · Fert · cv.	<0.0001	0.0173	NS	0.0011	0.0006
PM · Fert · cv.	0.0002	NS	NS	0.0379	NS
Yr · PM · Fert · cv.	NS	NS	NS	NS	NS
Mulch · cv.	<0.0001	NS	0.0005	NS	NS
Yr · Mulch · cv.	0.0017	0.0085	NS	0.0324	NS
PM · Mulch · cv.	0.0005	NS	NS	NS	NS
Yr · PM · Mulch · cv.	0.0386	NS	NS	NS	NS
Fert · Mulch · cv.	<0.0001	NS	NS	NS	NS
Yr · Fert · Mulch · cv.	NS	NS	NS	NS	NS
PM · Fert · Mulch · cv.	NS	NS	0.043	NS	NS
Yr · PM · Fert · Mulch · cv.	NS	NS	NS	NS	NS

The research results demonstrate the importance of choosing organic treatments, where fertilization with feather meal and growing with a weed mat led to an additional 20% increase in yield for the blueberry variety "Duke" (to 10.2–19.3 t ha -1), but had a reduced effect on the "Liberty" variety (13.5–22.7 t ha). Equally important is the interaction of treatments to obtain maximum yield of blueberry crops [26]. The results of an experiment conducted at ICDP Pitesti-Maracineni show that organic fertilizers had a positive effect on both the quantity and quality of blueberry fruits. Thus, of the two organic fertilizers used: Codamix (0.25%) and Ecoaminoalga (0.25%), the latter had a greater effect on crop yield, and both fertilizers are recommended for increasing quality. Tables 7 and 8 show the interdependence between the analysed characteristics. Fruit production per plant was negatively, distinctly significantly correlated with fruit firmness (Table 7), the correlation coefficient being r=- 0.208.

Table 7

Pearson correlation coefficients for productivity and main biophysical parameters of fruits (mass, firmness and color) [1].

Pearson Correlation		Yield (g/bush)	Fruit weight (g)	Firmness (Hpe)	L*	a*	b*
Yield (g/bush)		1					
Fruit weight (g)		0.063	1				
Fruit firmness (HPE)		-0.208(**)	0.060	1			
L		-0.184(*)	0.397(**)	0.056	1		
a*		-0.009	0.053	0.023	0.017	1	
b*		0.075	-0.178(*)	0.012	-0.470(**)	0.072	1
	Sig.	0.309	0.010	0.869	0.000	0.297	
	N	213	213	213	213	213	213

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The soluble solids content is significantly negatively correlated with the value of the colour coordinate b (Table 6), the correlation coefficient being r=-0.161, which means that bluer fruits (the value of the coordinate b decreases) have more soluble solids.

Table 8
Pearson correlations coefficients for the quality indicators for the studied blueberry varieties [1].

Pearson Correlation		Total sugar content (%)	Total acidity (%)	Total soluble solids (°Brix)	L*	a*	b*
Total sugar content (%)		1					
Total acidity (%)		0.057	1				
Total soluble solids (°Brix)		0.249	0.206	1			
L*		0.231	-0.168	0.114	1		
a*		0.126	-0.195	-0.086	0.017	1	
b*		-0.049	-0.187	-0.161(*)	-0.470(**)	0.072	1
	Sig.	0.839	0.430	0.020	0.000	0.297	
	N	60	60	213	213	213	213

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

4. Combined application of fertilizers in berry plantations

The aim of the research was to evaluate certain biochemical parameters (organic acids, total polyphenol content, total dry matter content, total sugar, and anthocyanin pigments) in blueberry fruits (*Vaccinium corymbosum* L.). The use of organic and mineral fertilizers at specific stages of plant development proved to be a highly important strategy for improving plant production. Two organic products—Algacifo 3000 (2 L/ha) and ERT 23 Plus (1 L/ha)—and one chemical product—Poly-Feed 19-19-19 + ME (10 kg/ha)—were used as foliar fertilizer treatments. The results indicated that foliar application of the organic treatments significantly enhanced fruit quality. Thus, it can be concluded that the fertilizer composition had a positive effect on the vegetative and biochemical parameters of the fruits; however, the experimental year had a more significant impact [11].

There are numerous reasons for using natural zeolites, particularly clinoptilolite (a natural zeolite), the most important being their positive effect on soil and plants by increasing the soil's electrical conductivity, thereby enhancing nutrient retention capacity and soil pH. Moreover, natural zeolites are an important source of many nutrients (N, K, Ca, Mg, micronutrients). They improve water use efficiency by increasing the soil's water-holding capacity and the availability of water to plants, thus directly and indirectly improving fruit quality [7].

To evaluate the effect of organic fertilizers on blueberry (*Vaccinium corymbosum* L.) cultivation, an experiment was conducted using the cultivars 'Corona', 'Legacy', and 'Liberty'. The fertilizers applied included: compost (CM), Purely Lysine (PL), Purely Grow (PG), Fertil (F), lupin meal (LM), blood meal (BM), along with a control treatment without fertilization (C) and two conventional treatments with urea (CF) and sodium nitrate (S). The results of the experiment indicate that lupin meal achieved the highest values for most evaluated parameters (vegetative growth and leaf nitrogen concentration before senescence, yield, and fruit weight). Thus, it is suggested that future experiments on organic fertilization in blueberries should include combinations of different nitrogen sources and consider fast-, medium-, and slow-release nitrogen supply rates [22]. The addition of yard waste compost to mulch was shown to have the potential to increase potassium (K) levels in soil and leaves, but had limited effects on plant nitrogen (N) content [25].

5. Discussion

Chemical fertilizers are used due to their ability to produce rapid effects and to modify soil characteristics, fruit quality, and their nutrient composition [7]. Although they have multiple advantages in the agricultural system, the uncontrolled use of chemical fertilizers can have negative consequences. In addition to reducing sustainable crop productivity, the decrease in the number of beneficial predators can lead to an increased risk of soil and groundwater contamination through the accumulation of residues [8, 9]. Another important aspect is related to the inorganic nitrogen-based fertilizers found in berry plantations. They can stimulate the excessive development of various weed species, which can ultimately reduce the benefits obtained through fertilization [18]. Among the notable advantages of organic fertilizers is the stimulation of beneficial microorganisms in the soil, as well as the optimization of its physical properties and fertility capacity [13]. The application of organic fertilizers has the potential to reduce soil-borne diseases, enhance plant defense mechanisms, and increase both the diversity of microorganisms and biological activity in the soil [11].

The main disadvantage is the lack of ability to respond promptly to plant nitrogen nutritional requirements, due to the low rate of transformation of nitrogen into absorbable forms [13]. Some of the organic treatments may also have higher production costs. [27]. A number of studies have highlighted the complexity of nutrient management in perennial cropping systems, as the available nutrient reserves in the soil and plants may provide sufficient nutrients to meet the needs of the vegetation. For this reason, soil organic content and plant resources should be considered as potential sources of nutrients when designing a nitrogen nutrient management plan for crops. Modifying nitrogen fertilizer amounts according to these characteristics could reduce fertilizer costs and the risk of environmental pollution caused by excessive fertilizer use [20].

Synthesis of research on the use of chemical and organic fertilizers and the benefits of their combined action

Chemical fertilizers	Organic fertilizers	Combined application
The best fertilization combination for high-yielding, good-quality blueberries was found to be N1P2K2 [21].	Algacifo 3000 (2L/ha) and ERT 23 Plus (1L/ha) - foliar application to blueberry (Vaccinium corymbosum L.) significantly stimulates fruit quality [11].	Compost from yard waste added to mulch increases potassium in soil and leaves, but reduces nitrogen in plants [25].
A low crop density is recommended to maximize fruit production and below 25 plants m-2 to optimize the efficiency of inorganic N fertilization [18].	Lupin flour (LM) increases blueberry fruit yield [22].	Adult cattle manure, as an organic fertilizer, and pelleted organo-mineral NPK fertilizer ("Excell Orga"-Excell), showed a weak influence on raspberry crop productivity [31].
It is recommended to use 35 kg•ha^{-1} N, 40 kg•ha^{-1} P and 30 kg•ha^{-1} K at the beginning of shoot germination each year for low bush blueberry [17].	Compost of plant origin (VOC, doses of 30 and 40 t ha $^{-1}$) can be used as fertilizer in the sustainable growth of red currants [28].	Intercropping with grass species may be an effective and sustainable alternative to counteract Fe deficiency in blueberries [32].
Specialized studies show that a simple increase in the application of nitrogen-based fertilizer (which is the most important nutrient) not only does not generate significant economic advantages, but also causes imbalances in plant nutrition [10].	Ensuring ample pollination can reduce the amount of nitrogen fertilizer required by 39 kg/hectare in raspberry (Rubus idaeus L.) cultivation [29].	Blueberry bushes foliarly fertilized with fertilizers containing calcium and microelements produced fruits with better quality parameters than unfertilized ones [33].
Foliar applications of Ca and B did not lead to significant increases in fruit type, yield estimate, or quality in northern blueberry cultivation [16].	Poultry litter offers advantages in blackberry production for mitigating the decrease in soil pH that occurs with fertilization [30].	
Increasing the fertilization rate twofold (60kg N/hectare) significantly increased the soil N content to a level higher than the optimal level recommended for blueberry production [27].	Fish-based fertilizer contributed relatively large amounts of sodium to the soil, without any adverse effects being observed [30].	
	Biostimulation (with preparations containing phytohormone precursors and biostimulants) has a beneficial, but not always considerable, effect on blueberry fruit yield [34].	

6. Conclusions

Soil nutrient depletion is a major problem related to soil health. Chemical fertilizers are used for their ability to generate quick results and change soil properties, crop yield and nutrient composition. However, poor management of chemical use negatively impacts agricultural crops and the entire ecosystem by degrading soil, contaminating surface and groundwater sources, and increasing greenhouse gas emissions. In order to preserve soil fertility and promote plant growth while protecting the environment, attention has been focused on addressing organic alternatives.

Similar to chemical fertilizers, organic fertilizers have both advantages and disadvantages. Significant benefits of organic fertilizers include stimulating beneficial microorganisms in the soil, along with improving its physical characteristics and fertility potential. The major disadvantage is the lack of a rapid response to the nitrogen nutrient needs of plants, due to the low efficiency in converting nitrogen into absorbable forms. Some organic treatments may also involve high production costs. In the investigations carried out, the authors summarized the advantages of the interaction between fertilizers, so future studies on the fertilization of fruit shrubs should integrate mixes of various nitrogen sources and analyze fast, moderate and slow nitrogen supplies.

Acknowledgement(s):

This research was supported by **Project METROFOOD-RO Evolve, SMIS Code 2021+ 309287,** Strengthening the integration of the Romanian METROFOOD-RO node into the European research infrastructure METROFOOD-RI, and Project **PN 23 04 02 01**, Contract no.: 9N/ 01.01.2023 SUSTAIN–DIGI -AGRI, Innovative biofertilizer production technology used to restore soil biodiversity and reduce the effects of drought on agricultural lands.

Conflicts of interest: The authors declare no conflict of interest.

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