ISSN (Print) : 0974-6846
Indian Journal of Science and Technology, *Vol 9(16), DOI: 10.17485/ijst/2016/v9i16/89804, April 2016* ISSN (Online) : 0974-5645

Innovative Processes in Floriculture: Current Status, Problems and Prospects

Oleg B. Kuzichev* **and Natalia Y. Kuzicheva**

Michurinsk State Agrarian University, Michurinsk, Russian Federation;
obkuzichev@hotmail.com, nykuzicheva@outlook.com

Abstract

Background/Objectives: The aim of the research is to substantiate the necessity of stimulating innovative processes as prospective means of overcoming negative trends and as a solution of economic problems in floriculture. **Methods/ Statistical Analysis:** The research methods included comprehensive analysis procedures based on the abstract logical connection between the phases of the production cycle (scientific research and experimental development, introduction, production). **Findings:** The expediency of developing the innovative processes is defined by high production efficiency. The other way to restore floriculture production capability is to ensure close cooperation between the economic entities employed in the various economic areas of the sector. The results of the research lead to the conclusion that selection as an element of the innovation process in floriculture bears economic load and should contribute to the increase in the production efficiency of planting stock and cut flowers production where new flower crops cultivars are concerned. **Application/Improvements:** Results of this research would allow creating a complete cycle of the innovative process and help to overcome the crisis developments in the floriculture sector.

Keywords: Efficiency, Floriculture, Innovative Process, Register, Scientific and Technical Progress

1. Introduction

Floriculture is one of the most important branches of ornamental plant-growing, and meeting the people's aesthetic needs is its main purpose. People's craving for the beauty and vitality of plants has determined the marketing prospects of the industry. The variety of people's tastes and their different perception of beauty have become a stepping stone for finding and creating new forms of flowers and ornamental plants, which is the main objective of introduction and selection. Reproduction and cultivation of cut flowers and planting stock belong to the domain of big agribusiness, which results in the increase of the producer's economic activity. All these factors determine the unity of market, economic, scientific and technological processes, where each single process is a separate aspect of the end product.

At present, the flower market capacity is estimated by experts at $4 billion, where about $3.6 billion accounts for import produce[6]. These figures raise concerns about the necessity of the domestic flower production development. The diversity of forms and cultivars of flower ornamental plants belonging to more than 100 species[5] will contribute to this development. Moreover, each of these cultivars as a source of valuable economic and biological properties may be used in future selection and innovative processes in the industry.

2. Materials and Methods

The research methods included comprehensive analysis procedures based on the abstract logical connection between the phases of the production cycle (scientific research and experimental development, introduction, production)[1-10]. The results obtained have proven the efficiency of the innovative processes implementation in floriculture. Particular attention should be paid to the indices describing the state of process or industry, efficiency and development prospects of new flower and ornamental plants cultivars, such as profit on product

* *Author for correspondence*

sales and profitability level. Due to the fact that complex processes of selection and innovation were chosen as the research subject, the application of analysis and synthesis methods is scientifically justified. Furthermore, conclusions and recommendations stated were based on the application of observation, experimental and forecasting methods[11-16].

Experimentation facility of the research was located in I. V. Michurin All-Russia Research Institute of Horticulture (ARRIH) and constituted of a land plot with an area of 0.2 ha with the gladiolus hybrid (Gladiolus hybridus hort.) plantings (about 200 cultivars and hybrids of gladiolus). Evaluation of the selection material obtained was done by applying the method of primary cultivar studies of the gladiolus hybrid[17], as well as methods of testing for the crop homogeneity and stability. The results obtained in the course of the gladiolus selection process were used as a starting material for economic efficiency and prospects study. It should be noted that prospects evaluation of the selection process as an integral part of innovative development was carried out by using the "Guidelines for Assessing the Investment Projects Efficiency".

3. Results

The development of floriculture as an agricultural sector reflects in multiplied form all economical processes that took and are currently taking place in the economy of the state. A large public sector of floriculture that had been considered a priority and had been systematically developed throughout the 1970s, was virtually eliminated in the course of the liberal reforms of the 1990s in Russia. Its restoration as an independent area of agribusiness began only 20 years later, and is currently based on the development scheme of a highly specialized industry, though the process as a whole is rather sporadic and stochastic by nature.

To a large extent it is caused by two factors:

- Destructurization of the industry;
- A decrease in consumers' paying capacity.

Furthermore, nowadays the import substitution problem is not accounted for, and the only goal is to supplement home-grown cut flowers supply. Unfortunately, the country has no conciliation system that would take into account the interests of all flower and ornamental plant market participants, despite the steadily growing demand not only for cut flowers but also for potted plants and planting stock of flower crops adapted for various zones. Floricultural products diversification in these areas should be considered a priority by agricultural producers. It is crucial that on the market with a wide variety of flower products ornamental characteristics of the cultivar are of particular importance. Opening the borders for flower and ornamental plants import adds to the severe conditions in the selection achievement market (in accordance with the phytosanitary control standards). Nevertheless, in Russia the work on developing new original and extra ornamental flower crop varieties adapted for climatic conditions of different zones of the country is underway. In this industry sector, amateurs made their invaluable contribution as well. As a result, in 2012 the share of individual selectors in the total number of the originators of flower and ornamental plants varieties listed in the *State Register of Selection Achievements Approved for Use in Russia* amounted to 11.8 %. The specifics of the main types of the flower and ornamental crops market is displayed in [Table 1].

Table 1. Specifics of the flower and ornamental crops market

Flower market	**Ornamental plant stock market**
Orientation to produce import	
High risk for participants at each stage of product marketing	High level of specialization
High sales seasonality	Opportunity to purchase large-sized plants
High buyers' income demand elasticity	Seasonality in prices (autumn prices are 5-10% higher)
Non-standardized products	Variety of goods
High transportation cost	
High level of profitability (up to 2000%)	High capital and labor-intensive production of ornamental plant stock
Short payback period of business projects	Long payback period of business projects in the ornamental plants nursery (determined by the norm)

Domestic producers have sufficient capacity to take one or more market niches for these kinds of produce. To a greater extent this applies to ornamental plant stock segment. But obtaining sufficient economic benefits requires the solution of some problems:

- Search for available investment resources.
- Further training of personnel involved in all aspects of product marketing: from manufactures up to consumers.
- Creating favorable economic conditions.

The further development of the flower and ornamental crops market should be concentrated in the following areas:

- Consistent development of ornamental plants nursery production base and specialized greenhouse cultivation.
- Creating an effective market infrastructure and interaction between all the participants, including scientific community.
- Providing economic support for the commodity producers by providing tax holiday until the commercial product is introduced to the market.
- Promoting innovative floriculture development.

Primarily, the stake should be placed on recreating an efficient floriculture system. It involves a dynamic and continuous innovative development of the industry. From an organizational point of view, the restoration process includes integration of plant selection centers, planting stock and flower seeds producers, as well as agricultural organizations that prioritize the large-scale production of floriculture crops in their economic activities.

Taking into account a range of theories[18,19], innovative floriculture development should be defined as an increase in floriculture production efficiency, based on the introduction and use of the results of scientific and technological progress, in the course of which agricultural commodity producers gain additional economic benefits. The benefits regard qualitative characteristics of resource utilization and flower production use, with account of the impact of a system of factors, as well as the external and internal conditions. Innovation processes are the basis of innovative floriculture development.

Innovation process is a synthesis of four development phases, involving qualitative changes in the properties and characteristics of the means and subjects of labor. The following stages constitute the innovation process: 1) fundamental and applied scientific work (research work); 2) creation of experimental development; 3) introduction, technological planning of production capacities; 4) production.

Intrinsically, the innovation process covers at least two spheres of the economy – science and production. The first two phases include innovation creation or improving the product by providing it with new consumer properties or introducing a technological change in the manufacturing process. The third phase involves the interaction between the research institutions and direct commodity producers. This interaction should be based on understanding the prospects for such cooperation and the possibility of meeting each participant's economic interests.

Unfortunately, innovation processes in floriculture are sporadic by nature. This is largely due to the lack of interest in the creation of new flower crops varieties. There are following characteristic features of scientific and technological development in the ornamental horticulture (and, consequently, in floriculture): 1) a relatively long period of development and innovation; 2) labor-intensive operations on pollination, selection and assessment of economic and biological characteristics of new varieties; 3) high risk in a consumer sector. Thus, the period of creating new cultivars to its implementation in industrial production is usually no less than 10-15 years.

The scheme of movement for an innovative half-finished product «from the research institute – to production» is represented in [Figure 1].

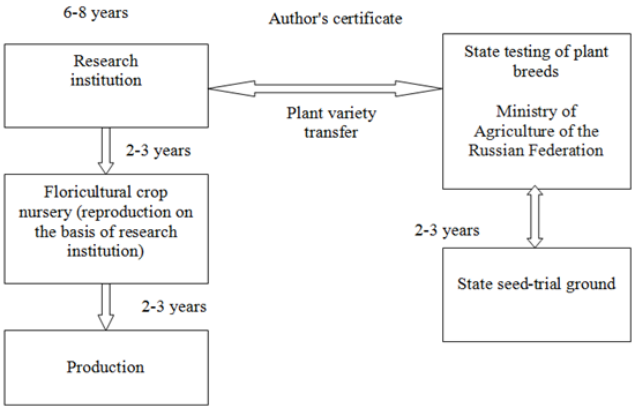

Figure 1. The innovative product movement scheme in floriculture (using the example of a new cultivar of the gladiolus).

In addition, the duration of the innovative development testing in ornamental horticulture (floriculture) may be prolonged by 2-3 years, since the results of planting stock production are largely dependent on weather conditions, etc. This limitation notwithstanding, the floriculture development on the innovative basis in Russia is still carried out, in part due to the amateur plant selectors' efforts. The widespread introduction of innovative products in the production sector is possible only if there is an effective mechanism for scientific and technological development represented by a system of relationships between participants of scientific and technical information market, which is aimed at the improvement of the final product creation process.

Currently, 1117 flower and ornamental crops breeds belonging to 103 species are included in the State Register of Selection Achievements Approved for Use in Russia.

The largest proportion among varieties originators belongs to public institutions operating in the forms of state research institutions and federal state-funded educational institutions (62%), whereas the smallest belongs to agricultural production cooperatives (0.2%). 697 varieties were introduced under copyright protection by the former, while for the latter copyright protection was acquired only on two varieties of roses.

It should be noted that the largest number of registered varieties in the State Register of Selection Achievementsis represented by such flower crops as the annual aster (164), the gladiolus (61), the iris (99), the lily (43), the peony (149) and the rose (31). However, where these crops are concerned, there are fundamental differences in legal organizational form of their varieties originators. While selection works of the iris, the lily, the peony (including treelike) is carried out by experts of public institutions that own the copyright on 60-89% of the total number of these flower crops cultivars included in the State Register of Selection Achievements, the copyright on annual asters breeds largely belongs to private entities (49%) and individual plant selectors (15%). Radically different picture can be seen regarding the gladiolus – 92% of its registered cultivars are owned by individual plant selectors (Gromov A. N., Kuznetsov M. A., Kiselev A. L., etc.) and only a number of research institutions conduct selection work of this plant species (8% of the total number of varieties included in the State Register). It is selection work that is of primary importance in the innovation process as an important direction of creative scientific work which allows to create new cultivars with excellent decorative qualities, various forms of bushes, flowers and inflorescences, that are resistant to adverse abiotic and biotic environmental factors. In a competitive environment, each action of an economic entity bears an economic load. Therefore, the category of 'efficiency' becomes the priority. Efficiency represents the value characteristic of the obtained effect as calculated per a resource unit used to achieve the end-result, and characterizes the type of reproduction in the industry. This applies to the selection work in floriculture[20-22].

Financial input is a particularly important kind of investment in the selection process, that should bring a return in the future. But it is necessary to consider the specifics of investment in the selection of plants cultivated in the industry

- Indefinite period of the investment of funds.
- The discrepancy between the general economic and personal profits (caused, among other factors, by the imperfect legislation on economic issues where plant breeds copyright holders are concerned).

Cash flow discounting practice coupled with effectiveness measurement per unit of effect obtained (1 perspective seedling, 1 elite seedling, 1 new cultivar) can be applied to evaluate the efficiency of flower and ornamental crops selection process. It is important to note that the quantitative characteristics of the selection work results that were analyzed in the course of the reference research are fixed at the average level.

Table 2 represents comparative data on the efficiency of the gladiolus selection process when using various pollination methods [Table 2].

Table 2 shows that in five years of gladiolus cultivation after hybridization, up to 270 perspective seedlings can be obtained per 1 ha by using artificial pollination, and by using natural pollination - more than half as many (130). However, this difference is not as significant as in the number of the selected elite seedlings (for 8-year period) - 164 elite seedling when using artificial pollination to 2 - when using natural. This is due to the fact that artificial hybridization carried out by a human involves a thorough selection of paternal and maternal plants among the sources of valuable morphological and decorative characters, including economically valuable qualities selection of these qualities in the collection is constantly done by plant breeders to ensure further

Table 2. The efficiency of the gladiolus selection process when using various crossing methods

Indices	Methods of pollination						Ratio, %		
	natural			artificial					
	Intermediate point of the selection process efficiency assessment		for the whole period of selection process	Intermediate point of the selection process efficiency assessment		for the whole period of selection process	point 5 to point 2	point 6 to point 3	point 7 to point 4
	for the period t_0-t_1 (5 years)	for the period t_0-t_2 (8 years)	t_0-t_3 (14 years)	for the period t_0-t_1 (5 years)	for the period t_0-t_2 (8 years)	t_0-t_3 (14 years)			
1	2	3	4	5	6	7	8	9	10
Agricultural output per 1 ha, item	130			270			207,7		
- promising seedlings									
- elite seedlings		2			164			8200	
- new breeds			2			164			8200
Discounted average annual production costs calculated per unit of selection results, rub.	113,3	587,6	483,10	83,3	12,40	34,80	73,52	2,11	7,20
Discounted average annual net profit calculated per unit of selection results, / thousands of/ rub.	21,07	351,3	1169,10	7,3	39,60	172,90	34,65	11,27	14,79
Discounted average annual profit on sales calculated per unit of selection results, / thousands of/ rub.	3,31	126,50	75,10	0,37	37,10	79,30	11,18	29,33	105,59
Internal revenue rate, share	-	-	0,402	-	-	0,378	-	-	-
Level of profitability, %									
- net income	18,6	59,8	242,0	8,8	319,4	496,8	-9,83	259,57	254,84
- profit on sales	2,9	21,5	15,5	0,4	299,2	227,9	-2,48	277,67	212,33

increase of the selection process intensity. When using natural pollination by insects, obtaining hybrid forms with exceptional qualities is random in character, so the number of elite forms and new varieties is so meager.

It is important to note that the discounted average annual production costs per unit of selection result, the average annual net profit, and the average annual profit on sales of planting stock are generally higher when using natural pollination rather than artificial pollination. This is caused by a considerable difference in the number of breeding material obtained depending on a pollination method.

The profitability level of the gladiolus hybrid selection process was calculated in two ways - on the basis of net income and profit on sales. In addition to that, three testing periods were taken into consideration: 5-year period during which perspective seedlings were being sorted out; 8-year period, when elite seedlings were selected from hybrid seedlings, and the third period - 14 years after the hybridization start, when new cultivars began to take shape. In the initial five-year selection period (t_0-t_1), the profitability level as calculated by net income is by 9.8 %, and as calculated by profit on sales – by 5% higher when using natural pollination. The reason is that the early years of hybridization are more costly when using artificial cross breeding.

A spike in the profitability level value when using artificial rather than natural pollination method can be already seen by the eighth year of selection period under review (319.4% against 59.8% as calculated by net income and 299.2% against 21.5% as calculated by profit on sales).

The level of profitability calculated by net income for the full period of the gladiolus selection process (14 years) when using artificial pollination totaled 496.8%, which is

254.8% more than for natural pollination. Comparing this index in terms of profit on sales, its value for artificial pollination was 227.9% whereas for natural –15.5%, i.e. 212.4% less.

Herewith, the investment in the selection process when using natural pollination of gladiolus flowers withstands higher risks of financial loss, but the method of artificial pollination is not less reliable. Internal rate of return at which the project remains profitable is 37.8% when using artificial pollination method.

Introducing new selection achievements in floriculture to business entails the increase of production efficiency and, consequently, accelerated development of productive potential Table 3.

Indices for "Without innovation" option include cost parameter for old cultivars of flower crops

Indices for "With innovation" option include overall production of flower crops planting stock of new and old cultivars, and their selling prices.

The figures in Table 3 demonstrate that the gross production per 1m^2 with innovations in I. V. Michurin All-Russia Research Institute of Horticulture was 13.6% higher than the gross production without innovations. The cost of planting stock production per 1 m^2 without innovations accounted for 650.1 rubles and with innovations – for 714.4 rubles, which is 9,8% higher. Profit on the sales of products without innovations per 1 m^2 accounted for 245.7 rubles and, whereas with innovations – for 315.3 rubles, which is 28.3 % higher. Profitability level of the outdoor crop planting stock production with innovations was 6.3 percentage points higher than without innovations. In general, the cost-effectiveness calculation of the innovation process in I.V. Michurin All-Russia Research Institute of Horticulture for 2012 year demonstrated that the use of innovations could significantly increase profit on sales of flower crops planting stock and thus the profitability of its production. This is a good example of the economic feasibility of developing floriculture-oriented agribusiness.

4. Discussion

The results of the research lead to the conclusion that selection as an element of the innovation process in floriculture bears economic load and should contribute to the increase in the production efficiency of planting stock and cut flowers production where new flower crops cultivars are concerned.

This is achieved by using the initial parental couples carrying high decorative genes, as well as the resistance to the adverse environmental factors and productivity genes. The industry resource potential (gene pool diversity, professionalism and competence of staff) is a prime consideration in this process.

The analysis of floriculture industry in Russia, problems of its development lead to definite conclusions:

- Structural analysis of the domestic floriculture indicates a large share of amateur sector in the production sphere. On the one hand, it provides self-employment; on the other hand, it increases severity of competition in the flower and ornamental crops market. As a result, it is necessary to create the conditions to economically move floriculture to the large agribusiness sector by applying tax and investment incentive mechanisms.
- Innovation processes in Russian floriculture are insufficiently developed, which is determined by the weak economic motivation of the parties involved.
- A range of problems of innovative floriculture development stems from the deficiency of scientific, investment and production factors.
- Economic growth in floriculture is possible under conditions of its innovative development, which in turn require creating a scientific and production system in the industry, that would contribute to the conciliation of interests of the parties represented on the flower and ornamental plants market.

Table 3. The efficiency of the innovation process in floriculture in I. V. Michurin All-Russia Research Institute of Horticulture, 2012

Indices	Without innovations	With innovations	Ratio of point 2 to point 3, %
Gross production per 1 m^2 of open ground, rub.	403,3	458,2	113,6
The cost of planting stock production per 1m^2,rub.	650,1	714,4	109,8
Revenues from sales per 1 m^2, rub.	895,8	1029,7	115,1
Profit on sales per 1 m^2, rub.	245,7	315,3	128,3
Level of profitability,%	37,8	44,1	+6,3 p.p.

5. Conclusion

The research performed has not fully covered the ways of solving industry problems. Further analysis of innovative floriculture development issues should focus on accelerating the processes – from selection and obtaining new cultivars of planting stock in amounts sufficient for mass production to their introduction.

6. References

1. Bernal J. Moscow: International Literature: Science in history of society. 1956 Dec.
2. Distinguishability, homogeneity and stability. Tester User's Guide. The Gladiolus. The document translated by the International Union for the Protection of New Varieties of Plants (UPOV). 1988. p. 10-21.
3. Gromov AN, Ardab'evskaia TV. Moscow: OLMA-PRESS: Gladioli. 2002.
4. Guidelines for Assessing the Investment Projects Efficiency. Second edition update. Rosstroy: Approved by the Ministry of Economic Development of the RF, The Ministry of Finance of RF. 1999 Jun.
5. International union for the protection of new varieties of plants. The State register of selection achievements, approved for use in Russia. 2013 Oct. p. 1-22.
6. Ivanova O. The review of flower market in Russia. 2013. Date accessed 10/10/2015: Available from: http://www.press-release.ru/branches/pr/08cd354badd83/.
7. Kilchevskij AV, Khotyleva LV. Minsk: Science and Technics: Genotype and environment in plant selection. 1989. p. 180-89.
8. Krylov EI, Vlasova VM, Zhuravkova IV. Moscow: Finance and Statistics: Performance Analysis of Corporate Investment and Innovation Activities. 2003. p. 608.
9. Kuzichev BA, Kuzicheva OA. The research results on introduction, cultivar studies and selection of the gladiolus hybrid in I. V. Michurin All-Russia Research Institute of Horticulture. In Introduction of rare, exotic plant species. Michurinsk, Russia: Proceedings of the VIII International scientific conference. 2008.
10. Kuzichev BA, Kuzicheva OA, Kuzichev OB. The selection and allocation of winter-hardy forms of gladiolus in the Central Black Earth Region. In Prospects of the horticulture development in the Central-Black earth state natural biosphere reserve, experience of industry development in other countries and regions. Voronezh: Voronezh State Agricultural University: Proceedings of the International research-to-practice conference of young scientists, devoted to Doctor of Agricultural Science, Professor A. N. Veniaminova, 100th anniversary. 2004. p. 29-30.
11. Kuzichev OB, Kuzicheva NY. The effectiveness of the selection process in floriculture: Methodological aspect. Vestnik Kras SAU. 2014 Apr; (6):133-38.
12. Murin AV, Lysikov VN. Kishinev: Shtiintsa: Genetic bases of creation of initial material of a gladiolus. 1989.
13. Nechaev VI. The gist of the selection process efficiency in a transition economy. In Wheat and triticale. Krasnodar, Russia: Sovjetskaia Kuban: Proceedings of the research-to-practice conference, P. P. Lukianenko's green revolution). 2001 Sep. p. 632-37.
14. Romanenko TN. Maikop: The economic efficiency of crops selection and the use of new varieties in farm production (author's abstract of dissertation). 2006. Date accessed: 04/10/2015: Available from: http://economy-lib.com/ekonomicheskaya-effektivnost-selektsii-zernovyh-kultur-i-ispolzovaniya-novyh-sortov-v-selskohozyaystvennom-proizvodstve.
15. Schumpeter JA. Moscow: Directmedia publishing: The theory of economic development. 2008.
16. Sokolova T, Bochkova IY. Moscow: Academy: Ornamental plant-growing: Floriculture. 2011.
17. Tamberg TG. Leningrad: N. I. Vavilov Research Institute of Plant Industry: Methodology of primary cultivar study of the gladiolus hybrid (Gladiolus hybridus hort.). 1972.
18. Tulintsev VG. Leningrad: Strojizdat: Floriculture with the elements of selection and seed growing. 1977.
19. Twiss B. Moscow: Economy: Managing scientific and technological innovations. 1989.
20. Vetrova IF. The indices, characterizing the efficiency of selection achievements creation processes. 2011. p. 147-50.
21. Gajendran Natarajan. Eritrea Institute of Technology: an Innovative Centre Imparting Knowledge and Discipline. Indian Journal of Science and Technology. 2007 Nov; 1(1):1-2.
22. Gupta Nishikant, Singh Navneet. The Abundance of Avifauna in an Agricultural Landscape: A Benefit of Community Conservation Initiatives in Haryana, India. Indian Journal of Science and Technology. 2014 Jan; 7(4):537-41.