

## ASSESSMENT OF THE EFFICIENCY OF INFORMATION TECHNOLOGIES USE IN FRUIT-GROWING FARMS

### Summary

The aim of the conducted study was to evaluate to what extent information technologies are used by farmers engaged in fruit-growing production with respect to implementing and maintaining a production system that is compliant with the GLOBAL G.A.P. standards. The study covered 71 farms associated in five producer groups. The study was conducted in Łódzkie and Mazowieckie provinces. Commercial farms were used in the study; those farms use the latest technologies and means in production, and they achieve high yields. In order to reach the established aim of the study, a survey was conducted. Based on the survey, it was estimated to what extent those farms use information technologies when designing the production system and implementing the GLOBAL G.A.P. system. Most of the studied farmers do not see the benefits of implementing quality systems in primary production. Based on the conducted study it was found that information on the principles of quality systems as well as information concerning plant protection are usually searched for on the Internet, whereas trade journals are the most trusted by the surveyed farmers as regards information on new technologies. When it comes to fertilization, the studied farmers use information technologies to a very small extent. All the respondents claim that development of new production technologies is conditioned by the access to a quick and accurate source of information.

**Key words:** fruit farm, information technologies, GLOBAL G.A.P.

## OCENA EFEKTYWNOŚCI WYKORZYSTANIA TECHNOLOGII INFORMACYJNYCH W GOSPODARSTWACH PROWADZĄCYCH PRODUKCJĘ SADOWNICZĄ

### Streszczenie

Celem przeprowadzonych badań była ocena zakresu wykorzystania technologii informacyjnych przez rolników prowadzących produkcję sadowniczą w zakresie wdrażania oraz utrzymywania systemu produkcji zgodnego z zasadami GLOBAL G.A.P. Badaniami objęto 71 gospodarstw zrzeszonych w pięciu grupach producenckich. Badania przeprowadzono na terenie województwa łódzkiego i mazowieckiego. Do badań wykorzystano gospodarstwa towarowe, które stosują w produkcji najnowsze technologie i środki oraz osiągają wysokie plony. W ramach celu realizacji założonego celu badań przeprowadzono wywiad, na podstawie którego oszacowano w jakim zakresie korzystają z technologii informacyjnych przy projektowaniu systemu produkcji oraz przy wdrażaniu systemu GLOBAL G.A.P. Większość badanych rolników nie dostrzega korzyści z wdrażania systemów jakości w produkcji pierwotnej. Na podstawie przeprowadzonych badań stwierdzono, że najczęściej informacje o zasadach systemów jakości oraz informacje dotyczące ochrony roślin poszukiwane są w źródłach internetowych, natomiast czasopisma branżowe cieszą się największym zaufaniem ankietowanych rolników w zakresie informacji o nowych technologiach. Ankietowani rolnicy w bardzo małym zakresie korzystają z technologii informacyjnych w zakresie nawożenia. Wszyscy ankietowani twierdzą, że rozwój nowych technologii produkcji jest uwarunkowany dostępem do szybkiego i rzetelnego źródła informacji.

**Słowa kluczowe:** gospodarstwa sadownicze, technologie informacyjne, GLOBAL G.A.P.

### 1. Introduction

Development of agriculture in the current market and environmental conditions is associated with increasing effectiveness of production means. The need for rationalization of land use, work and depletable environmental resources results on one hand from the need to lower the costs of food production, and on the other hand from the needs of the consumer who seeks high quality food, for production of which methods based on the sustainable use of environmental resources were utilized. Conventional farming, whose aim is to maximize yields from a unit of surface, is regarded as an activity that has a very negative effect on the environment. In addition, products produced in such a system can contain high amounts of pesticide, nitrate and heavy metal residues. In order to enable producers to implement production methods that guarantee a better quality

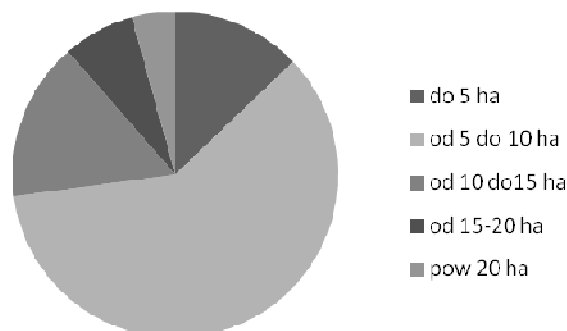
of products (with respect for environmental resources), certified production systems are being implemented all over the world. These systems include: Integrated production (IP), Tesco Nature, or G.A.P. Certification of a production management system and marking of products allow the consumer to choose them consciously, that is why certified products are more and more frequently chosen by customers. The idea of all certified quality systems in primary production puts emphasis on environmental and health aspects in agricultural production. Environmental benefits are associated with the reduced amount of xenobiotics introduced into the environment through rational plant protection techniques (based primarily on agrotechnical and biological methods). Using pesticides should be preceded by results of thorough monitoring of crops and by making every effort to first use biological and agrotechnical methods to protect plants [7, 14, 18]. Optimization of the plant protection sys-

tem may reduce the ecotoxicological effect of farming on the environment and consumer, even by several orders of magnitude. Many researchers have drawn attention to this problem [5, 8, 16]. Fertilization also plays an important role in crop production because it influences the amount and quality of yield, and also shapes the physical and physico-chemical properties of soil [12]. From the producer's point of view, fertilization is an important factor that shapes production costs. Too high and too low doses of fertilizers, and also improper fertilization technologies have an adverse effect on the environment and on the amount and quality of yield [15]. Implementation of the principles of primary production systems is, however, problematic due to the necessity to keep extensive documentation of production and because of the difficulties in implementing new technologies. The mentioned problems are associated with insufficient preparation of farmers in terms of drawing up implementation documentation as well as with their little knowledge of biological and environmental aspects of agricultural production and lack of universalism in the used fertilization and plant protection technologies [10]. Effective implementation and production compliant with the IP or G.A.P. systems are very often connected with the necessity to engage highly qualified personnel to deal with plant protection, fertilization and keeping documentation [6]. Due to substantial costs of comprehensive management of quality systems by consulting firms, many producers decide to partly use their services, seeking alternative sources of information on the issue of production technology compliant with the adopted quality system. Despite the benefits which arise from the ideological assumptions, implementation of quality systems is risky with the present level of knowledge and experimentation owing to a higher risk of crops being destroyed by pest, diseases, and also owing to the risk of plant malnutrition, mainly with nitrogen [11]. The aim of the study was to evaluate to what extent information technologies are used by farmers engaged in fruit-growing production. All the studied farmers carried out production compliant with the GLOBAL G.A.P. standard.

## 2. Material and methods

The study covered 71 farms associated in five producer groups: Gold Sad, Eurosad, Rajpol, Janfruit, and Roja. The study was conducted in Łódzkie and Mazowieckie provinces, in Rawa, Skierniewice and Grójec counties. Fruit farms that were used in the study produce only apples and have highly intensified production. Average area in the group of studied farms is 9.11 ha. The biggest group were farms with the area between 5 and 10 ha (Fig. 1). The study material was purposefully selected. Commercial farms were used in the study; those farms use the latest technologies and means in production, and they achieve high yields. In order to reach the established aim of the study, a survey was conducted. Based on the survey, it was estimated to what extent those farms use information technologies when designing the production system and implementing the GLOBAL G.A.P. system. The questions concerned sources of information about the Global G.A.P. system and about other systems in primary production, as well as sources of information connected with production technologies (protection, fertilization, use of new varieties and new cultivation systems) and the extent to which this information is used. Questions about the usefulness of available sources of in-

formation in terms of their practical use constituted another group.



Source: own work / Źródło: opracowanie własne

Fig. 1. Number of farms in particular groups of cultivated areas

Rys. 1. Ilość gospodarstw w poszczególnych grupach powierzchni upraw

## 3. Results

Efficient decision making when managing a farmstead is conditioned by speed, fullness and reliability of information obtained by the farmer. Agricultural producers obtain information about new production technologies, new cultivars, pesticides and fertilizers from various sources, among which the following are most often mentioned: private consultancy, trainings organized by agriculture-supporting institutions, trade literature, and Internet sources (which have been gaining importance in recent years). Information technologies are increasingly important for primary production as they provide farmers with information necessary for efficient management of a farm [1, 2, 3, 4]. Optimization of crop production requires a supply of knowledge of linking the course of weather conditions to intensification of pests in specific soil conditions, at the production of specific cultivars. Interrelations between the size of production, the quality of yield and the use of production means require large amounts of information to be provided as well as proper interpretation of this information [9, 17]. Results of the conducted study indicate that producers have little awareness of the implementation of the GLOBAL G.A.P. system in primary production. In most cases, the farmers were informed about the rules of Global G.A.P. certification by boards of producer groups which had imposed this certification on them. Similar results were obtained by Papadopoulos and Markopoulos [13] in a group of farmers who implemented Integrated Production. In this study, approximately 20% of respondents had learned about the possibility of certification of compliance with this system at trainings organized by Agricultural Consultancy Centers and other entities such as stores, fertilizer production companies, certification bodies. Almost 10% of the farmers had obtained information about certification from trade press, and 7% of the farmers had obtained it from the Internet (Tab. 1). Studies have shown that the Internet is not often used as a source about new agricultural systems. Most respondents do not see the benefits connected with implementing new quality systems, and this is how they justify their lack of actions to look for information on this issue. Maintaining the GLOBAL G.A.P. system involves the need to raise costs, and the price of certified products is not higher than the price of fruit from conventional farming.

Table 1. Sources of information used by surveyed producers with regard to GLOBAL G.A.P. certification

Tab. 1. Źródła informacji wykorzystywane przez ankietyowanych producentów w zakresie certyfikacji GLOBAL G.A.P.

		Producer group	Internet	Trade journals	Trainings	Other farmers	Consulting
source of knowledge on quality systems	amount	40	5	7	15	4	-
	%	56.4	7.0	9.9	21.1	5.6	-
source of knowledge on GLOBAL G.A.P	amount	6	38	10	15	2	-
	%	8.5	53.5	14.1	21.1	2.8	-
implementation of the GLOBAL G.A.P. system	amount	10	-	-	-	-	61
	%	15.5	-	-	-	-	84.5

Source: own work / Źródło: opracowanie własne

Table 2. Sources of information used by surveyed producers with regard to production technologies

Tab. 2. Źródła informacji wykorzystywane przez ankietyowanych producentów w zakresie technologii produkcji

		Producer group	Internet	Trade journals	Trainings	Other farmers	Cconsulting
source of information on new technologies	amount	4	20	25	13	3	6
	%	5.6	28.2	35.2	18.3	4.2	8.5
source of information on plant protection techniques	amount	0	40	10	0	6	15
	%	0	56.3	14.1	0	8.5	21.1
source of information on fertilization technologies	amount	2	10	20	4	25	10
	%	2.8	14.1	28.2	5.6	35.2	14.1

Source: own work / Źródło: opracowanie własne

They usually obtain information on the principles of the system from Internet sources. 53% of the respondents indicate the Internet as the most important source of knowledge, and the second place belongs to trade literature. As many as 49% of respondents have subscribed to at least one trade journal (Tab. 1). All the respondents who have subscribed to trade journals believe them to be a reliable source of news on the principles of management compliant with the GLOBAL G.A.P. system. All the producers think

that it is important to gain knowledge on the principles of implementing a quality system. The fear of non-conformities, which can lead to a loss of certification, is an argument in favor of acquiring knowledge on the GLOBAL G.A.P. system. Implementation of the GLOBAL G.A.P. system is connected with reorganization of the production technology, a change in the approach to the issues of plant protection, and with the need to create necessary risk analyses and procedures whose observance will ensure conformity of production with the principles of the system. From all the surveyed farms, 84.5% had used services of a consulting firm when preparing documentation connected with implementation of the system. 15.5% (Tab. 1) of producers implemented the system individually, using services of a consulting firm. None of the surveyed producers implemented the GLOBAL G.A.P. system alone. Structure of using information from various sources is different in the case of new production technologies, new varieties and agricultural machines. More than 60% of respondents indicate Internet sources and trade press as the most important source of information on new technologies. Approximately 13% of respondents obtain most information during trainings organized by a producer group and entities that constitute institutional support for agriculture.

Approximately 8.5% of respondents do not acquire knowledge by themselves, they use consultancy with respect to implementing new technologies (Tab. 2). Most of the surveyed farmers use the internet based pest alert system, administrated by PIORiN (Main Inspector of the State Plant Health and Seed Inspection), and 56.3% indicate it to be the most important and the most reliable source. 20% of the producers indicate orchard plant protection programmes as the most important, while most of them also use the pest alert system. Approximately 21% of the studied producers purchase a comprehensive system of consultancy associated with plant protection, whereas 8.5% follow their neighbours' advice (Tab. 2). Integrated protection of orchard plants is difficult; this is connected with a variable range of products permitted for use and with the need to apply them at the proper stage of pest intensification. All farmers are aware that proper use of pesticides, both from the quantitative and qualitative perspective, has an effect on the size of production and trade quality of the product. The studied producers use information technology the least in fertilization management. Only 14% of respondents use Internet sources, twice as many indicate trade literature as the main source of knowledge. As many as 35% of the farms apply fertilization based on advice from people they know, and 10% use comprehensive services of specialized firms. Only 4 farmers indicated trainings as the main source of knowledge (Tab. 2). All the studied farmers believe that information provided during trainings is not objective because in most cases trainings are conducted by trade representatives. More than 80% of respondents do not trust the fertilization methods promoted in modern production systems. Fertilization that is based on analyses of soil and leaves requires thorough knowledge on physiological and environmental aspects of element uptake by plants. Implementation of these fertilization technologies is always associated with reducing the amount of fertilizers used. More than half of the respondents believe that there is a high risk of reducing the amount of yield. All the farmers who took part in the study are aware that the level of fertilization translates into yield quality. In order to assess the effect of

the farm size on the preferences regarding the source of information, the studied farms were divided into two groups. First with an area up to 10 ha, and second with the size of cultivated area of more than 10 ha (Tab. 3).

Table 3. Sources of information used by surveyed producers depending on size of the crop area [%]

Tab. 3. Źródła informacji wykorzystywane przez ankietowanych producentów w zależności od powierzchni upraw [%]

		Producer group	Internet	Trade journals	Trainings	Other farmers	Consulting
source of knowledge on quality systems	≤10 ha	55	5	20	15	5	0
	> 10	56.9	7.8	5.9	23.5	5.9	0
source of knowledge on GLOBAL G.A.P	≤10 ha	10	55	20	10	5	10
	> 10	7.8	52.9	11.8	25.5	2.0	7.8
implementation of the GLOBAL G.A.P. system	≤10 ha	2	10	20	4	25	10
	> 10	2.8	14.1	28.2	5.6	35.2	14.1
source of information on new technologies	≤10 ha	0	20	35	20	0	25
	> 10	7.8	31.4	35.3	17.6	5.9	2.0
source of information on plant protection techniques	≤10 ha	0	35	15	0	0	50
	> 10	0	64.7	13.7	0	11.8	9.8
source of information on fertilization technologies	≤10 ha	0	15	25	10	20	30
	> 10	3.9	13.7	29.4	3.9	41.2	7.8

Source: own work / Źródło: opracowanie własne

In the group of farms of up to 10 ha, the farmers are more inclined to use Internet sources and trade literature when it comes to acquiring knowledge on fertilization and plant protection. Owners of bigger farms use consultancy on fertilization and plant protection more often. Owners of bigger farms usually use consultancy and trade literature to acquire knowledge about new technologies, whereas in the case of smaller the Internet and trainings were indicated more often. When it comes to obtaining information on certification of compliance with the GLOBAL G.A.P. standard, no relationship between the preference of source of information and the size of farm was observed.

#### 4. Conclusions

1. Most of the studied farmers do not see the benefits of implementing quality systems in primary production.
2. Information about quality systems being implemented and information concerning plant protection are usually searched on the Internet.
3. Trade literature is the most trusted by the surveyed farmers as regards information on new technologies.
4. When it comes to fertilization, the studied farmers use information technologies to a very small extent.
5. All the respondents claim that development of new production technologies is conditioned by the access to a quick and accurate source of information.

#### 5. References

- [1] Behera B.S., Panda B., Behera R.A., Nayak N., Behera A.C., Jena S.: Information Communication Technology Promoting Retail Marketing in Agriculture Sector in India as a Study. *Procedia Computer Science*, 2015, Vol. 48, 652–659.
- [2] Cole D.C., Levin C., Loechl C., Thiele G., Grant F, Girard A.W., Sindi K., Low J.: Planning an integrated agriculture and health program and designing its evaluation: Experience from Western Kenya. *Eval. and Program Plann.*, 2016, Vol. 56, 11–22.
- [3] Craheix D., Angevin F., Doré T.: de Tourdonnet S.: Using a multicriteria assessment model to evaluate the sustainability of conservation agriculture at the cropping system level in France. *Europ. J. of Agron.*, 2016, Vol. 76, 75–86.
- [4] Cupał M., Szelaż-Sikora A., Niemiec M.: Dobór dawki nawozów mineralnych w gospodarstwie przy wykorzystaniu programu Nawozy-2. *Proceedings of ECOpole*, 2015, Vol. 9(1), 179–184.
- [5] Danis T.G., Karagiozoglou D.T., Tsakiris I.N., Alegakis A.K., Tsatsakis A.M.: Evaluation of pesticides residues in Greek peaches during 2002–2007 after the implementation of integrated crop management. *Food Chem.*, 2011, Vol. 126(1), 97–103.
- [6] Deike S., Pallutt B., Christen O.: Investigations on the energy efficiency of organic and integrated farming with specific emphasis on pesticide use intensity. *Europ. J. Agron.*, 2008, Vol. 28, 461–470.
- [7] Dyrektywa Parlamentu Europejskiego i Rady z dnia 21 października 2009 r. 2009/128/WE ustanawiająca ramy wspólnotowego działania na rzecz zrównoważonego stosowania pestycydów.
- [8] Jurasić R., Sanjuán N.: Life cycle toxicity assessment of pesticides used in integrated and organic production of oranges in the Comunidad Valenciana, Spain. *Chemosphere*, 2011, Vol. 82(7), 956–962.
- [9] Kersting S., Wollni M.: New institutional arrangements and standard adoption: Evidence from small-scale fruit and vegetable farmers in Thailand. *Food Policy*, 2012, Vol. 4, 452–462.
- [10] Morris C., Winter M.: Integrated farming systems: the third way for European agriculture? *Land Use Policy*, 1999, Vol. 16, 193–205.
- [11] Mzoughi N.: Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? *Ecol. Econ.*, 2011, Vol. 70, 1536–1545.
- [12] Niemiec M.: Efficiency of slow-acting fertilizer in the integrated cultivation of Chinese cabbage. *Ecol. Chem. Eng. A*, 2014, Vol. 21(3), 333–346.
- [13] Papadopoulos S., Markopoulos T.: Factors Affecting the Implementation of Integrated Agriculture in Greece. *Procedia Economics and Finance*, 2015, 33, 269–276.
- [14] Perdikić D., Fantinou A., Lykouressis D.: Enhancing pest control in annual crops by conservation of predatory *Heteroptera*. *Biol. Control*, 2011, Vol. 59(1), 13–21.
- [15] Pypers P., Sanginga J-M., Kasereka B., Walangululu M., Vanlauwe B.: Increased productivity through integrated soil fertility management in cassava-legume intercropping systems in the highlands of Sud-Kivu, DR Congo. *Field Crop. Res.*, 2011, Vol. 120(1), 76–85.
- [16] Shahpoury P., Hageman KJ, Matthaeci CD, Francis S, Magbanua FS.: Chlorinated pesticides in stream sediments from organic, integrated and conventional farms. *Environ. Pollut.*, 2013, Vol. 181, 219–225.
- [17] Shukla K.K., Patel D.J., Radadiya B.L.: Role of Information Technology in Improvement of Current Scenario in Agriculture. *Oriental Journal of Computer Science and Technology*, 2014, Vol. 7(3), 390–395.
- [18] Tuomisto H.L., Hodge I.D., Riordan P., Macdonald D.W.: Exploring a safe operating approach to weighting in life cycle impact assessment a case study of organic, conventional and integrated farming systems. *J. of Clean. Prod.*, 2012, Vol. 37, 147–153.