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The role of basic substances in organic farming: Scientific and market perspectives

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Abstract. Basic substances are natural products that can be used in agriculture without meeting the full registration requirements for plant protection products. These substance include plant extracts (e.g. garlic or nettle, horsetail or willow bark), natural oils (e.g. onion, sunflower), food processing by-products (e.g. wine vinegar or whey) and minerals and chemical compounds found in the environment (e.g. baking soda, talc, and sodium chloride). In plant protection, their role is primarily to support the natural defense mechanisms of crops. The main objective of the study was to analyze the market for basic substances and their potential applications in organic agriculture. This review examines the role of basic substances in the overall crop protection market and the factors shaping the development of this market segment. It also presents examples of basic substances from different groups, their mechanisms of action, and applications. It explains why organic farming is an area where the use of basic substances is most effective. It also presents examples of research results regarding the use of these substances in agriculture. The review shows that basic substances are a safe, cheap and EU-compliant plant protection tool, but now their use is limited to niche areas, such as organic farming, and the future of this market sector depends on marketing and information activities.

Keywords: basic substances, plant protection products, organic farming.

1. INTRODUCTION

In recent years, there has been a notable shift in the European Union's attitude towards the use of pesticides. Increased environmental awareness and growing concerns about the residues of active substances in food have led to a search for alternatives to synthetic pesticides, particularly in light of the documented negative impact of some of these substances on the agro-phytocenosis, particularly pollinating insects, soil microorganisms, and aquatic organisms. At the same time, the agricultural sector is under pressure to ensure high productivity and phytosanitary safety while reducing chemical inputs.

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These objectives are outlined in the Farm to Fork Strategy, which is a key component of the European Green Deal. The strategy aims to reduce the risk and use of chemical pesticides by 50% by 2030, while promoting the development of biological and mechanical control methods. Against this backdrop, the significance of biopreparations and tools that align with the principles of integrated and organic plant protection is growing rapidly.

One such tool is basic substances, i.e. natural, widely available raw materials that are used in the food sector, and that have additional protective effects on plants. Due to their high safety profile and simplified approval process, basic substances are an important element of low-chemical-intensity production systems, including organic farming. A particular advantage of basic substances is that they can be used in the form of simple formulations that can be prepared independently, which reduces protection costs further, and allows methods to be adapted to farm conditions (Kowalska et al., 2021).

The primary objective of the study is to analyse the market for basic substances and their potential applications in organic farming system.

2. THE VOLUME AND STRUCTURE OF THE PLANT PROTECTION PRODUCTS MARKET IN POLAND

The plant protection products (PPP) market in Poland is one of the largest in the European Union both in terms of value and the quantity of active substances consumed. According to industry data, the value of the PPP market in the 2023/2024 season (calculated from harvest to harvest) amounted to slightly over PLN 4 billion, which represents an increase of approximately 13% as compared to the previous season (Kowalczyk, 2025). This increase in market value is largely due to rising preparation prices, with slightly more varied trends in terms of sales volume.

Long-term analyses indicate a significant increase in the sale of active pesticide substances in Poland since the beginning of the 21st century – rising from under 10,000 tonnes in 2000 to approximately 26,900 tonnes in 2021 (Urban, 2024). However, data from 2023–2024 indicate a shift in the trend: sales of pesticides in terms of active substance in Poland and across the EU have reached their lowest level in over a decade. This is linked to increasing regulatory pressure, the adoption of integrated plant protection methods and greater awareness among farmers and consumers (Kupczak, 2025b).

In terms of PPP application intensity, Poland ranks below the EU average. According to the latest data, pesticide consumption per hectare of agricultural land in Poland was approximately 35% lower than the EU average in 2023, which was the lowest level since 2010 (CenyRolnicze, 2025). Consumption patterns vary considerably depending on the crop: relatively small doses are used for cereals, whereas much higher doses are applied to fruit and vegetable crops, where intensive chemical protection is standard practice (Kowalska, 2024).

The market is dominated by synthetic preparations produced by large international corporations. Despite the growing role of domestic producers, foreign suppliers still dominate in terms of market share and product range sold in Poland (Chemia i Biznes, 2017).

3. TRENDS IN DEVELOPMENT – FROM CHEMISTRY TO BIOLOGICAL SOLUTIONS

The nature of the PPP market is strongly influenced by regulatory and social factors. The Farm to Fork (F2F) strategy and the European Green Deal’s objectives aim to reduce the use and risk of synthetic pesticides. This results in the gradual withdrawal of certain active substances, as well as stricter requirements for marketing authorisation process, good agricultural practices and product compliance with applicable residue standards (Tostado, 2024). From the perspective of producers and distributors, this represents a dual challenge – stemming from the reduced availability of active substances and higher compliance costs, and an opportunity to develop alternative technologies.

Consequently, the biological preparations market is expanding rapidly at both the global and national levels. Estimates indicate that biological plant protection products currently account for around 4% of the global plant protection product market, whereas in Poland they represent only about 2% of all registered preparations (Polskie Stowarzyszenie Zrównoważonego Rolnictwa i Żywności; n.d.). According to the latest data, there are approximately 52–55 microbiological plant protection products registered in Poland, while the total number of registered preparations is approximately 1,800–2,000 (Molenda, 2025).

Despite its relatively small market share in terms of volume, the market for biopreparations has been expanding rapidly. However, several barriers to its development have been identified, including the lack of a clear legal definition of "biological plant protection products", lengthy and costly registration procedures comparable to that applied to chemical preparations, and limited practical knowledge among farmers (Polskie Stowarzyszenie Ochrony Roślin; n.d.). On the other hand, the planned simplification of authorisation procedures for biological products within the European Union may accelerate the development of this segment in the coming years (Kupczak, 2025a).

4. STATUS OF BASIC SUBSTANCES ON THE POLISH MARKET

Basic substances constitute a specific, very small but qualitatively significant part of the market for alternative plant protection solutions. According to Article 23 of Regulation (EC) No 1107/2009 and the interpretation of the Ministry of Agriculture and Rural Development (Ministerstwo Rolnictwa i Rozwoju Wsi, 2018), these are substances:

- not considered potentially dangerous,
- do not have an inherent endocrine, neurotoxic or immunotoxic effect,
- are not primarily used in plant protection but may be beneficial in this area (e.g. vinegar, salt, milk, plant extracts).

An important aspect is that basic substances are not marketed as plant protection products. Instead, they may take the form of food, feed, or technical raw materials that perform a protective function only when used for plant protection purposes (Ministerstwo Rolnictwa i Rozwoju Wsi, 2018). Consequently, they are not included in conventional plant protection product (PPP) sales statistics – neither in terms of market value nor the volume of active substances. This is despite their actual role in plant protection systems, particularly in organic farming and amateur gardening.

Basic substances therefore occupy a niche position on the market:

- economically – they are mainly sold on the raw materials market (vinegar, milk, baking soda, dried herbs) rather than as registered PPPs, making it difficult to distinguish them in terms of turnover value;
- functionally – they complement classic plant protection products, especially on organic farms, where they can be applied in accordance with Regulation 2021/1165 as part of disease and pest control, but not as herbicides (Malusà, Tartanus, 2022);
- image-related – they are part of the growing trend towards "natural" and "residue-free" plant protection, responding to the expectations of consumers and producers looking for solutions that are less harmful to the environment.

Together with the markets for synthetic preparations and registered biopreparations, basic substances constitute a segment of considerable strategic importance, although their quantitative significance remains limited. Their role is particularly evident in niche areas such as organic farming system, specialised high-value crops (including fruits, vegetables, and berries), as well as small-scale production and non-professional gardening. The further development of this segment largely depends on investments in marketing activities, the dissemination of practical knowledge, and the provision of advisory services that enable farmers and gardeners to use this category of substances safely and effectively.

5. AN OVERVIEW OF BASIC SUBSTANCES

Currently, 28 basic substances are officially approved in the EU. A complete list of basic substances with their names, types, intended uses and dates of approval is shown in Table 1.

The basic substances approved by the EU fall into three main groups: foodstuffs and raw materials of animal origin, plant raw materials, and mineral substances.

5.1. Examples of food products and raw materials of animal origin

- Sucrose – strengthens plant immunity and disrupts fungal growth through its osmotic effect.
- Beer – used as bait in snail traps; its attractive fermentation aromas make it easier to catch snails.
- Milk and whey – demonstrate anti-powdery mildew properties thanks to the presence of whey proteins and microflora, forming an environment on the leaf surface unfavourable to pathogens.

Table 1. The list of basic substances approved for use in organic farming in the EU (as of 9 December 2025).

No.	Name	Type	Application	Year of approval
1	Field horsetail (*Equisetum arvense*)	Plant extract	Fungicide	01.07.2014
2	Chitosan	Biopolymer (natural origin)	Plant elicitor, stimulator of resistance to pathogenic fungi and bacteria	11.04.2022
3	Chitosan hydrochloride	Linear polysaccharide consisting of D-glucosamine and N-acetyl-D-glucosamine,	Elicitor with fungicidal and bactericidal properties through stimulation of natural plant defence mechanisms	01.07.2014
4	Sucrose	Organic compound (table sugar – disaccharide)	Elicitor – stimulation of natural plant defence mechanisms	01.01.2015
5	Fructose	Organic compound (fruit sugar – monosaccharide)	Elicitor – stimulation of natural plant defence mechanisms	01.10.2015
6	Calcium hydroxide (slaked lime) in the form of a suspension with a concentration of 24–33.12%	Inorganic compound	Fungicide	01.07.2015
7	Aluminium-coated activated carbon	Organic compound	Protective agent against root pathogens	31.03.2017
8	Wine vinegar	Organic acid	Fungicide, bactericide (treating and disinfecting)	01.07.2015
9	Lecithins	Phospholipids, natural emulsifiers (natural carriers)	Fungicide	01.07.2015
10	Willow bark (*Salix* spp.)	Plant extract	Fungicide	01.07.2015
11	Sodium bicarbonate (baking soda)	Inorganic compound	Fungicide, moss and liverwort control	08.12.2015
12	Magnesium hydroxide E528	Inorganic compound	Fungicide	02.04.2024
13	Whey	By-product of cheese or cow’s milk casein production	Fungicide	02.05.2016
14	Talc E553b	Silica mineral	Insect and fungus repellent	28.05.2018
15	Sunflower oil	Vegetable oil	Fungicide	02.12.2016
16	Nettle extract (*Urtica* spp.)	Plant extract	Insecticide, acaricide, fungicide	30.03.2017
17	Hydrogen peroxide	Inorganic compound	Disinfection, fungicidal and bactericidal action	29.03.2017
18	Sodium chloride (sea salt, table salt)	Mineral	Fungicide, insecticide	28.09.2017
19	Beer	Food product	Molluscicide	05.12.2017
20	Mustard seed powder (*Brassica alba, B. juncea, B. nigra*)	Plant extract	Fungicide (seed treatment)	04.12.2017
21	Onion oil (*Allium cepa*)	Vegetable oil	Repellent (masking the smell of the protected plant)	17.10.2018
22	L-Cysteine	Amino acid	Insecticide (Formicide)	02.06.2020
23	Cow’s milk	Food product	Fungicidal and virucidal action	30.07.2020
24	Onion extract (*Allium cepa*)	Plant extract	Fungicide	17.02.2021
25	Welsh onion extract (*Allium fistulosum*)	Plant extract	Bactericide	01.12.2024
26	Ammonium hydrogen phosphate	Mineral compound	Attractant	29.04.2016
27	Dried pellets from sainfoin (*Onobrychis viciifolia*)	Organic product (pellets)	Nematocide	23.05.2024
28	Grape seed extract (*Vitis vinifera*)	Seed extract	Fungicide	11.02.2025

Source: Search Active substances, safeners and synergists (https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/start/screen/active-substances), Substancje podstawowe (https://rolnictwo-ekologiczne.ior.poznan.pl/substancje-podstawowe)

5.2. Examples of mineral substances

- Sodium bicarbonate – acts on powdery mildew by increasing the pH of the leaf surface and causing osmotic disturbances in fungal structures.
- Calcium hydroxide – used in orchards as a disinfectant and to limit the growth of bark pathogens.
- Sodium chloride – thanks to its osmotic action, it can limit the growth of certain pathogens, although its role is limited due to its potential phytotoxicity.

5.3. Examples of plant raw materials

- Field horsetail (*Equisetum* arvense) – contains silica, strengthening plant structures, and phenolic compounds with antifungal properties; used against powdery mildew and leaf diseases.
- Nettle (*Urtica* spp.) – extracts and manure improve plant condition, provide microelements and support natural immunity.
- Willow bark (*Salix* spp.) – rich in salicylates, a natural regulator of plant immunity; used mainly in fruit and vegetable cultivation.

5.4. Mechanisms of action of basic substances

- Increase or decrease in leaf surface pH,
- Osmotic action leading to pathogen destabilisation,
- Antiseptic or antioxidant action,
- Induction of plant resistance (e.g. salicylates, silica),
- Repellent or attractant effect (beer, fermentation aromas),
- Support for beneficial epiphytic microorganisms.

The mechanisms mentioned above make basic substances particularly effective as preventive measures, although when applied at the right time and in the right way, they also limit early infections.

Table 2 presents selected basic substances that can be used to prepare plant protection products.

Table 2. Basic substances with the potential for independent preparation of formulations.

Substance (UE status)	Main effect	Typical application	Example of a standalone preparation
Vinegar	pH reduction, phytotoxic effect on young weeds, reduction of certain pathogens	minor weed infestation, algae, mosses	aqueous vinegar solution of a specific concentration for spot spraying of weeds
Sodium bicarbonate	fungistatic effect (change in pH on the leaf surface)	powdery mildew and downy mildew in orchards, vegetables	soda solution with the addition of a wetting agent (e.g. potassium soap)
Sodium chloride	osmotic, disinfectant	limited applications, e.g. surface disinfection, some soil pathogens	solution for disinfecting tools, infrastructure elements (caution due to phytotoxicity!)
Calcium hydroxide	disinfectant, pH increase	trunk whitewashing, disinfection	classic "lime milk" for whitewashing tree trunks
Equisetum arvense (horsetail)	strengthening effect, silica, reduction of fungal diseases	prevention of fungal diseases, including powdery mildew	horsetail decoctions/extracts applied to leaves
Urtica spp. (nettle)	stimulating, repellent, partially fungistatic effect	aphids, mites, plant strengthening	liquid manure/nettle extract for spraying and/or watering
Salix spp. *cortex* (willow bark)	salicylic acid – immunity induction, slight fungistatic effect	strengthening immunity, reducing seedling diseases	bark extract, applied to the soil or foliage
Whey	proteins and lactose – unfavourable environment for some pathogenic fungi	powdery mildew, leaf diseases	diluted whey as a spray
Chitosan hydrochloride	immunity inducer, antifungal and antibacterial action, antiviral in some cases	numerous fungal diseases, viruses	chitosan solution as recommended (more often in the form of ready-made preparations)

Source: own study

6. AREAS WITH THE MOST EFFECTIVE IMPLEMENTATION OF BASIC SUBSTANCES

The implementation of basic substances in plant protection requires consideration of legal, organisational and technological aspects, including the realities of agricultural production. The following analysis reveals where, how and under what circumstances basic substances can prove effective in practice.

6.1. Organic farming

Organic farming is an agricultural system based on the principles of sustainable development, aimed at producing high-quality food while respecting the natural environment, animal welfare, and soil fertility. It excludes the use of synthetic mineral fertilisers, chemical plant protection products, growth regulators, and genetically modified organisms (GMOs). Instead, the system relies on natural biological processes, biodiversity, ecosystem services and appropriate agronomic practices, such as crop rotation, organic fertilisation, and biological plant protection methods (Czym jest rolnictwo ekologiczne?, 2025). In accordance with principles mentioned above, products authorised for use in organic farming must meet safety and natural origin criteria (Regulation (EU) 2018/848, 2018).

6.1.1. Typical applications in organic farming

Basic substances can be applied in organic farming across several key areas:

– Disease prevention and immunity boosting

Substances such as plant extracts and natural compounds (e.g. of plant or animal origin) serve as immunity boosters for plants or as fungistatic and bacteriostatic agents, reducing pathogen pressure (Kowalska et al., 2021).

As a result, the natural defence mechanisms of plants can be enhanced, in alignment with the principles of environmentally sustainable farming.

– Reducing risks to the environment and consumers

Basic substances present a relatively low risk profile – in line with the "low-risk/natural substances" regulation – reducing potential negative impacts on the environment, beneficial organisms, soil, water and consumer health (Kowalska et al., 2021).

The application of basic substances facilitates the acquisition or maintenance of organic farming certification (Welcome to the FiBL ..., 2025).

– Compliance with organic farming principles and reduction of chemical use

Organic farming favours natural methods, closed material cycles and recycling of raw materials – basic substances, often available locally or as natural products, fit well into this model.

In circumstances where synthetic pesticides are banned or restricted, basic substances are a viable alternative in line with the idea of organic production (PHYTOWEB; n.d.).

6.1.2. Benefits of implementation in organic farming

- Low cost and easy availability – many basic substances are commonly available raw materials or natural products, which reduces purchase costs and makes them attractive to organic farms (Toffolatti et al., 2023).
- Increased social and consumer acceptance – consumers of organic products appreciate natural, safe plant protection methods; the use of basic substances can be an element in building competitive advantage.
- Reduced environmental and health risks – the elimination of synthetic chemicals minimises the impact on the environment, soil, water and human and animal health, which is one of the main objectives of organic farming (Kowalska et al., 2021).
- Compliance with legal regulations and ease of certification – due to their regulated status within the EU (2021/1165 and 2018/848) basic substances are certified to use under organic farming system conditions.

6.1.3. Why is organic farming the best domain for basic substances?

1. Convergence of values and goals – both organic farming and the idea of basic substances are based on minimising the use of chemicals, protecting the environment and promoting natural protection methods.

2. Supportive regulations – EU regulations (2018/848 + 2021/1165) allow the legal use of basic substances in organic production, providing legal stability.
3. Adaptation potential in small and medium-sized farms – lower costs, the possibility of independent preparation, flexibility of use – all this favours organic farms, often on a smaller scale.
4. Building competitive advantage – growing consumer interest in "natural", "chemical-free" and organic products enables farms using basic substances to better respond to demand and social expectations.

7. EXAMPLES OF SCIENTIFIC RESEARCH ON BASIC SUBSTANCES

Drury et al. (2003) assessed the effectiveness of milk and whey as preventive treatments against powdery mildew in greenhouse experiments on winter wheat. Disease progression in plants treated with milk or whey was, on average, approximately two-thirds lower than in the untreated control group, with preventive applications (prior to inoculation) proving more effective than post-infection interventions. In a subsequent experiment, milk and whey achieved results comparable to those obtained with sulphur, which is the standard treatment in organic farming (Drury et al., 2003).

However, in a field experiment evaluating the control of tomato powdery mildew, the application of 10% raw cow's milk significantly reduced the severity of the disease compared to the control (Drury et al., 2003). According to the results published by Sepúlveda-Chavera et al. (2013), the treatments used in the studies, including 10% raw milk, significantly decreased the severity of powdery mildew symptoms on leaves compared to water (used on the control object). Twenty-one days after application, the severity of disease symptoms was assessed at 91.8% in the control and 41.5% in the milk-treated plot. The reduction in disease incidence was noticeable, although significantly lower than that achieved with the most effective chemical agents evaluated in the study.

In research conducted by Konecki (2025), the impact of selected basic substances was assessed over two growing seasons: wine vinegar, chitosan hydrochloride, mustard seed powder and ozone treatment of seed material – in terms of reducing mycotoxins in spring wheat grain.

The most effective treatment was a combination referred to as "comprehensive protection" (vinegar + chitosan hydrochloride + mustard), which was identified as the most efficacious in both pot and plot experiments and subsequently applied in large-scale production. The study also reported total mycotoxin levels under different experimental conditions: 352.6 µg/kg in pots, 101.8 µg/kg in plots, and 90.1 µg/kg in the field, with the highest concentrations observed for deoxynivalenol (DON) and HT-2, among others. In the field experiment, applications of basic substances reduced mycotoxin levels below the established safety thresholds (HT-2 and T-2 – 50 µg/kg), thereby meeting the regulatory requirements for unprocessed cereal grains.

The study by Žabka and Pavela (2021) evaluated the effectiveness of chitosan hydrochloride in limiting the growth of *Phytophthora infestans*. For comparison, two other naturally occurring substances were tested: sodium bicarbonate and lecithin, known for their ability to inhibit pathogen growth. The results indicate that chitosan applied in concentrations ranging from 0.1% to 1% effectively reduces infection growth, with the observed effect depending on the dose applied. Sodium bicarbonate, by contrast, demonstrated moderate efficacy, resulting in a 41.36% reduction in disease progression compared with the untreated control.

In experiments conducted by the same authors on whole plants, under conditions conducive to intensive pathogen development, the addition of chitosan at a concentration of 0.4% resulted in a significant reduction in disease, reaching 84.72% (Žabka, Pavela, 2021). A distinct reduction in leaf damage was observed, amounting to 23.3%, while in the control object, as much as 95% of the leaf surface was affected. Under the same conditions, sodium bicarbonate at a concentration of 1% exhibited low efficacy, achieving only 15.63% inhibition.

The number of treatments performed proved to be a key factor influencing the effectiveness of protection under conditions similar to those in field practice. A single application of chitosan led to a 37.25% reduction in disease, with an infestation level of 48.0%, compared to 76.5% in the control. Increasing the number of treatments to three and four significantly enhanced the protective effect, raising the inhibition level to 90.46% and 99.35%, respectively, resulting in a very low leaf infestation rate of 7.3% and 0.5%.

The results clearly indicate that the effectiveness of protection against potato blight depends on both the concentration of the preparation and the number of protective applications. Similar effects of chitosan have been reported by Francesconi et al. (2020) in studies on durum wheat, demonstrating that chitosan hydrochloride inhibits the germination and growth of *Fusarium graminearum* spores. The authors further showed that chitosan can limit the development of fusarium head blight and reduce both the pressure and virulence of the pathogen.

Available literature also indicates that chitosan hydrochloride has the potential to disrupt pathogen cell membranes, thereby inhibiting their metabolic activity. This mechanism has been described, among others, for *Phytophthora infestans* in potato cultivation (Poldmets et al., 2025) and for fungi of the genus *Fusarium* spp. in tomato cultivation (Safari et al., 2021).

In studies by Sarhan et al. (2020) and Meng et al. (2022), mustard seeds, which are rich in glucosinolates, were used; when ground, these compounds are metabolised into isothiocyanates, which effectively inhibit the growth of selected pathogens. The resulting mustard seed powder was applied in biofumigation to protect eggplant seeds from *Verticillium dahliae* and chickpea seeds from infection by *Fusarium* spp. fungi.

Wine vinegar is another basic substance used in plant protection. It acidifies the environment, damages cell membranes and inhibits the cellular respiration of pathogens. Due to these properties, it effectively reduces the growth of microorganisms (Stratford et al., 2009). The effectiveness of wine vinegar was also confirmed by Kowalska et al. (2021), who applied wine vinegar solutions with concentrations ranging from 0.5% to 2.0% to protect barley against *Pyrenophora graminea*, as well as pumpkin, tomato and pepper crops against fungi of the genus *Alternaria* spp.

Another basic substance, sodium bicarbonate, has been tested in apple orchards. Studies by Ilhan et al. (2006) and Kelderer et al. (2008) demonstrated that applications of sodium bicarbonate, both alone and in combination with tebuconazole, effectively reduced infection of apple fruit by *Venturia inaequalis*. Its efficacy has also been reported in reducing infection by *Sphaerotheca macularis* in strawberry cultivation (Pertot et al., 2008).

Furthermore, lecithin solution is also frequently used in field studies as a fungicide to protect vineyards, orchards, vegetable crops and ornamental plants. Trdan et al. (2008) reported that foliar applications of soy lecithin significantly reduced infection of chicory by the pathogenic fungus *Alternaria cichorii*.

There are gaps in research on the application of basic substances in scientific studies, including a lack of long-term field experiments, a lack of standardisation of the doses applied, a lack of data on the impact of basic substances on the soil microbiome, a lack of data on economic efficiency, and an insufficient number of comparative studies with synthetic plant protection products. All issues mentioned above create opportunities for future research on basic substances.

8. CONCLUSIONS

Basic substances represent an exceptionally promising way for plant protection management in organic farming systems, as they combine attributes desired from both an environmental and economic perspective. Their natural origin, high safety profile and compatibility with European Union regulations provide a solid basis for their widespread use on farms seeking to minimise the use of chemicals in production. These substances align well with the principles of organic farming, including closed material cycles, the use of locally sourced raw materials, and the activation of natural plant resistance mechanisms.

Compared to conventional plant protection products, basic substances offer low-cost, easily accessible and self-preparable solutions, particularly beneficial to small and medium-sized farms. Simultaneously, they respond to public expectations regarding the reduction of pesticide residues and the implementation of more environmentally friendly production methods.

The EU regulations ensure a consistent legal framework and clearly defined criteria for the use of basic substances, increasing certainty for farmers and facilitating the organic certification process. Consequently, basic substances not only complement existing plant protection methods, but are also becoming an important element in the transition towards sustainable and low-chemical agriculture. Their importance is expected to grow as regulations on synthetic plant protection products continue to tighten and consumer awareness of environmental issues increases.

Scientific research confirm that basic substances have real and measurable effectiveness in reducing plant diseases. Although they are often less effective than synthetic plant protection products, they are a valuable component of integrated and organic protection strategies, especially when used preventively, at appropriate concentrations and with the right frequency of treatment. Their importance in agricultural practice is further enhanced by their high safety profile and compliance with applicable EU regulations.

The wide adoption of basic substances has the potential to strengthen farms' resilience to market and climate-related stresses. Farms' vulnerability to external market shocks and supply chain disruptions was especially visible during the polycrisis period of 2020–2023 (COVID-19 outbreak, Russian-Ukrainian war). The year 2026, due to the blockage of the Strait of Hormuz, might be another difficult year for farmers worldwide, especially those reliant on synthetic chemical inputs. This vulnerability highlights the urgent need to redesign current value chains into more autonomous production models that prioritize internal farm resources over global supply chains. The use of basic substances can lower the dependency of farms on global markets while enhancing circularity through the utilization of local resources. By safeguarding biodiversity and supporting the health of the surrounding ecosystem, basic substances contribute to a self-sustaining "biological buffer" that allows the farm to adapt more effectively to climate variability and evolving pest pressures.

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