Estimation of the prospects of using agrobiotechnologies to increase yield and preservation of soils

V I Startsev, A P Glinushkin and Y Y Spiridonov

State Scientific Institution "All-Russian Research Institute of Phytopathology", Russian Agricultural Academy", st. Institute, own 5, Bolshie Vyazemy, Odintsovo distr., Moscow reg., 143050, Russia;

Corresponding author’s e-mail: yplehova@mail.ru, mpp27@mail.ru

Abstract. The article substantiates the possibility of creating agrobiocenoses with strategically important crops for the formation of a nutritional balance in the diet of the population of the Russian Federation without the use of chemically synthesized agrochemicals, in which the variety of the main elements of biologic technologies of cultivation of agricultural plants plays a key role. Progressive analysis of demand from the agro-industrial complex, indicators of the development of the agrobiotechnology market, consumer trends, and venture investments in biologic technologies allow us to conclude that the development and proposed approaches are promising, allowing to obtain high yields of agricultural crops while maintaining and increasing soil fertility, improving the phytosanitary state of fields.

Key words: soil, phytopathogens, weeds, agrophytocenoses, agrobiotechnology.

1. Introduction

“Three things make a nation great and prosperous: fertile soil, active industry and ease of movement of people and goods” - asserted in the 17th century the English philosopher, historian, politician, founder of empiricism Francis Bacon.

Despite the fact that only about 10% of the soil area is plowed on planet Earth, agricultural lands have been and remain an irreplaceable asset and source of wealth for mankind.

The soil is a completely special natural formation with only its inherent structure, composition and properties. The most important property of the soil is its fertility, i.e. the ability to ensure the growth and development of plants. This property of the soil is of exceptional value for human life and all organisms living on land. Soil fertility determines its importance as a basic means of agricultural production.

However, the value of soil is determined not only by its economic importance for agriculture, forestry and other sectors of the national economy; it is also determined by its irreplaceable ecological role as the most important component of all terrestrial biocenoses and the biosphere of the Earth as a whole. Numerous ecological links of all organisms living on earth and in the earth (including humans) with the lithosphere, hydrosphere and atmosphere go through the soil cover of the Earth [1].

The growth in the intensity of industrial and agricultural production, the increasing anthropogenic load on the natural environment leads to soil degradation. According to FAO, the world's areas of degraded and diseased (conduct) soils occupy more than 1.2 billion hectares, or 22% of the world's...
land, 12% of the world's soil resources are chemically degraded. More than 80% of agrocenoses of grain crops in the Russian Federation are inhabited by phytopathogens. And this trend is only growing. In general, annually due to degradation, up to 17 million hectares of world soil resources are lost [2].

The agrarian industry of the Russian Federation has shown good growth in recent years both in terms of individual economic indicators and the nominal contribution to GDP [3]. This is due to the incredible growth in investment in the industry, the creation of new government programs to subsidize and support the agro-industrial complex, which allowed companies to update and expand the means of production [4]. However, the low culture of agriculture, aggressive intensive cultivation causes soil degradation and impoverishment [5]. Every year 2,000,000 degraded soils appear in Russia, and now 15% of all lands have already been eroded. Moreover, over 80% of agricultural fields in Russia are degraded.

This is mainly due to the widespread use of agrochemicals by domestic enterprises, which are still the most widely used by domestic companies, work with extremely low efficiency: the bulk of the substances introduced into the soil is very quickly washed out of the soil, without having time to exert a proper effect on plants, and their concentration is fast falls [6].

Soil degradation is a complex process, but the main anthropogenic risks can be identified:
- accumulation of hazardous chemicals in soil and water bodies;
- the spread of pests and pathogens to the more northern regions of the country;
- production and use of new chemical plant protection products;
- the emergence of pesticide-resistant populations of pests;
- reduction of populations of entomophages, pollinating insects, beneficial microorganisms;
- imperfect legal basis for organic farming in the Russian Federation.

The need to take urgent measures to form ecologically balanced agricultural landscapes every year becomes more and more obvious [7].

Research goal. In Russia, the recovery of soil microbiota damaged as a result of the use of intensive farming methods is much slower than in countries with milder climates. Therefore, the task of technological support for the cultivation of each crop consists in the development of agricultural technologies that allow obtaining high agricultural yields. crops while maintaining and increasing soil fertility, improving the phytosanitary state of fields.

Record grain yields obtained in recent years in the agricultural sector of the economy have shown the high potential of domestic crop production and the possibility of its dynamic growth. By many indicators, the production of agricultural products corresponds to the indicators of the country’s Food Security Doctrine. The next task is to improve the quality of manufactured products as the basis for a healthy lifestyle of the population. Improving the quality of life is the most acute problem facing the leadership of every state focused on the development of the social sphere. Its solution can only be complex. But one of the main components is the production and consumption in sufficient volumes of a wide range of high-grade food products in terms of biochemical composition [8].

According to a global Deloitte study, 51% of consumers in developed countries said that when choosing food products, they attach greater importance to non-traditional factors, such as healthy eating, product safety and social responsibility of the leader [9].

Survey data from Russian manufacturers show that they also expect changes in Russian consumer preferences. The most pressing consumer demands, according to representatives of the agro-industrial complex, are greening products (noted by 82% of respondents), focus on healthy eating. (noted by 76% of respondents).

Projects and startups in the field of biotechnology (a generic name for a class of technologies in which the properties of living organisms are used to obtain a required product or service) and smart agriculture appear more and more often and receive large investments. for example, new venture capital funds ARCH Venture Partners raised a record $ 1.46 billion from investors for investments in biotechnology [10].

The international technology incubator Idea2scale together with the Agri-FoodTech AgFunder venture fund in November 2019 published the results of a study of the investment market in agricultural
technologies and food tech [11]. Biotechnology in agriculture topped the list of preferred areas for investors in 2020. The study involved 50 investors from around the world. A key focus for startups in this category is to help farmers increase their yields through new ecological methods. 58% of surveyed investors included Ag Biotechnology in the top three in terms of planned investments. In recent years, the global market has indeed grown at an unprecedented rate, in some sectors the growth ranges from 7 to 30%, and today the total world volume is about $ 0.6 trillion, according to Abercade Consulting. More than 60% of the market is occupied by biomedicine and biopharmaceuticals, and 35% belongs to agrobiotechnology, the volume of the world market of which today has reached $ 46 billion.

The main directions in agrobiotechnology is the production of transgenic (genetically modified) crops, which is developing at a rapid pace. 42% of the market is occupied by immunobiology, that is, the production of drugs, including veterinary drugs, for livestock. Biotechnology for plants, which includes the technology we are considering, occupies only 6%, but by 2025 growth is projected up to 13-18%, being the fastest growing sub-industry [12]. In Russia, the biofertilizers market is at the initial stage of development: imports are only 4%, and exports are practically absent [13]. This creates excellent opportunities for increasing capacity in this area by domestic producers. According to the Union of Organic Agriculture, "the weak point of the domestic market is that 98% are biofungicides with the same active ingredients, as well as the lack of proper legislation, which is becoming an increasingly serious obstacle to the development of the industry" [14]. Among other things, agricultural enterprises for the most part exist in conditions of low profitability and prefer more effective and versatile chemical means of protection. In addition, in Russia, there is a weak level of farming culture in general and awareness of modern trends in agricultural practice [15]. Organic farming, which is widespread in Europe, is just beginning to develop in Russia.

"The level of implementation of agrobiotechnology in Russia is only 2%, while their potential and significance is enormous." - this was announced by the Chairman of the Board of the Union of Organic Farming Sergey Korshunov as part of the track on the comprehensive modernization of the agro-industrial complex of the first national forum "Import Substitution 2017". [sixteen]

Despite the fact that Russia owns 3% of the global agrobiotechnology market, and domestic producers are actively increasing exports, the situation continues to be tense: the overall import dependence of the industry as a whole reaches 85%, and imports for some items are 4 times higher than exports.

Conditions, materials and methods. In 2018-2019, in the fields of the experimental production base of the Federal State Budgetary Scientific Institution VNIIF, a study was carried out of the possibility of cultivating crops introduced in the Moscow Region: sugar sorghum, Sudanese grass and chickpea without the use of chemically synthesized agrochemicals.

The experiments were carried out with the use of chickpea seeds, varieties of the Moscow Region, created at the Federal State Budgetary Scientific Institution of VNIIF, against various backgrounds of endemic contamination characteristic of the soils of the Western Moscow Region.

The species composition of weeds was dominated by: White Mary Chenopodium album L.; Field sow thistle, about, yellow Sonchus arvensis L.; Lamb's lamb Lamium amplexicaule L.; Galium aparine L.; Medium stellate, wood lice Stellaria media (L.) Vill.; Odorless chamomile Matricaria inodora L.; Field violet Viola arvensis Murr.; Dymyanka medicinal Fumaria officinalis L.; Plantain large Plantago major L. [17. eighteen].

Since the most widespread in the crops of agricultural crops were white marmot and stalk embracing, they were chosen as background variants of studies of growing chickpeas of the Privo 1 variety without chemical and agrotechnical treatments, i.e. option No. 1 and option No. 2 of the experiment, grade Privo1 was taken as a control with mechanical weeding, option No. 4.

2. Results and discussion
As the research results showed, the greatest contamination of crops was observed in the control variant (No. 4) - 104 pcs / m², then in the variant of crops with a predominance of white mari - 56 pcs / m² (No.
2). In both variants there was the smallest weed infestation of the crops with lucid stalk, which in the other two variants (No. 1 and No. 3) prevailed and suppressed the development of other types of weeds. Antagonistic relationships were established between the stalky and white mari. At the same time, the presence in the crops of a large number of white mari plants (option No. 2 - 53.6% and option No. 4 - 55.8%) to a lesser extent inhibited the development of other weed vegetation compared to the lacunae.

3. Conclusion

Thus, it can be concluded that during the formation of agrophytocenoses, there is a significant change in the species composition and number of plants in agricultural landscapes.

A crop variety, correctly selected for a specific soil-climatic zone, or specially created for it, can effectively compete in growth and development with weeds without the use of chemical, biological or mechanical means of weed control in crops [19,20,21].

The prospect of using the approaches proposed in the article to increase yields is confirmed not only by the urgent need to prevent soil degradation, but also by the growing interest from the agro-industrial complex, which are potential consumers of the proposed technology, indicators of the development of the agrobiotechnology market, the fixed interest of investors, as well as changes in consumer trends.

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