Trop. J. Eng., Sci. & Techn. 2024.3(2) 90-98 Tropical Journal of Engineering, Science and Technology

Pesticides Survey and identification of common Insecticides used for foodstuff storage in Makurdi, Benue State, Nigeria

Qrisstuberg M. Amua* and Emmanuel K. Ukpoko**

*Department of Natural Sciences, British Canadian University Obudu, Cross River State, Nigeria.
Email: dr.qrisstuberg@gmail.com, dsa@bcu.edu.ng

**Chemistry Department, Joseph Sarwuaan Tarka University Makurdi, Nigeria.

Corresponding Author: ukachiiemma@gmail.com

Abstract

Pesticides in foodstuffs have become a daily deal with potential health challenges. Identification of these pesticides would be helpful in precautionary ways of dealing with their consequences on foodstuff and human health. A survey of pesticides was done in five major markets located in different axes of Makurdi town. The survey was achieved with the instrument of questionnaire and interview, anchored, and recorded during the interview with pesticide sellers at their respective stores at the markets in Makurdi. At least three pesticide dealers were interviewed from each market on the types of pesticides available (inventory) comprehensively, those used for foodstuff storage, effective types of insecticide for foodstuff storage, the most patronized and their mode of application. Identification and classification of the pesticides were based on active chemical names, common names or trade names in Nigeria, the nature of active chemicals and applications on the field or in-store foodstuff. The average percentage of daily patronage was calculated, and knowledge of the expiration date was uncertain. Interestingly, three active chemicals were considered the most popular and sought-after for aiding food storage: aluminium phosphide, dichlorvos, and permethrin, all under different brand names. These chemicals accounted for 37.50%, 33.33%, and 20.83% of the market, respectively, with the remaining insecticides accounting for just 8.33%. The study also revealed that many illegal and outdated pesticides are still in use in Makurdi, often in absurd quantities without a shelf life, endangering the health of everyone who consumes the food products obtained from their usage.

Key Words: Pesticides, Survey, Foodstuff, Storage, Chemicals.

Enquête Sur les Pesticides et Identification des Insecticides Courants utilisés Pour le Stockage des Aliments à Makurdi, État de Benue, Nigéria

Resume

Les pesticides dans les produits alimentaires sont devenus une réalité quotidienne avec des défis potentiels pour la santé. L'identification de ces pesticides serait utile pour adopter des mesures préventives face à leurs conséquences sur les produits alimentaires et la santé humaine. Une enquête sur les pesticides a été réalisée dans cinq grands marchés situés dans différentes zones de la ville de Makurdi. L'enquête a été menée à l'aide de questionnaires et d'entretiens, enregistrés lors des discussions avec les vendeurs de pesticides dans leurs magasins respectifs sur les marchés de Makurdi. Au moins trois revendeurs de pesticides ont été interrogés dans chaque marché sur les types de pesticides disponibles (inventaire), ceux

utilisés pour le stockage des aliments, les types d'insecticides efficaces pour le stockage des aliments, les plus sollicités et leur mode d'application. L'identification et la classification des pesticides ont été basées sur les noms chimiques actifs, les noms commerciaux ou de marque au Nigeria, la nature des produits chimiques actifs et leur application sur le terrain ou dans les produits alimentaires stockés. Le pourcentage moyen de fréquentation quotidienne a été calculé, et la connaissance de la date d'expiration était incertaine. Fait intéressant, trois produits chimiques actifs ont été considérés comme les plus populaires et recherchés pour aider au stockage des aliments : le phosphure d'aluminium, le dichlorvos et la perméthrine, tous sous différentes marques. Ces produits chimiques représentaient respectivement 37,50 %, 33,33 % et 20,83 % du marché, les insecticides restants représentant seulement 8,33 %. L'étude a également révélé que de nombreux pesticides illégaux et périmés sont encore utilisés à Makurdi, souvent en quantités excessives sans durée de conservation, mettant en danger la santé de toute personne consommant les produits alimentaires obtenus de leur utilisation.

Mots-clés : Pesticides, Enquête, Produits alimentaires, Stockage, Produits chimiques.

ملخص

أصبحت مبيدات الآفات الموجودة في المواد الغذائية تعاملاً يوميًا مع التحديات الصحية المحتملة. وسيكون تحديد هذه المبيدات مفيداً في الطرق الاحترازية للتعامل مع عواقبها على المواد الغذائية وصحة الإنسان. تم إجراء مسح لمبيدات الآفات في خمسة أسواق رئيسية تقع في محاور مختلفة من بلدة ماكوردي. تم تحقيق المسح باستخدام أداة الاستبيان والمقابلة، وتم تثبيتها وتسجيلها خلال المقابلة مع بائعي مبيدات الآفات في متاجرهم في أسواق ماكوردي. وأجريت مقابلات شاملة مع ما لا يقل عن ثلاثة من تجار مبيدات الآفات من كل سوق بشأن أنواع المبيدات المتاحة (المخزون)، وتلك المستخدمة في تخزين المواد الغذائية، والأنواع الفعالة من المبيدات الحشرية لتخزين المواد الغذائية، وأكثرها رعاية وأسلوب تطبيقها. استند تحديد وتصنيف مبيدات الآفات إلى الأسماء الكيميائية النشطة، والأسماء الشائعة أو الأسماء التجارية في نيجيريا، وطبيعة المواد الكيميائية النشطة والتطبيقات في الميدان أو المواد الغذائية الموجودة في المتاجر. تم حساب متوسط النسبة المئوية للمحسوبية اليومية، والمعرفة بتاريخ انتهاء الصلاحية غير مؤكدة. ومن المثير للاهتمام أن ثلاث مواد كيميائية نشطة كانت تعتبر الأكثر شيوعًا والمطلوبة للمساعدة في تخزين الطعام: فوسفيد الألومنيوم، وثنائي كلورفوس، وبيرميثرين، وكلها تحت أسماء تجارية مختلفة. شكلت هذه المواد الكيميائية 37.50٪ و 33.33٪ و 20.83٪ من السوق على التوالي، بينما شكلت المبيدات الحشرية المتبقية 8.33٪ فقط. كشفت الدراسة أيضًا أن العديد من المبيدات الحشرية غير القانونية والتي عفا عليها الزمن لا تزال قيد الاستخدام في ماكوردي، غالبًا بكميات سخيفة بدون مدة صلاحية، مما يعرض صحة كل من يستهلك المنتجات الغذائية التي يتم الحصول عليها من استخدامها للخطر.

الكلمات الرئيسية: مبيدا للآفات، استقصائي، مواد غذائية، حفظ، مواد كيمياوية .

Introduction

Pesticides are chemicals capable of destroying pests or controlling their activities, so it is used in agriculture to boost the foodstuff supply by protecting crops against destructive pests, both in the field and in storage. The application of pesticides varies from preparation of seeds, and soil, crop growth on fields and post-harvest treatment of farm harvest (Orefi and Omojo, 2017). Pesticides are applied to grain foodstuff during storage to prevent pest infestation. Concerns have been raised from many quarters in Nigeria about the risks of pesticides in foodstuffs (Onuwa *et al.,* 2017; Atsen *et al.,* 2021) as most of these pesticides have shown a high degree of toxicity, especially in developing countries (Adeyeye, 2022).

For European countries, wherever a high level of pesticides in foodstuff has been discovered, the European Union did place a ban on some agricultural commodities from those areas for some time now. Food items banned by European countries since June 2016 include beans, sesame seeds, melon seeds, dried fish and meat, peanut chips and palm oil (SAPEA, 2020). The beams

banned by the European Food Safety Authority banned were found to have a dichlorvos concentration ranging from 0.03 mg/kg and above; whereas the acceptable maximum residue limit is 0.01 mg/kg (SAPEA, 2022 and WHO, 2022).

Pesticides are formulated to stop pest organisms from the destruction of crops and foodstuff, but they also generate some residual contaminants and risks within foodstuff (Fantke *et al* 2012: Duru, 2022). Human health is now threatened by the presence of pesticides residues in crops and foodstuff (Fantke *et al* 2012; Duru, 2022). Examples of these pesticides of concern include cypermethrin (α-cyano-3-phenoxybenzyl-2,2-dimethyl-3-(2,2 dichloro vinyl) cyclopropanecarboylate), butachlor, aldrin, dieldrin, pendimethalin, propanil, alpha HCH, etc (SAPEA, 2020).

In Nigeria the National Agency for Food and Drug Administration and Control (NAFDAC) banned 30 pesticides and other chemicals in Nigeria on 2nd January 2022 (Adeyeye, 2022). According to Adeyeye (2022), Nigeria was a signatory to several international treaties and conventions that banned chemicals and pesticides such as the Rotterdam Convention, an international treaty designed to facilitate informed decision-making by countries regarding trade in hazardous chemicals and pesticides. Adeyeye added that, in the last four years, NAFDAC has reviewed its regulations, and guidelines and strengthened collaboration with government agencies and stakeholders to ensure effective regulations and such collaborative effort has been recorded in agrochemicals regulation and other areas (Adeyeye, 2022).

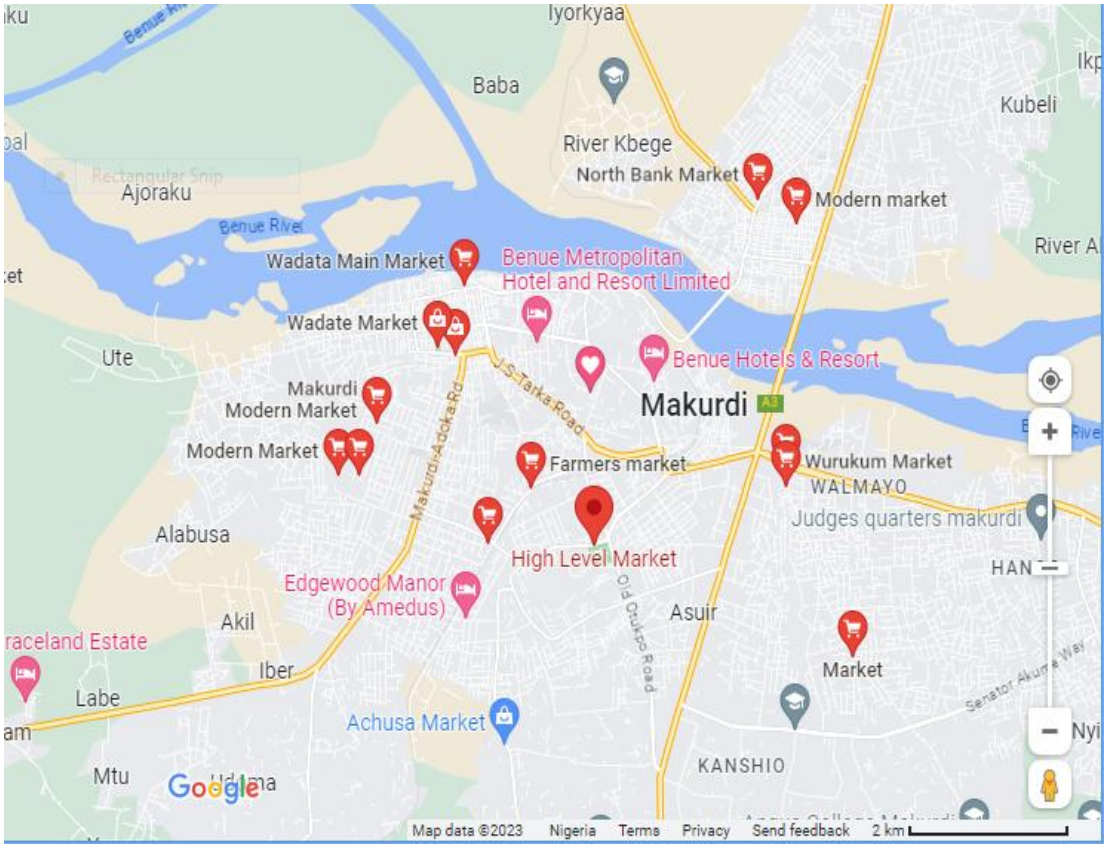
The objective of this study was to survey the available and common pesticides used in the storage of agricultural produce within Makurdi, Nigeria and to test the knowledge of the farmers and marketers on these chemicals banned by NAFDAC.

Methodology

Study Area: Sample areas were the main markets of Makurdi Town in Benue State**.** Benue State is in the North Central region of Nigeria. The state accounts for over 70% of Nigeria's Cereal crop production. Makurdi is a Town at latitude 7.732152, and longitude 8.539144, on Nigeria GPS coordinates of 7^{o} 45’ 55.7472” N and 8^{o} 32’ 20.9184” E at 91.237 meters altitude (Wikipedia, 2023). Makurdi is the political headquarters of Benue State with a population estimate of 454,419 as at the year 2023; where the domestic and commercial cereal foodstuff are massively kept in storage to enhance market value and also mitigate glut in the supply chain.

A survey of pesticides was done in the five main markets from different axes as shown in **Figure 1**, Map of Makurdi Town in Benue State, Nigeria (Wikipedia, 2023). These markets are the High-level Market, Moden Market, North Bank Market, Wadata Market and Wurukum Market

.



Key: Red drops are market areas of High-level Markets, Modern Markets, North Bank Market, Wadata Markets and Wurukum Market.

Figure 1: **Map of Makurdi Town in Benue State of Nigeria showing the markets where samples were collected**.

Survey of pesticides in Makurdi town

A survey of pesticides was done in five major markets located on different axes of Makurdi Town as described on the Map of Makurdi town above. The survey was conducted with the instrument of a questionnaire and oral interview. Structured questionnaires were anchored and recorded during the interview with pesticide sellers at their respective stores at the markets in Makurdi town. At least three pesticide dealers in the same market were interviewed from each market on the types of pesticides available, those used for storage of foodstuff, the effective types of insecticide for foodstuff storage, the most patronized insecticides, and their mode of applications.

Results

Classification of the surveyed pesticides available in Makurdi, Benue State, Nigeria is shown in Table 1 presented with chemical names, trade names in Nigeria, nature of the active chemical, the target organisms and mode of application. The results in Table 2 show the daily patronage of common and effective insecticides for the storage of foodstuff in Makurdi, Benue State, Nigeria.

Table 1: Classification of the Surveyed Pesticides Available in Makurdi, Benue State, Nigeria

S/N	Chemical Names	Trade Names in Nigeria	Nature of Active Chemical	Target Organisms	Applications/Cautions
1	Actellic	Actellic 25 EC	Organophosphorus Synthetic	Insects	Insecticide: Not to consume or sell the grains mixed and stored with Actellic until after 3 months for short-term and 6 months for long term storage.
2	Aluminium phosphide (AlP)	Justoxin, Phostoxin, Fumitoxin, Fostox, Celphos, Aluminium(lll) phosphide, Pestphos, Talunex Aluminium monophosphide etc.	Phosphates Inorganic Synthetic	Insects	Systemic insecticide for many cereal crops.
3	Apron or Aspirin	Apron Star 42WS, Mefenoxam.	2-Acetoxybenzoic acid Synthetic	Fungi	Pre-plant seed coat treatment. Apply as slurry or dust and plant after treatment. (Fungicide/ insecticide).
4	Atrazine	Atrazine, Atrataf, Atraforce, Delzine, Xtrazine	Organochlorine Synthetic	Grass	For the control of grass weeds in cereals crops fields.
5	Alachlor	Lasso, Alachlor, etc.	Organochlorine Synthetic	Grass seeds	For pre-emergence weed control in maize and some leguminous crops
6	Butachlor	Butachlor, Butacrop, Butastar, Butacot, Butaclear, Butaforce, Cleweed, Risene, Teer, Amichlor etc.	Organochlorine Synthetic	Grass and Broadleaf	For the control of broadleaf and grass weeds in rice and some leguminous crops fields.
7	Carbofuran	Bay, Diafuran 3G. Furadan, Curater, Furacarb, Yaltox, etc.	Benzofuran amine	Insects and nematodes	Controls foliar and soil insects and nematodes in vegetables, maize, sorghum, groundnut, cowpea, soybean, potatoes, and rice. (Insecticide/ Nematicide).
8	Cypermethrin	Best, Cypermethrin, Suraksha, Superthrin, Cymbush, Cypercot, etc.	Organochlorine	Insects	Contact insecticide for many crops pests.
9	Dimethoate	Perfekthion 2.5 EC (Insecticide)	Organophosphate	Insects	Contact and systemic action. Apply during early stages of insect life cycle. Controls plant sucking insects in cotton, cowpea, groundnut, and cereals. (Insecticide).
10	Dichlovos	Amine, Nuvan, Pestoff, Rhonclov, Dash, Smash, Delvap, Wonder, Shooter, Nopest, Clepest, DDforce, VIP, Sniper, etc.	Organophosphate (Chlorinated)	Insects	Contact insecticide for the control of insects in storage and in houses. It is combined with Actellic and used to protect grains in storage.
11	2,4-D Amine	Aminoforce, Delmin-forte, 2,4-D-Select, etc.	Organochlorine Synthetic	General weeds	For pre- and post-emergence control of broadleaf weeds.

S/N	**Chemical Names**	**Trade Names in Nigeria**	**Class of Active Chemical**	**Target Organisms**	**Applications/Cautions**
12	Glyphosate	Glyphosate, Roundup, Glycel, Wipeout, Clearweed, Bushfire, Forceup, Sarosate, Rhonasate, Delsate, Touchdown forte, etc.	Organophosphate Synthetic	Herbicide	Systemic herbicide for general weed control before land preparation.
13	Lamdacyhalothrin	Karate, Laraforce, Attack, Karto, Zap, etc.	Organochlorofluoride Synthetic	Insects	Systemic insecticide for many crops insects pest.
14	Mancozeb	Mancozeb, Mycotrin, Z-force, Hi-shield etc	Carbamate of Sufur amide Non-synthetic	Fungi	Contact fungicide for disease control in many crops.
15	Oxidiaxone	Ronstar, Riceforce, Unicrown	Organochlorine	Grass	For pre-emergence weed control in rice fields.
16	Paraquat	Dragon, Gramoxone, Bret-P, Paraforce, Weedoff, Weedcrusher, Dizmaxone, Lasher, Miazone, Weedex, Ravage, etc.	Organochlorine Synthetic	General weed	General weed control (by contact) in all crops fields.
17	Pendimenthalin	Stomp, Pendilin	Dinitroaniline Synthetic	General weed	For pre-emergence weed control in rice, maize and some leguminous crops.
18	Permethrin	Rambo Nix, Ride, Elimite etc.	Organochlorine	Insects	Used as medication for scabies and Lice, it can be applied on outer cloth, nets or silos to kill insects that touch them. It can be mixed with grains for storage.
19	Propanil	Orizo, Propanil, Propacare, Propan, Rhonil, Propaforce, etc.	Organochlorinamide Synthetic	General weed	For post- emergence weed control in rice.

Table 2: Daily Patronage of Common and Effective Insecticides for Storage of Foodstuff in Makurdi, Benue State, Nigeria.

Sn		Daily patronage	Averages	Av.Daily Sales%	Applications	Expired awareness
1	Aluminium phosphide	4-7	4.5	37.50	Indirect/direct	Uncertain
2	Dichlovos	3-5	4	33.33	Direct/indirect	Uncertain
3	Permethrin	2–3	2.5	20.83	Direct contact	Uncertain
4	Others	0-2	1	8.33	Direct/indirect	Uncertain
5	Total	9-17	12	99.99		

Discussion

Nineteen different active chemical species were identified in over 53 marketing brand names in the markets in Makurdi Town which is markedly higher than those reported by Dugji (2022) in Bornu state. The nature of the active chemicals were organochlorine, organophosphate and Carbamates respectively. From the nineteen active chemicals in the inventory, nine of these active chemicals - Atrazine, Alachlor, Butachlor, Glyphosate, Oxidiaxone, paraquat, Pendimethalin and Propanil, are being used on fields for control of grass weeds and other pests, in different brand names respectively; while the rest ten pesticides - Actellic, Aluminium phosphide, Apron or Aspirin, Carbofuran, Cypermethrin, Dimethoate, Dichlorvos, Lamdacyhalothrin, Mancozeb, and Permethrin are being used for postharvest insect pest control on foodstuff in storage, also indoors in domestic places.

Three active chemicals: Aluminium phosphide, Dichlorvos, and Permethrin, in different brand names were identified as the insecticides in top demand or the most patronized insecticides for foodstuff storage; and at 37.50%, 33.33% and 20.83% respectively. The rest of the insecticides were found at a combined 8.33% only; in agreement with the report by Pii, *et al*. (2019). Furthermore, the study revealed the presence of many restricted and obsolete pesticides still in inventory within Benue State, without expiry dates and in high quantities which could pose health challenges to consumers of the food products these are applied on.

Conclusion

Agrochemicals like pesticides are extensively used in Benue State Nigeria, without appropriate consideration of extant regulation, evaluation and supervision; which poses a significant challenge. This is quite worrisome especially with the broad utilization of both banned and yet to be banned pesticides. Some of the banned pesticides are rebranded for sale while the buyers use them without proper knowledge of the real chemical composition and the effects on human health and environmental toxicity; rather they focus solely on their effect on weeds, insects or other pests.

Intensive training on pesticide composition, the safe use of pesticides, application techniques, mitigation of environmental pollution, human health hazards, export restrictions; and the application of pesticide in compliance with extant regulations and specifications on maximum residue limits and Good Agricultural Practices (GAPs) are direly necessary for the farmers in Benue state. Three active insecticide chemicals - Aluminium phosphide, Dichlorvos, and Permethrin in different brand names were found to be the top demanded or patronized insecticides for post-harvest foodstuff storage applications; at 37.50%, 33.33% and 20.83% respectively. The rest of other insecticides recording 8.33% only; with percentage patronage reflective of directly proportionality in volume of application of these insecticides by farmers and foodstuff dealers and storage merchants alike, in Benue State, Nigeria. This signifies an unacceptably high concentration of these

pesticides in the environment and in foodstuff, thus requires an urgent high level intervention by regulatory and government authorities; even requiring enactment of relevant legislation for the establishment of a Benue Agency for Food and Drug Administration (BAFDA).

References

Adeyeye, M., (2022). National Agency For Food And Drug Administration And Control (NAFDAC) bans 30 pesticides, other chemicals in Nigeria on 2nd January, 2022 The Nation; The Cable news and views unlimited.

Atsen, S. N., Mafuyai, G. M., and Eneji, I. S., (2021). Pesticide Residue In Maize Stored In Bassa, Bokkos, Jos – North And Mangu Local Government Area Warehouses, Plateau State African *Journal Of Agriculture And Food Science* Issn: 2689-5331 Volume 4, Issue 1, 2021 (Pp. 79- 88) 79 Www.Abjournals.Org.

Dugje, I.Y., Ekeleme, F., Kamara, A.Y., Omoigui, L. O., A. Tegbaru, A., Teli,I.A., and Onyibe J. E., (2008). Guide to Safe And Effective Use Of Pesticides for Crop Production Promoting Sustainable Agriculture in Borno State (PROSAB) International Institute of Tropical Agriculture (IITA) Canadian International Development Agency (CIDA) April 2008.

Duru, P., Vanguard News Paper, (2022). Poisoned food claims 11 lives in Benue https://www.vanguardngr.com/2022/11/.

Fantke, P., Friedrich R., and Jolliet, O., (2012). "Health Impact and Damage Cost Assessment of Pesticides in Europe". *Environment International*. 49: 9–17.doi:10.1016/j.envint.2012.08.001 . PMID 22940502 .(https://doi.org/10.1016%2Fj.envint.2012.08. 01).

Onuwa, P. O., Eneji, I. S., Itodo, A. U., and Sha'Ato, R., (2017). Determination of Pesticide Residues in Edible Crops and Soil from University of Agriculture Makurdi Farm Nigeria, *Asian Journal of Physical and Chemical Sciences 3(3): 1-17, 2017; Article no.AJOPACS.35001, ISSN: 2456-7779.*

Orefi, A,. and Omojo, A., (2017). Growth and Instability in Selected Cereal Crops in Benue State, Nigeria and Its Implications for Food Security *Asian Research Journal of Agriculture 5(2): 1-8, 2017; Article no.ARJA.33100 ISSN: 2456- 561X,* DOI: 10.9734/ARJA/2017/33100.

Pii, B. T., Wuana, R., Nwafor, S., (2019). Survey of Common Pesticides Used in Storage of Agricultural Produce within Makurdi, Benue State Nigeria, *Asian Journal of Applied Chemistry Research Published* 19 April 2019DOI:10.9734/AJACR/2019/V3I130082 Corpus ID: 198401962.

Pinniger, D. and Meyer, A., (2015). Integrated Pest Management in Cultural Heritage. Archetype Publications. ISBN 978-1-909492-22-6. (https://books.google.com/books?id=GH7brQEACAAJ).

SAPEA, (2020). A Sustainable Food System for the European Union (https://web.archive.org/web/20200418105107/ https://www.sapea.info/wp content/uploads/sustainable-food-system-report.pdf) (PDF) . Berlin: Science Advice for Policy by

European Academies. p.39.doi:10.26356/sustainablefood (https://doi.org/10.26356%2Fsustainablefood) .ISBN 978-3-9820301-7-3. Archived from the original (https://www.sapea.info/wp content/uploads

World Health Organisation (WHO) (2022). Pesticide residues in food 15 September 2022.