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Environmental management, land use, biodiversity

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APPLICATION OF PESTICIDES BY DRONES FROM THE POINT OF AUTHORITIES

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ABSTRACT

Agricultural precision farming has gone through a huge development recently, which applies to plant protection as well. It can be said that it is no longer just a strong interest in using drones as plant protection machines, but the use of these machines in agriculture has actually begun. As though drone spraying has been granted social legitimacy. In our research, the regulatory instruments currently in force have been examined. However, for the time being, the exercise of the activity constitutes an infringement that the authorities – following the existing legal requirements – may only consider as fine to be imposed on the person carrying out the activity. It has been declared that, as a result of a growing interest coming from the farmers, a more extensive use of drones in activities of pest protection will be made available when creating the related regulations.

keywords: sustainable agricultural, crop protection, drone technology, legislation

INTRODUCTION

Agricultural production has undergone a vast technical development during the past decades. (Rodroques 2009). As a result of development, our yields in terms of cultivated plants have increased in such a way that in the meanwhile a much higher emphasis was put on environment protection as well as nature conservation (Lav R. et al. 2012). As a consequence of technological development, less and less dosage of both fertilising products and pesticides has to be used (Gebbers és Adamchuk 2010). A growing demand towards plant protection treatments with the use of drones has also occurred lately.
I analysed how –as part of precision agriculture – farmers are increasingly encouraging the use of drones as plant protection machines, in particular for the application of plant protection products, however, the domestic legal environment of this activity is still being developed and the exercise of this activity is therefore still illegal. Meaning by this that plant protection treatments with a drone should be sanctioned by the imposition of plant protection penalty. The legislative process has not progressed by the time this study was written. The use of pesticides by drones continues to be illegal activity. Meanwhile, not only has the interest in drone plant protection increased, but the plant protection authority had been informally aware from the beginning of 2020 that drone treatments were becoming more common. In the end, it was inevitable that by the end of August 2020 a drone treatment is officially on the authority's radar and an official administrative procedure is therefore initiated for the imposition of a fine. The study seeks to demonstrate how the authority interprets existing legislation, and in the light of that how legally assesses the plant protection activity with a drone and what sanction it applies.
The authority carried out its procedure for the application of pesticides by drone on the basis of the legislative provisions referred to below (Figure 1.).

Figure 1: Drones with precision sprayers (insert) apply agrochemicals only where they are needed
(Source: Anthony 2017)

1. In accordance with Paragraph 1. (4) of the Act No CLXV of 2013 on Complaints and Public Interest Disclosures:
„Any person may lodge a complaint and public interest

notification with the body entitled to take action in the matter relating to the complaint or to the public interest notification (hereinafter: competent body). The public interest notification made orally shall be recorded in writing by the competent body and shall be provided in a duplicate to the public interest notifier.".

According to Paragraph (1). 2. of Act on Complaints:

„The complaint and the notification in the public interest must be dealt with within 30 days of receipt of the complaint by the competent body, unless provided otherwise by law.".

According to point d) Paragraph (1) 3. of Act on Complaints:

„In the light of the complaint or the public interest notification - if it proves to be valid – provision should be made for the initiation of Liability where appropriate.".

2. According to Paragraph 99. of the Act CL of 2016 on the Code of General Administrative Procedure (hereinafter: GAP.):

„The authority shall – within its powers – verify compliance with the provision of law, and compliance with the enforceable decision.".

According to point a) of Paragraph (1) of 101. GAP:

„If the authority finds an infringement during an official inspection, it shall initiate proceedings,".

According to Point a) in Paragraph (1) of 104. GAP:

„The authority initiates the procedure ex officio in its area of competence if it becomes aware of the circumstance giving rise to the initiation of proceedings,".

3. According to the Decree 43 of 2010 of the Ministry of Agriculture and Rural Development on the rules of plant protection 5. Paragraph (1)-(2):

„5. § (1) Plant protection products shall only be used as authorised in full compliance with occupational health and chemical safety rules."

„(2) Plant protection products shall be used in accordance with the requirements of the marketing and use authorisation (hereinafter: licence), in compliance with its labelling requirements for the prevention of risk to man and the environment and in accordance with its instructions for its use and plant protection technology. "

According to Paragraphs (1), (2) of 32 and Paragraph (1) of 34 of the Decree 43/2010:

„32. § (1) Plant protection machines with tanks bigger than 5 dm3 – except plant protection machines for research, testing, experimenting or exhibition purposes - shall be subjected to the type-approval procedure in accordance with Annex 3 for droplet formation and spraying technology before marketing.

(2) Plant protection machines that have legally binding international quality assurance certification documents may be approved administratively. The producer, or the distributor must declare to the Institute of Agricultural Engineering National Agricultural Research and Innovation Centre (hereinafter: the Institute) that the plant protection machinery meet the marketing requirements specified in this regulation.

34. § (1) If, as a result of the type-rating procedure a plant protection machinery does not comply with the requirements set out in Paragraph (1) 32. § (1), the Institute shall not grant the marketing authorisation, or withdraw the authorisation already granted.

4. According to Paragraph (1) 17/B of Act XLVI of 2008 on the food chain and the official supervision thereof (hereinafter: Act on Food Chain):

„Plant protection machinery shall be subject to type rating before marketing and periodic technical inspection (hereinafter: technical inspection) during use in accordance with the legislation issued for the implementation of this Act."

According to Paragraph (1) 56 of Act on Food Chain:

"In case of infringement of this Act, or the legislation issued for the implementation of this Act, as well as the infringement of the Act of the European Union which is directly applicable, and in the event of infringement of the provisions of an official decision the Food Chain Inspection Body may take action, impose a fine or give a warning to the legal person subject to the proceedings, an organization or natural person without legal personality (hereinafter in this chapter: the person subject to proceedings."

According to Point d) of Paragraph (1) of Act on food Chain 60:

„A plant protection fine shall be imposed on persons who market, advertise, offer to the public or use a product that is subject to prior authorisation without authorisation, by way other than authorisation, without registration or by way of derogation of registration, or without the qualification or certification for the activity;"

According to Point i) of Paragraph (1) of Act on Food Chain 60:

„A plant protection fine shall be imposed on persons who do not have marketing authorisation (type rating), in addition did not participate in a periodic inspection, or marketed, operated or used non-compliant plant protection machinery;"

5. The section entitled "Plant Protection Fine" and Annex I. of the Government Decree of 194/2008. (31.VII.) concerning the method of calculation and the scale of penalties in relation with food chain control set out the rules under which the authority determines the amount of the fine to be imposed.

MATERIAL AND METHODS

After reviewing the existing legislation, the procedural acts that the authority has taken to clarify the facts will be described as well as what facts had to be assessed.

On 31 of August 2020 a notification has been submitted to the plant protection authority. According to the

notifier, the iceberg lettuce grown by the notifier was damaged due to the dessication of the neighbouring sunflowers by drone. It needs to be clarified that the authority's notification procedure was a broader one that investigated the illegal drift during pesticide application, and this included the legal assessment of the plant protection treatment with the drone.

The authority examined the notification with regard to the provisions of the Complaint Act. In the course of the investigation, it carried out an official inspection according to the Code of General Administrative Procedure., as a part of which an on-the-spot check was carried out on the 2nd of September 2020. During the visit the user of the sunflower area presented and verified with an invoice that the dessication of the sunflowers was carried out in the evening of 26 August 2020 using the product Reglone Air in the dosage of 2,0 l/ha with a total spray volume of 8 l/ha by drone application by a service provider. During its procedure the authority concluded that the operator did not have a pilot authorisation for plant protection treatment with the drone.

Although it is no longer necessary to prove unlawful use of drones, it is interesting to devote a few sentences to the experience of the field check that demonstrate the drift of the plant protection product. During the on-site visit it was found that the sunflower is dried due to desiccation, as was the weed it contained in it. Cultures on the East, South and West sides of the plate show no symptoms. However, beyond the 18 metres wide stubble field of oil radishes, on the iceberg and maize at the depth of 168 metres and some of the weeds contained therein had necrosis spots in the leaves, and in more severe cases, leaching of the leaves. The effects of the spray reaching into the cornfield were also observed in lower weeds inside the stock. A significant part of the declared iceberg lettuce culture has been damaged to such an extent that it has become unmarketable. Phytotoxic symptoms on vegetation indicate scorching herbicide, which includes diquat-dibromide, the active substance of Reglone Air. So there is a causal link between the desiccation of the sunflower and the damage to adjacent cultures.

The authority found an infringement on the basis of the experience of the site visit, customer statements, documentary evidence and laboratory examination records, and, of its own motion, initiated an official procedure against a customer carrying out plant protection treatment with a drone.

The authority has notified the client of the initiation of the procedure. The client did not make use of his right to make a statement within the deadline, so the authority issued a decision imposing a plant protection fine on the basis of the evidence at its disposal.

RESULTS

In this section, an overview is given of how the authority applied the legal provisions cited in relation to the use of pesticides by the drone. In other words, how the authority has established that the application of pesticides by a drone by the customer is illegal and, in view of this, what penalties were applied and to what extent.

Decree 43 of 2010 of the Ministry of Agriculture and Rural Development on the rules of plant protection Paragraph 5. Article (1), (2) provide that plant protection products may be used only in the authorised manner and in accordance with the specifications and instructions of the marketing and use authorisations and labels. The authority considers that the customer by the application of the product Reglone Air subject to licence with an agricultural drone, in the amount of 8 litres per hectare has performed a use and application different than set out in the licence, as the emergency licence of NÉBIH 6300/234-1/2020 states that *"Reglone Air may be used in autumn colza and sunflower crops for the production of good, furthermore in sunflower seed production for pre-harvest stock drying in the dosage of 1,5-2,0 l/ha by land-based machinery (hydra-tractor) spraying 300-400 l/ha… The preparation may be used by air applications in sunflower and autumn colza in at least 10 ha contiguous areas with an obligatory addition of a drop heavy additive in the amount of 50 to 60 litres/ha spray mixture."* Even the emergency licence does not approve the spraying in the volume of 8 l/ha by the use of agricultural drone.

The Act of 17/B. § (1) on the food chain and the official supervision thereof and 32. § (1), (2) and 34. § (1) state that plant protection machinery shall be subject to a type-approval procedure as a precondition for the granting of a marketing authorization. The authority concluded that the client had carried out plant protection services activities with drone equipment without Type Rating. The client attempted to interpret the activity as pilot application, however no experimental authorization has been granted by the competent authority for that area.

As a result of the official control carried out during the investigation of the complaint received on the 31st of August 2020 – on the basis of the on-site inspection, customer statements and documents obtained – the authority concluded that by using the plant protection product subject to authorisation in a different way, and using plant protection machinery without marketing authorisation (type rating) the client has committed an infringement.

In the light of the infringement established, the authority has decided to initiate proceedings on its own motion against the client for the imposition of a plant protection fine in accordance with point a) Paragraph (1) of 101 in the Code of General Administrative Procedure.

In the following, the basis and extent of the imposition of

Table 1: Basic fines to be applied in determining the amount of the plant protection penalty shown in table B) in thousand HUF

Infringement of Table B)	Persons subject to proceedings that are not subject to the Accounting Act	Subject to the Accounting Act not exceeding HUF 500 million net annual turnover	Subject to the Accounting Act exceeding HUF 500 million net annual turnover
d) point 3.	100	300	500

the fine will be examined. In case of infringement of the provisions laid down in the Act on the food chain and the official supervision thereof 56. Paragraph (1) or in the legislation issued for its implementation, the authority may impose a fine. In the present case, the grounds for imposing a fine are laid down in Article 60 of the Act on the food chain and the official supervision thereof Paragraph 1, points d) and i), according to which a plant protection fine shall be imposed on a person using a product subject to authorisation in a manner other than set out in the authorisation; using plant protection machinery without marketing authorisation (type rating).

As the authority found, as above, the infringements committed by the customer, thus imposed the two fines.

The amount of the fine is primarily determined by the rules of the Government Decree. At this point, it must be borne in mind that the authority also assessed the fact of the drift in the original proceedings when imposing the fines. Thus, instead of describing the specific fine amount, only the rules of the calculation are derived. In accordance with Point i) 2 of Annex No 1 of the Government Decree, the amount of the plant protection fine set out for the use of plant protection machinery without marketing authorisation (type rating) is HUF 50.000 per machinery. In accordance with Point 3., Paragraph d) in Table B) of Annex No1 of the Government Decree plant protection penalty rate for the use of a product subject to authorisation in a manner other than permitted is up to HUF 150 million, depending on the risk arising from use. Paragraph (1) of the Government Decree 5. provides that plant protection fines for infringements listed in Table B) of Annex No 1.shall not be less than the minimum specified in Table C) of Annex No1 for the given facts (Table 1.).

In the procedure described, the client was a company with an annual net turnover not exceeding HUF 500 million.

In view of the above, the minimum amount of the fine to be imposed is HUF 350.000. In other words, no lower amount may be set by the authority. The upper limit is HUF 150 million. The amount of the fine to be imposed under the fines shall be determined by the authority, taking into account the circumstances of the case, in which it may not disregard the principle of graduality. Thus, in the case of a first infringement, the amount of the fine clearly tends towards the lower limit.

DISCUSSION

It can be said that it is no longer just a strong interest in using drones as plant protection machines, but the use of these machines in agriculture has actually begun. As though drone spraying has been granted social legitimacy. However, for the time being, the exercise of the activity constitutes an infringement that the authorities – following the existing legal requirements – may only consider as fine to be imposed on the person carrying out the activity.

CONCLUSIONS

It can be said that it is no longer just a strong interest in using drones as plant protection machines, but the use of these machines in agriculture has actually begun. As though drone spraying has been granted social legitimacy. However, for the time being, the exercise of the activity constitutes an infringement that the authorities – following the existing legal requirements – may only consider as fine to be imposed on the person carrying out the activity.

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7. Act XLVI of 2008 on food chain and the official supervision thereof;
8. Government Decree No.194 of 2008 concerning the method of calculation and the scale of penalties in relation with food chain control;
9. Decree 43 of 2010 of the Ministry of Agriculture and Rural Development on the rules of plant protection;

NATIONAL GUIDANCES OF BEST AVAILABLE TECHNIQUES CONCERNING THE INTENSIVE REARING OF PIGS AND POULTRY

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ABSTRACT

The Ministry of Agriculture recognized with the changing of legal basis that since the intensive rearing of pigs and poultry is a significant sector within Hungary an environmental guidance is needed for the operators of these installations, for authorities but also for experts assembling and submitting permit application documents.
Herman Otto Institute Nonprofit Ltd. has developed two guidance documents taking into consideration the previous existing guidelines produced by the Institute for Environmental protection, updating them with the help of the Poultry Product Council and the Hungarian Pig Breeders and Pig Rearers Association.
The Article below contains the aim of these documents, a description of the basic legal information on how the requirements have changed in time and how the content of the documents have changed to help interested parties involved in the process.
In the second part a practical comparison is made concerning the past and present documents with an insight on what steps can be expected in the future for all participants active in the agricultural sector. Readers will be able get a short glimpse of the strategies and direction of the European Union concerning agriculture and environmental protection.

Figure 1: Cover of the two BAT guidances
(Source: Herman Otto Institute Nonprofit Ltd.)

INTRODUCTION

On behalf of the Ministry of Agriculture Herman Otto Institute Nonprofit Ltd. has elaborated two national BAT guidances, one for the intensive rearing of pigs and the other for the intensive rearing of poultry. Main aim of these guidances is to enlighten the determination of BAT for applicants and for the authority as well. These guidances contain information about the permitting procedure and for the definition requirements within these permits.

These BAT guidances on intensive rearing of pig and poultry are based on a European directive, that dates back to more than twenty years ago. The idea of Integrated Pollution Prevention and Control emerged in 1996, when Europe intended to introduce a holistic approach within environmental protection, European Directive 96/61/EC aimed at minimising pollution from various industrial but also agricultural sources. Annex I. of the Directive contains the installations under its scope, that have to comply with its requirement and obtain a permit. In our case these are installations under point 6.6 with more than 40 000 places for poultry, with more than 2 000 places for production pigs (over 30 kg), or with more than 750 places for sows.

It is evident from the diagram above that intensive rearing of pigs and poultry is a significant sector in Hungary. In 2010 the Industrial Emissions Directive (IED) has repealed IPPC and incorporated other directives, nevertheless leaving the agricultural sector intact. In accordance with IPPC and later IED, BAT Reference documents are produced on a continous basis by the Technical Working Groups of the Joint Research Centre in Seville.
The BREFs are a series of reference documents covering,

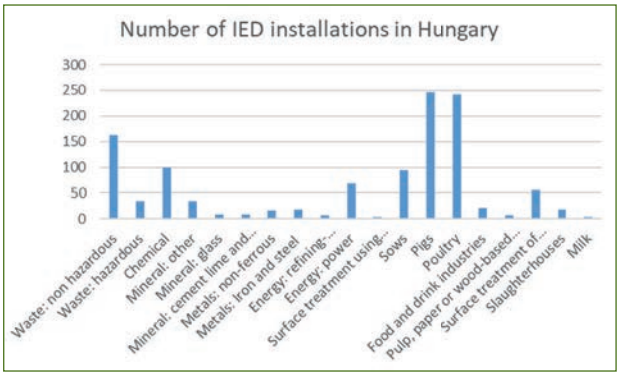

Figure 2: Number of IED installations in Hungary
(Source: IPPCD and IED reporting / DG Environment, Personal Communication (2018))

as far as is practicable, the industrial activities listed in Annex 1 to the EU's IPPC Directive. They provide descriptions of a range of industrial processes and for example, their respective operating conditions and emission rates. Member States are required to take these documents into account when determining best available techniques generally or in specific cases under the Directive.
These are voluminous documents with a uniform content, they contain: the applied processes and techniques, consumption and emission levels, techniques to consider in the determination of BAT, BAT conlusions, Emerging techniques, concluding remarks, a glossary and annexes.

But what are the Best Available Techniques?

The permits mentioned previously must be based on best available techniques and emission limit values. These techniques can be found within the BREFs and are determined by the information exchange procedures. Let's see the meaning of these three words. 'Best' means the most effective in achieving a high general level of protection of the environment as a whole. 'Available' techniques are the ones that allow implementation in the various sectors, and are economically and technically viable. 'Techniques' mean a technology, but also how the installation is designed, built, maintained, operated and decomissioned. BAT also means operating with low waste flows, using less hazardous substances, the possibility of recovery and recycling, and the list goes on.

Permitting based on best available techniques

The application for a permit must contain a list of aspects. First of all, a description of the installation must be presented, then all the materials and energy used and generated should be described. The sources of emissions must be shown with all the proposed technology and techniques to prevent or at least reduce them. What measures are planned to prevent or recover wastes, and what alternatives are there to be the most efficient? The possible emissions will have to be monitored, and a non-technical summary must be compiled about all the further mentioned aspects. The permit application must be made available to the public, and in case cross-border issues arise, Member States should be involved as well.
The operator of installation holding a permit must use all appropriate pollution prevention measures to prevent all large scale pollution. It must prevent, recycle or dispose of waste in the least polluting way possible, use energy efficiently, ensure accident prevention and damage limitation and if the installation ceases to operate, the site must be returned to its original state. The permit must contain specific requirements, such as emission limit values for polluting substances, measures for soil, water and air protection, waste management rules, what to do when facing leaks, malfunctions and shutdowns, but also how it will minimize long distance or transboundary pollution. All emissions will have to be monitored during the operation phase.

Figure 3: Intensive rearing of pigs
(Source: https://pexels.com/)

BAT conclusions are mandatory for all operators

Best available techniques (BAT) conclusions are the reference for setting permit conditions for installations covered by Chapter II of Directive 2010/75/EU (the Industrial Emissions Directive or IED), and competent authorities should set emission limit values which ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the BAT conclusions.

The European Union has published Implementing Decision 2017/302 to establish best available techniques (BAT) conclusions for the intensive rearing of poultry or pigs under the Industrial Emissions Directive and they cover the following on-farm processes and activities:

- nutritional management of poultry and pigs;
- feed preparation (milling, mixing and storage);
- rearing (housing) of poultry and pigs;
- collection and storage of manure;
- processing of manure;
- manure landspreading; and
- storage of dead animals.

These BAT conclusions do not cover all the activities and processes which may occur on a permitted farm, for example waste activities and the disposal of dead animals.

The BAT conclusions were published on 21st February 2017. The Industrial Emissions Directive stipulates that all EU member states must ensure that existing operational permitted sites will be compliant with the BAT conclusions within 4 years of publication. These BAT conclusions must be implemented at existing sites by 21st February 2021. From the 21st February 2017 all new farms and any new or replacement housing or plant at existing permitted farms must be compliant with the BAT conclusions and meet associated emission limits from the date that they are first permitted.

The BAT conclusions include a number of individual conclusions that indicate which techniques or combinations of techniques are BAT for achieving a specific environmental objective. The required environmental performance levels can be expressed as BAT Associated Emission Levels (AELs). Monitoring of BAT (e.g. measurement frequency and/or methods) is also included. Where BAT-AELs are specified, operators need to demonstrate that they can meet these AELs or provide sufficient technical and commercial information that allows the determination of a derogation under IED (Article 15(4)).

The techniques listed and described in the BAT conclusions are neither prescriptive nor exhaustive. Operators must follow the BAT conclusions relevant to their facility, however they can use an alternative technique where they can demonstrate that it will provide a level of environmental protection that is equivalent to the BAT.

Comparison of the first and second generation BAT guidances for pig and poultry

The two first generation guidances (for intensive rearing of pigs in 2004 and for intensive rearing of poultry in 2010) hardly differ from each other in their content and structure. Both of them were issued during the early phase of the environmental impact assessment regulation, which was followed by Gov. Decree 314/2005. (XII. 25.) defining the regulation in its present form. The main aim of the first generation guidances is to achieve a uniform application of the BAT requirements and to serve with as many practical information as possible about the impact assessment procedure, its procedural details and the compilation of the permit application to be introduced, which was still unknown at that time.

The second generation BAT guidances (intensive rearing of pigs and intensive rearing poultry, both published in 2020) contain less direct information about the procedure because since then the environmental impact assessment procedure has become more detailed, therefore more expertise, or the assignment of expert groups might be needed to compile the permit application or to carry out the permitting procedure. IPPC Departments were established within authorities to carry out and evaluate environmental impact assessment procedures. In the course of time the domestic environmental administration and the applicants striving for a permit or the experts assembling the permit application got familiar with these procedures and gathered important experiences.

The new guidances contain a more detailed sectoral description, touching upon the COVID 19 pandemic and also the African swine fever endangering pigs, or the H5N1 avian influenza affecting the poultry sector. These pandemics are still going on since issuing the guidances. The second generation BAT guidance on poultry includes a sectoral analysis written by the Poultry Product Council in accordance with the changing situation within the EU but also describing the inner structural transformation of the sector.

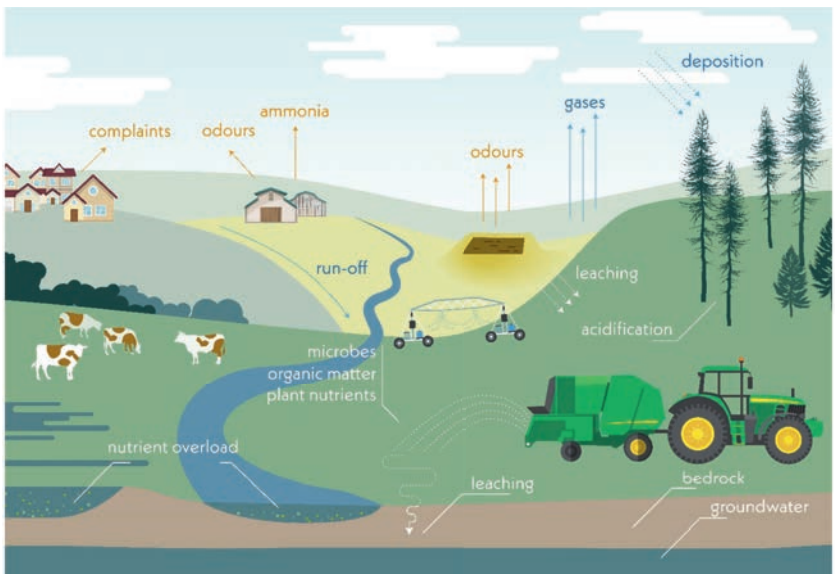

Figure 4: Environmental issues of intensive rearing of animals
(Source: Best Available Techniques (BAT) reference document for the intensive rearing of poultry or pigs)

Figure 5: Intensive rearing of laying hens
(Source: https://pexels.com/)

An important issue is the timeliness of contents within the guidances, knowing that flow of information is so rapid especially concerning the BAT regulation system. Every BAT guidance is based on the sectoral BREFs, BAT Reference Documents, and the mandatory BAT conclusions.

The objective of the BREFs is to display comprehensive information about processes, data, solutions and approaches that are suitable to demonstrate the sector in a credible way to serve as a benchmark for defining the best processes.

In this context BREFs do not show compulsary processes, only give directions for use that should be handled together with the national characteristics, e.g. differing climate, environmental conditions, economic-social advancement and various traditions when producing national guidances.

It is decisive how the documents deal with the ever strengthening and always changing concept of climate protection and circular economy within the EU. Since it is not yet fully elaborated, it is not known how the EU will realize the circular way of agriculture e.g. the objectives of the farm to fork strategy. In the focus of the strategy are the agricultural use of pesticides, antimicrobial agents, the reduction of nutrient loss of soils by 50% until 2030 and the reduction of fertilisers by 20%. All this foreshadows that we have 9 years to change the presently accepted agricultural technologies.

The preparation of adoption of the Waste Framework Directive strengthening circular material use (Directive (EU) 2018/851 of the European Parliament and of the Council) and the creation of the new National Waste Management Plan has begun, and is still going on. This could be the explanation why climate change, circular material use, manure management, composting, waste management and air protection appear in the text, but do not represent a defining role when looking at the whole document. Greenhouse gases originating from manure, and concretely methane can be found in the document during the analysis of emissions, the constant rise of temperature is mentioned together with the examination of climate change, but these are interpreted mainly concerning the direct environment of animals.

Although BAT conclusions do not refer to the latest climate protection and circular economy objectives, these ambitions appear in the requirements for animals concerning the sparing use of energy, water and feed but also the various material releases into the environment. Emissions to air are not only regulated by general rules but by BAT emission limit values on a technology level. Standardization of material and energy use, a central regulation of emissions can be important factors of the circular economy transition. In this context this regulation innovation will affect the material flow inputs and outputs of technologies for other environmental elements apart from air and will shortly actualize BAT requirements as well.

Looking at the content and size, the first generation guidance for pigs is the shortest with its 61 pages focusing mainly on the domestic technologies, but the second generation guidance for poultry contains 144 pages, since the executive summary of the BREF is also included. In 2004 it was sufficient in the guidance for pigs to introduce the four technologies used for buildings built in the 1960s and 70s, these were Agrocomplex, Bábolna, Mez panel and ISV.

After 15 years the development changes everything, the sector and its economic-social environment changes in a fast pace, and these changes happen in a more complex way. A common feature is the fast paced reformation of the theory and methodology of feeding, the prevalence of animal welfare, environmental protection and animal health aspects with a market influencing factor. Domestic animal rearing lands into a competitive disadvantage, therefore a modernization is inevitable. In the case of the new guidances emphasis is laid on the introduction of international examples, solutions and processes.

The first generation guidance for poultry published in 2010 contains 144 pages, 38 graphs and focuses on broilers and egg production while the second generation guidance for poultry contains 129 pages, 9 graphs and also involves the domestic husbandry technologies for turkey, duck and goose. It analizes the situation of the international and domestic sector and to save the

competitiveness of the latter it provides a development concept besides indicating the underdevelopment of the domestic sector compared to its international competitors. It presents the ever growing trend of the prevaling animal welfare affecting the sector by favouring the cage-free egg and broiler production.

CONCLUSIONS

An important element of the EU's environmental policy is the integrated pollution prevention and control granting a protection for the environment as a whole by applying the IED requirements. Its feature is not only to regulate emissions but to intervene on a technology level as well by using the tool of BAT, which is defined in a permitting procedure and to be used for existing and new installations laid down in a decision with emission limit values set by the authority.

When using BAT as a tool first of all environmental, economical, technical and energetical aspects should be integrated. After this step the installation's special characteristics may be taken into consideration when defining BAT. It is explicative how temporal these statements are based on the comparison of the environmental performance of an existing installation and a new installation using the latest techniques. The all-time BAT level is determined by the development, which is based on the technical and scientific findings, the regulatory environment directing agriculture into a circular mode or the defence against animal or human pandemics affecting our lives.

The environmental authority monitors the applied technologies, emissions according to the new BAT requirements during the revision of IPPC permits. Basically the applicant has to prove to the authorities that the used technology complies with the BAT requirements, the dialogue between them forms the state of the art technology which is the provision of operating further.

In this article our aim was to draw attention to the latest BAT guidances concerning the rearing for poultry and pigs, and according to our hopes all interested parties will find them useful during the definiton of best available techniques and they will also result in a fruitful discussion between the authority and operators.

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EFFECT OF DIFFERENT SUBSTRATE MIXTURES ON CRUDE FAT AND CRUDE PROTEIN CONTENT OF *ZOPHOBAS MORIO* LARVAE

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ABSTRACT

It is a proven fact that the feed conversion efficiency of insects provides a higher yield compared to conventional slaughter animals. Thus, by feeding the insects with feeds used in conventional animal husbandry and reusing the insect as a conventional slaughter animal feed, a more economical feed route can be provided. However, human activity in our environment generates a number of organic by-products and wastes which, although they could be suitable for feeding on the basis of their content, cannot yet be used because they are rejected by conventional slaughter animals. If, based on the content characteristics, we can provide by-product / waste mixtures with a similar composition to normal feed and feed them to the insects, then we give them to traditional farm animals according to the legal environment, it could further increase the economy of the feed route. However, it is important that the breeding rate of insects is not impaired during breeding, so the feed path must not only have satisfactory content characteristics, but also ensure the main nutrient values as crude protein and crude fat content in the harvested larvae. Studies have focused on identifying combinations of insects and organic waste to optimize bioconversion. Here, the effects of four different substrates (poultry manure, sewage sludge, dried beer pomace, bakery by-product) mixing two types at once in four ratio (20:80; 40:60; 60:40; 80:20), on nutritional value of *Zophobas morio* were investigated. Compared with chicken feed the mixtures decreased the crude protein content of the larvae, for the crude fat content it had lower effect.

keywords: circular economy, insect; animal nutition, biowaste management

INTRODUCTION

In recent years, insect consumption, called entomophagy, has been a very popular topic among researchers for a number of important reasons. The per capita food consumption of a growing global population is currently placing a significant burden on the agricultural sector, leading to over-exploitation of many resources. In addition, intensive agriculture, climate change, and biodiversity loss exacerbate the problem (Herrero et al. 2015; Newbold et al. 2015; Ramankutty et al. 2018). More and more researchers emphasize that insect breeding may make it possible to reduce the growing protein deficiency of humans worldwide (Liu et al. 2019; Nowak et al. 2016; Zieli nska et al. 2015). Furthermore, insects have been shown to be a safe source of good quality nutrients. In addition, insect farming produces less greenhouse gases than conventional animal husbandry and has much less land, feed, and water they need (Oonincx et al. 2012). In addition, insects are sources of bioactive components such as bioactive peptides or antioxidant enzymes. (Mlcek et al. 2014).

In many European countries, the breeding and processing of insects is still in its infancy. Accordingly, there are indications that insect-based food consumption is coming to Europe and has become more acceptable in the future. Several strategies are proposed to overcome the challenges of accepting insects as food (Raheem et al. 2019). There are always one million known insect species worldwide, all of which play a crucial role in food chains and the functioning of the entire ecosystem.

However, the nutritional value of insects depends on a number of factors. First, composition is known to be species-dependent (Rumpold et al. 2013; Payne et al.

2016). The nutrient content of insects can also be influenced by the breeding technique (Bjørge et al. 2018), the composition of the provided feed and (van Broekhoven et al. 2015; Latney et al. 2017), the origin of the insects (Adámková et al. 2017) and their gender (Kulma et al. 2019). The results of such research will contribute to a better understanding of the chemical composition of insects at different stages of life and may help to optimize breeding techniques for the timely and optimal harvesting of high-quality nutrient biomass. Insects in nature, using organic matter largely indiscriminately, carry out a circular process that is important for industry and the environment. The potential of insects may not only be of particular importance in food, but may also play a role in modern waste management in the future.

MATERIAL AND METHODS

Before starting the feeding experiments, the newly hatched larvae of *Z. morio*, was reared on chicken feed, fresh carrots, and cucumber (70%, 20%, and 10%, respectively) for 40 days, when they started to grow intensively. The diet provided during this period ensured that the larvae were in good condition at the start of the experiment. Air humidity was maintained at 60% ± 4% during the subsequent weeks to provide optimal conditions for healthy insect development. In the rearing environment, the temperature was 26.5 ± 2.5 °C and humidity was 60% ± 4%, with a 12:12-h light/dark cycle. We focused of the effect of different substrate mixtures on the crude protein and crude fat content value of larvae. The experiments lasted for 15 days. The initial number of larvae was 500 in each trial, with three replications. 750 g of the mixtures were obtained as a starting material, regardless of type. In addition to daily monitoring, the larvae received water spray in addition to 10 ml of normal drinking water per rearing drawer. Fresh substrates mixtures were added, and the residues and excreta were removed on day 15. The size of the plastic box (width × length × height) for *Z. morio* was 30 × 38 × 10 cm.

Mixtures of different substrates (**P**oultry manure, **S**ewage sludge, **D**ried beer pomace, **B**akery by-product mixed in different proportions (20:80; 40:60; 60:40; 80:20) were used for the experimental treatments. As a control we used **C**hicken feed provided by Vitafort Zrt.

Total nitrogen concentration was determined using the Kjeldahl method according to the standard ISO 5983-1:2005 method for animal feedstuff. Crude protein concentration (P) was calculated using Equation 1:

$$P = \text{total Kjeldahl nitrogen} \times CF,$$

where CF is the conversion factor, which is 4.76 for the larvae. Janssen et al. proved that nonprotein N in insects leads to an overestimation of protein concentration. They reported comparable CF values among larvae belonging to different orders; the CF for *T. molitor* was 4.76 ± 0.09. Crude fat concentration in the substrates and the larvae was determined using the standard ISO 11085:2015 method for cereals, cereal-based products, and animal feedstuffs using an automated extractor (VELP Scientific, Randall).

RESULTS

The poultry manure and the dried beer pomace showed higher crude protein content. In the case of sewage sludge and the bakery by-product the measured values are lower compared with the chicken feed. The nutrient composition of the substrates, showed the dried beer pomace had similar crude protein and crude fat content as the chicken feed, what we used as control (Figure 1).

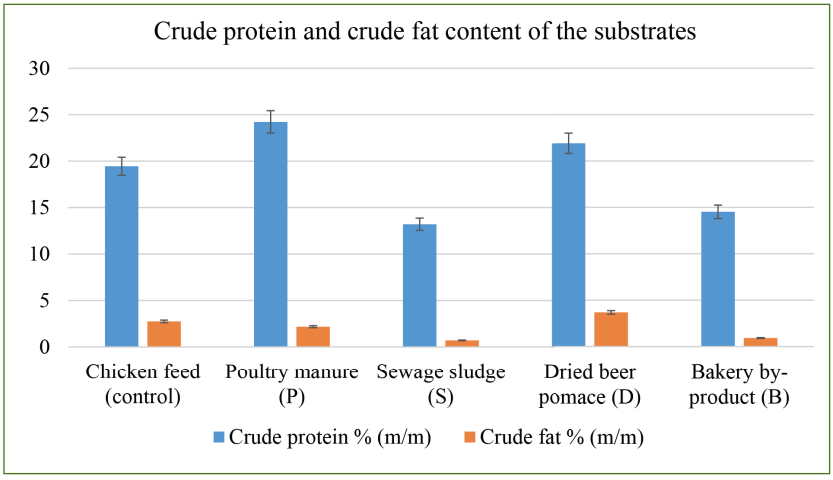

Figure 1: Crude protein and crude fat content of the substrates

The nutrient composition of the larvae, evaluated at the end of the experiments, showed differences with the diets (Figure 2). The highest crude protein concentration was 49.2 % when fed chicken feed and the lowest level was 45.4% when fed P-S;40-60 substrate mixture. Any other mixtures of the substrates could not reach the 48 % level. The crude fat content in the case of the control was 42.1 %, it was almost the lowest measured value, the S-B; 40-60, 20-80 and the D-B 20-80 were on the similar level. In the other cases, the measurement of crude fat content showed a higher result.

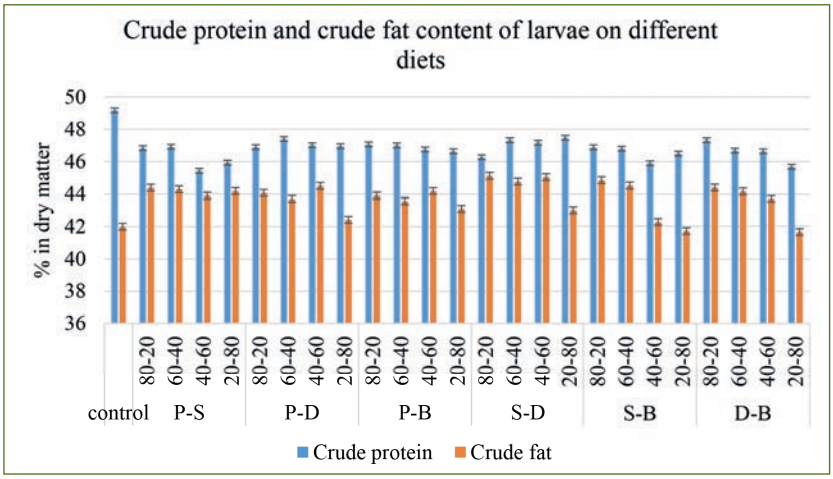

Figure 2: Crude protein and crude fat content of Z. morio larvae fed with different substrates in different ratio (Poultry manure, Sewage sludge, Dried beer pomace, Bakery by-product)

DISCUSSION

With the hypothesis that diet has a significant effect on the macronutrient composition of larvae, the protein or fat concentrations in diet for a given species can be tailored. It is necessary to test diets that represent a wide range in nutrient concentrations. In this study, chicken feed had the highest crude protein and the lowest crued fat concentration. The different substrates in different mixture showed different nutritional composition, all low-nutrient value substrates resulted in reduced protein concentration and increased fat concentration. For *Z. morio*, Broekhoven et al. found that the larval protein concentration was relatively stable in diets that differed 2–3-fold in protein concentration and that dietary fat has an effect on larval fat concentration. In the present study, the variation in the protein and fat concentrations was low despite the considerable differences in the dietary compositions. Furthermore, the differences between the protein and fat concentrations were lower than the findings of Adámková et al. They found the protein concentration in *Z. morio* was 46% and 35%, respectively. In *Z. morio* larvae reared on wheat, corn, soybean meal, water, fruits, and vegetables, Araujo et al. reported 46.8% protein and 43.3% lipid concentrations, which are similar to the concentrations recorded in larvae reared on chicken feed in this study.

CONCLUSIONS

Our results confirmed that the different ratio of biowaste mixtures can elevate the nutrient values of *Z morio* larvae thus the application of combined substrates in insect feeding seems a promising future. This protein recovery process fits well into circular economy and due to the low prices of substrates it might compete with protein feed from GMO soybeans.

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