ISSN: 2633-4828 Vol. 4 No. 2, September, 2022

International Journal of Applied Engineering & Technology

ADVERSE EFFECT OF PESTICIDES ON ENVIRONMENT AND HUMAN HEALTH

Keshav Kumar Saini[1], Vandana Saini[2] and Ravi Kant[3,*]

[1]Department of Chemistry, Dyal Singh College, University of Delhi, Lodhi Road, New Delhi-110003, India
[2]Department of Chemistry, Raj Rishi College, Alwar-301001, India
[3]Department of Chemistry, Government P.G. College, Noida-201301, India

*Corresponding author

Date of Submission: 21st June 2022 Revised: 28th July 2022 Accepted: 12th August 2022

ABSTRACT

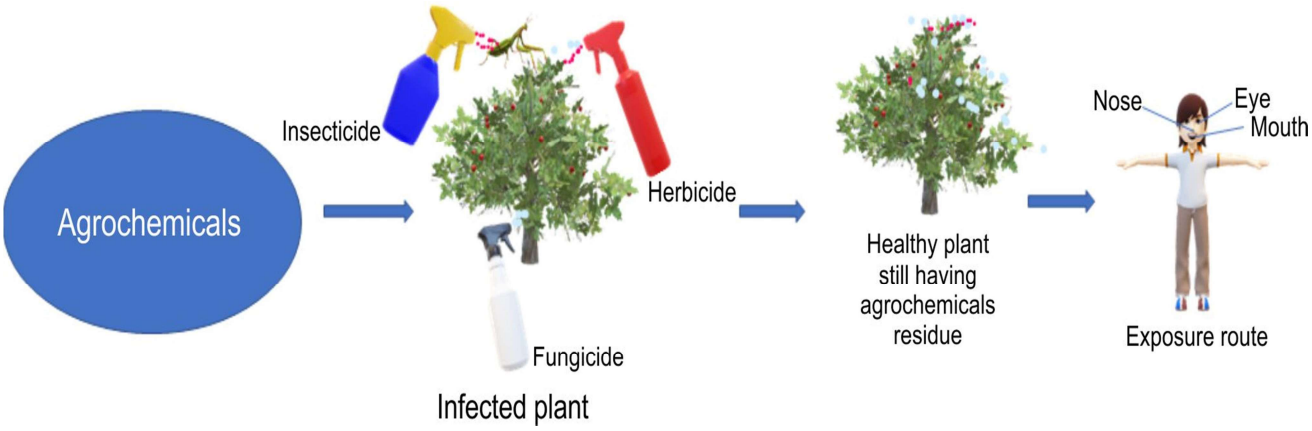
Pesticides have been used for a long time to control mosquitoes, insects, fungus, herbs, ticks, rats, and mice. Use of pesticides will increase in the future due to control of vectors and food security. Most of the pesticides are hazardous in nature to humans and the environment and posing serious health issues. Exposure to these pesticides is linked with a number of human diseases, like asthma, bronchitis, Alzheimer's disease, Parkinson's disease, birth defects, reproductivity disorder, infertility, amyotrophic lateral sclerosis, attention deficit hyperactivity disorder, diabetes, obesity, multi-organ failure, and respiratory disease. In this review, we try to summarize disparate information on the nine most hazardous pesticides that the Indian government is considering banning. We have complied the information from the literature into a single platform to enable readers to get a comprehensive picture of the adverse effects of these pesticides on human health. Here, we discussed acephate, atrazine, benfuracarb butachlor, captan, carbendazim, carbofuran, chlorpyrifos, and 2,4-Dichlorophenoxy acetic acid pesticides and their impact on human health on exposure to them. This review draws researchers' attention to the need to develop or synthesize a new class of pesticides that are less harmful to humans and the environment.

Keywords: Pesticides, Environment, Human health.

1. INTRODUCTION

The food security for exponentially growing population is going to be a big challenge in near future. According to World population prospects: The 2015 revised report by United Nation Department of Public information world population will be 8.5 billion in 2030 and reach up to 11.2 billion in 2100 [1]. Food for this huge population is matter of concern. Increase in food production is the only way to control hunger of rapidly increasing population. In order to provide food for rapidly raising population pests are major road block in the way of food security for starving population [2]. Pests are group of animals, plants, and microorganisms including mosquitoes, insects, fungus, herbs, ticks, rats, mice, *etc*. These pets are responsible for illness in humans and destroy food grain or materials important to human beings [3]. These pests are deteriorating the crop production and are major threat to human health. To control pests and to enhance quality and quantity of crop use of pesticides are increasing day by day. Pesticides are the chemical or mixture of chemicals or natural agents having active ingredients which are intentionally discharge in order to deter, repel, control, mitigate or kill the pests. Basically, pesticides are broad class of agrochemicals including insecticides, fungicides, herbicides, rodenticides fumigants, molluscicides, nematicides, *etc*. [4]. These pesticides play an important role in agriculture to fulfill demand of food for rapidly raising world population. These agrochemicals control and save the corps from insects, weeds, fungus, rodents, *etc*. and improve the quality and quantity of the corps. Pesticides also save the time, money, men's power and improve the efficiency. Beside agriculture pesticides also useful for humans in domestic use. Pesticides protects human beings from vector borne diseases like dengue, malaria, west Nile virus, Lyme disease, *etc*. Use of

pesticides increasing exponentially worldwide. But these agrochemicals are very poisonous in nature and are not species specific. Blindly use of pesticides, improper handling, misusing and excessive spray raise major health concerns. Pesticides Exposure to these pesticides cause mild to acute diseases and environmental pollution [5,6]. In this review we trying to draw attention towards the 9 pesticides among the total 27 pesticides that have adverse effect on human health, environment and whom Indian Government considering to ban. The objective of this review is to systematic arrange the published study with reference to role of pesticides in environmental pollution and adverse effect of pesticides on human and animal health due to pesticide exposure. This review will help to researches to synthesized new pesticides which have no or less impact on human health.



1. **Acephate**

Acephate is a member of organophosphate pesticides family. Acephate may be very harm full to human body when exposed to it. It could be a genotoxin which may cause various disease in human body [7]. It is responsible for human DNA damage in lymphocytes and changes in chromosomes [8]. It found that acephate affect mobility, sperm count and cell membrane of human sperm and show cytotoxic and genotoxic effect [9].

2. **Atrazine**

Atrazine is basically chlorotriazine and act as herbicide. On inhaling atrazine is less toxic [10]. It may cause runny nose [11], swelling or redness in eyes. It may also cause mild skin irritation, redness or swelling when exposure to skin. On ingestion symptoms like nose bleed, drooping eyelids, salivation and swelling on the face appears [12]. Sometimes other symptoms like muscle weakness, tremors, goosebumps, difficulty in breathing and fatigue also observed on exposure to atrazine.

3. **Benfuracarb**

Benfuracarb is an organic insecticide which belongs to benzofuranyl methylcarbamate pesticide family and it is highly toxic [13]. Generally, it is use for pest control in vegetables, citrus, sugar beet and maize, *etc*. Even though it is not irritating for eyes and skin and none allergic for skin, but acute toxic on inhalation. It is highly genotoxic and creates structural disorder in chromosomes [14]. Carbamate causes diarrhea, dyspnea, hypoxemia, urinary incontinence, *etc*. [15].

4. **Butachlor**

This is one of the chloroacetanilide group pesticides and use as herbicide [16]. Generally, butachlor is less toxic than the other member of chloroacetanilide herbicides. On oral exposure it causes vomiting and depression in central nervous system. In rare cases death also reported after hypotention and coma [17].

5. **Captan**

Captan belongs to phthalimide group of fungicide. Captan inhibits the placental CYPL19A1 enzyme which is responsible for synthesis of estrogen. Hence creates complication in pregnancy [18]. Captan exposure also cause

dermatitis [19]. However, captan seems to be less toxic but ingestion in large quantity may leads to vomiting, diarrhea, arm numbness, nausea, weakness and lower chest pain [20]. Captan desegregates quality of oocyte quality by homeostasis and exerted toxic effect. This reproductive toxicity is associated with oxidative stress, DNA damage, mitochondrial dysfunction autophagy and early apoptosis which are induced by exposure of captan [21].

6. **Carbendazim**

Since many decades carbendazim is use globally in number of purposes in agriculture and veterinary science [22,23]. Studies show that cabendazim is responsible for hepatocellular disorder in rats and mice [24–27]. Carbendazim is evidently show embryotoxicity and developmental disorder in number of mammalian species [28–31]. Carbendazim found to be responsible for decline of platelets count and total WBC. On Prolonged exposure to carbendazim, humans and animals may encounter estrogen caused pathologies like abnormal development of the sex differences and enhance tumorigenicity of carcinogen [32].

7. **Carbofuran**

Carbofuran belongs to carbamate family of pesticides. It is a broad spectrum insecticidal nematicidal and acaricidal which is highly toxic in nature [33,34]. Study suggested that carbofuran is responsible for destruction in the mitotic, the nuclear progression and the cell division. Moreover, cause lysosomal damage and lower cellular metabolism [35]. Studies reveal that carbofuran is responsible for cholinergic indication and toxic effects by the carbamylation of catalytic centers in acetylcholinesterase which result in destruction in nervous system [36]. Carbofuran is able to penetrate placental system and show destructive effect on reproductive system and development of maternal placental fetal unit. Isoenzyme-I in mother and isoenzyme-II in fetus decline due to toxicity of carbofuran [37,38].

8. **Chlorpyrifos**

Chlorpyrifos belongs to class of organophosphorus pesticides. It is phosphorus containing organic ester act as broad spectrum herbicidal, fungicidal and insecticidal [39]. Studies indicate that chlorpyrifos is responsible for imbalance of reactive oxygen species (free radical) production and antioxidant defenses which result in oxidative stress. This oxidative stress further causes disorders like inflammatory damage in multiple organs such as brain, eyes and hepatic tissues [40–44]. Evidences reveals that chlorpyrifos exposure associated with adverse effect on fetal growth, decrease in red blood cells (RBC) and maternal toxicity [45,46]. Chlorpyrifos causes disturbance in functioning of thyroid and adrenal glands and decrease the serum levels of hormones secreted from these glands [47-50].

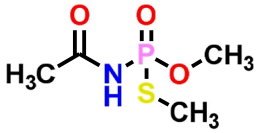
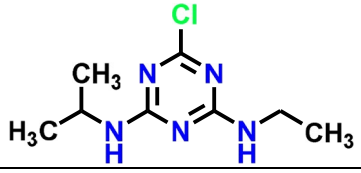
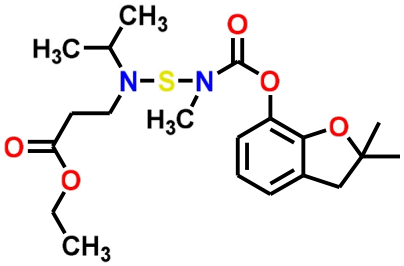
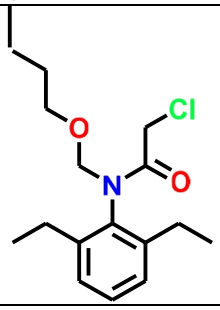
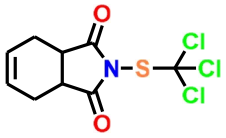
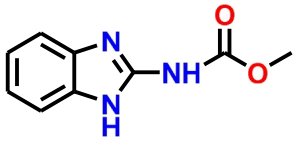
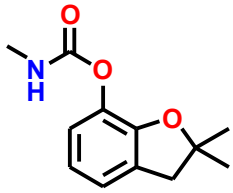
9. **2,4-Dichlorophenoxy acetic acid**

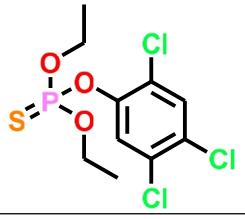
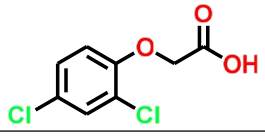
2,4-Dichlorophrnoxy acetic acid (2,4-D) is well-known broad-spectrum herbicide and also work as auxin like plant growth regulator [51-53]. 2,4-D is fall under second dangerous pesticide on the basis of World Health organization classification [54-56]. On acute oral ingestion it may cause diarrhea, hypertension, vomiting, headache, illusion, abnormal behaviour, renal disorder, *etc*. [54]. 2,4-D is metabolized efficiently by humans and is largely excreted in urine. 2,4-D may cause antibiotic resistance in the domestic animals as well as in humans [55,56].

Conclusion

Pesticides are an important part of today's life. Pesticides are required to manage agriculture, public health, pests and to ensure food security for a starving world population. But now pesticides have become an essential part of everyday life and will be difficult to remove in the future, but they may be carefully handled and can minimize the exposure to them. However, the indiscriminate use of pesticides is a major concern for human, animal, and other living organisms' health, as well as environmental pollution. Insecticide resistance and excessive use are the main concern for human toxicity. The health hazards may be reduced by using non-toxic or less toxic and environmentally friendly pesticides. Synthesis of new pesticides having less or no toxicity may decrease rick of various the health issues.

Table-1
List of pesticides that the Indian government is considering banning

S. No.	Name of pesticide	Structure of pesticide	Type of insecticide	Effect on human body
1	Acephate		Herbicide	Genotoxin Change in Chromosome DNA Damage Sperm mobility and count
2	Atrazine		Herbicide	Skin and eyes irritation Nose bleed, drooping eyelids, salivation and swelling on the face
3	Benfuracarb		Insecticide	Genotoxic Creates structural disorder in chromosomes Diarrhea, dyspnea, hypoxemia, urinary incontinence
4	Butachlor		Herbicide	Vomiting and depression in central nervous system. Hypotension and coma
5	Captan		Fungicide	Complication in pregnancy, Vomiting, Diarrhea, Arm numbness, nausea, Weakness and Lower chest pain
6	Carbendazim		Fungicide	Hepatocellular disorder, Embryotoxicity and developmental disorder, Decline of platelets count and total WBC
7	Carbofuran		Insecticide Nematicide Acaricide	Destruction in the mitotic, Lysosomal damage, Destruction in nervous system, Disturbance in functioning of thyroid

8	Chlorpyrifos		Herbicide Fungicide Insecticide	Oxidative stress, Inflammatory damage in multiple organs, Decrease in red blood cells
9	2,4-Dichlorophenoxy acetic acid		Herbicide	Diarrhea, Hypertension, Vomiting, Headache, Illusion, Abnormal behavior, Renal disorder

REFERENCES

1. Hakeem, K.R.; Akhtar, M.S.; Abdullah, S.N.A. Plant, Soil and Microbes: Volume 1: Implications in Crop Science. Plant, Soil Microbes, vol. 1, pp. 1-366, **2016**.
2. Sabarwal, A.; Kumar, K.; Singh, R.P., *Environ. Toxicol. Pharmacol*., *63*, 103, **2018**.
3. Popp, J.; Karoly Peto, J.N. *Agron. Sustain. Dev*., *33*, 243 **2013**.
4. Nicolopoulou-Stamati, P.; Maipas, S.; Kotampasi, C.; Stamatis, P.; Hens, L. *Front. Public Health*, *4*, 1 **2016**.
5. Weisenburger, D.D. *Human Pathol*., *24*, 571, **1993**.
6. Florio, S.; Balci, M. *Pure Appl. Chem.*, *88*, 559, **2016**.
7. Lin, Z.; Pang, S.; Zhang, W.; Mishra, S.; Bhatt, P.; Chen, S. *Front. Microbiol*., *11*, 1, **2020**.
8. Özkan, D.; YüzbaşIoğlu, D.; Ünal, F.; Yılmaz, S.; Aksoy, H. *Cytotechnology*, *59*, 73, **2009**.
9. Dhanushka, M.A.T.; Peiris, L.D.C. *J. Toxicol*. 2017, **2017**.
10. EPA; OCSPP. Atrazine Human Health Risk Assessment United States Environ. Prot. Agency, No. D418316, pp. 1–212, **2009**.
11. Gammon, D.W.; Aldous, C.N.; Carr, W.C.; Sanborn, J.R.; Pfeifer, K.F. *Pest Manag. Sci.*, *61*, 331, **2005**.
12. International Agency for Research on Cancer. Report of the Advisory Group to Recommend Priorities for the IARC Monographs during 2020. IARC Monogr. Eval. Carcinog. Risks to Humans 2020, No. April 2014, i-ix+1-390.
13. Lee, S.K.; Ameno, K.; Yang, J.Y.; In, S.W.; Kim, K.U.; Kwon, T.J.; Yoo, Y.C.; Kubota, T.; Ameno, S.; Ijiri, I. *Int. J. Legal Med*., *112*, 268, **1999**.
14. Eren, Y. Evaluation Of In Vitro Genotoxic Effects of Blood Lymphocytes, **2015**.
15. Rosman, Y.; Makarovsky, I.; Bentur, Y.; Shrot, S.; Dushnistky, T.; Krivoy, A. *Am. J. Emerg. Med.*, *27*, 1117, **2009**.
16. Abigail, M.E.A.; Samuel, S.M.; Ramalingam, C. *Int. J. Environ. Sci. Technol*., *12*, 4025, **2015**.
17. Lo, Y.C.; Yang, C.C.; Deng, J.F. *Clin. Toxicol.*, *46*, 716, **2008**.
18. Wang, Y.; Pan, P.; Li, X.; Zhu, Q.; Huang, T.; Ge, R.S. *Food Chem. Toxicol*., *128*, 46, **2019**.
19. Arce, G.T.; Gordon, E.B.; Cohen, S.M.; Singh, P. *Crit. Rev. Toxicol*., *40*, 546, **2010**.

20. National Pesticide Information Center, *Environ. Prot*., 53, 1, **2009**.
21. He, Q.K.; Xu, C.L.; Li, Y.P.; Xu, Z.R.; Luo, Y.S.; Zhao, S.C.; Wang, H.L.; Qi, Z.Q.; Liu, Y. Chemosphere, *286*, 131625, **2022**.
22. Bányiová, K.; Nečasová, A.; Kohoutek, J.; Justan, I.; Čupr, P. *Chemosphere*, *145*, 148, **2016**.
23. Magnucka, E.G.; Suzuki, Y.; Pietr, S.J.; Kozubek, A.; Zarnowski, R. *Pestic. Biochem. Physiol*., *88*, 219, **2007**.
24. Janardhan, A.; Rao, A.B.; Sisodia, P. *Bull. Environ. Contam. Toxicol*., *38*, 890, **1987**.
25. Muthuviveganandavel, V.; Muthuraman, P.; Muthu, S.; Srikumar, K. *J. Toxicol. Sci*., *33*, 25, **2008**.
26. Dikić, D.; Landeka, I.; Knežević, F.; Mojsović-Ćuić, A.; Benković, V.; Horvat-Knežević, A.; Lončar, G.; Teparić, R.; Rogić, D. *Basic Clin. Pharmacol. Toxicol*., *110*, 433 **2012**.
27. Salihu, M.; Ajayi, B. O.; Adedara, I. A.; Farombi, E.O. *J. Diet. Suppl*., *13*, 433 **2016**.
28. Carter, S.D.; Hess, R.A.; Laskey, J.W. *Biol. Reprod*., **37**, 709, **1987**.
29. Yenjerla, M.; Cox, C.; Wilson, L.; Jordan, M.A. *J. Pharmacol. Exp. Ther*., *328*, 390, **2009**.
30. Mantovani, A.; Maranghi, F.; Ricciardi, C.; Macrì, C.; Stazi, A. V.; Attias, L.; Zapponi, G.A. *Food Chem. Toxicol*., *36*, 37, **1998**.
31. Rama, E.M.; Bortolan, S.; Vieira, M.L.; Gerardin, D.C.C.; Moreira, E.G. *Regul. Toxicol. Pharmacol*., *69*, 476 **2014**.
32. Morinaga, H.; Yanase, T.; Nomura, M.; Okabe, T.; Goto, K.; Harada, N.; Nawata, H.A *Endocrinology*, *145*, 1860, **2004**.
33. Sharma, R.; Sharma, A. *Sri Lanka J. Surg*., *29*, 103, **2012**.
34. Gupta, J.; Rathour, R.; Singh, R.; Thakur, I.S. *Bioresour. Technol*., *282*, 417, **2019**.
35. Soloneski, S.; Reigosa, M. A.; Molinari, G.; González, N. V.; Larramendy, M.L. *Mutat. Res. Genet. Toxicol. Environ. Mutagen*., *656*, 68 **2008**.
36. Guo, D.; Luo, J.; Zhou, Y.; Xiao, H.; He, K.; Yin, C.; Xu, J.; Li, F. *BMC Bioinformatics*, *18*, 1, **2017**.
37. Gupta, C. *J. Toxicol. Environ. Health*, ***43***, 383, **1994**.
38. Whyatt, R.M.; Barr, D.B.; Camann, D.E.; Kinney, P L.; Barr R., J.R.; Andrews, H.F.; Hoepner, L.A.; Garfinkel, R.; Hazi, Y.; Reyes, A.; Ramirez, J.; Cosme, Y.; Perera, F.P., *Environ. Health Perspect*., *111*, 749, **2003**.
39. Pundir, C.S.; Malik, A.; Preety. *Biosens. Bioelectron*., ***140***, 5653, **2019**.
40. AlKahtane, A.A.; Ghanem, E.; Bungau, S.G.; Alarifi, S.; Ali, D.; AlBasher, G.; Alkahtani, S.; Aleya, L.; Abdel-Daim, M.M. *Environ. Sci. Pollut. Res*., *27*, 11663, **2020**.
41. Weis, G.C.C.; Assmann, C.E.; Mostardeiro, V.B.; Alves, A. de O.; da Rosa, J.R.; Pillat, M M.; de Andrade, C.M.; Schetinger, M.R.C.; Morsch, V.M. M.; da Cruz, I.B.M.; Costabeber, I.H. *Chemosphere*, *278*, 130417, **2021**.
42. Reuter, S.; Gupta, S.C.; Chaturvedi, M.M.; Aggarwal, B.B. *Free Radic. Biol. Med*., *49*, 1603, **2010**.
43. Albasher, G.; Albrahim, T.; Alsultan, N.; Alfaraj, S.; Alharthi, M.S.; Kassab, R.B.; Abdel Moneim, A.E. *Environ. Sci. Pollut. Res*., *27*, 3979, **2020**.
44. Gorrini, C.; Harris, I.S.; Mak, T.W. *Nat. Rev. Drug Discov*., *12*, 931, **2013**.

45. Eskenazi, B.; Harley, K.; Bradman, A.; Weltzien, E.; Jewell, N.P.; Barr, D.B.; Furlong, C.E.; Holland, N.T. *Environ. Health Perspect*., *112*, 1116, **2004**.

46. Mink, P.J.; Kimmel, C.A.; Li, A.A. *J. Toxicol. Environ. Heal. - Part B*., **15**, 281, **2012**.

47. De Angelis, S.; Tassinari, R.; Maranghi, F.; Eusepi, A.; Di Virgilio, A.; Chiarotti, F.; Ricceri, L.; Venerosi Pesciolini, A.; Gilardi, E.; Moracci, G.; Calamandrei, G.; Olivieri, A.; Mantovani, A. *Toxicol. Sci*., **108**, 311, **2009**.

48. Blount, B.C.; Pirkle, J.L.; Osterloh, J.D.; Valentin-Blasini, L.; Caldwell, K.L. *Environ. Health Perspect*., *114*, 1865, **2006**.

49. Giddings, J.M.; Williams, M.W.; Solomon, K.R.; Giesy, J.P. in eds.: In: Giesy, J., Solomon, K. (eds) Ecological Risk Assessment of the Uses of the Organophosphorus Insecticide Chlorpyrifos, in the United States, In: Ecological Risk Assessment for Chlorpyrifos in Terrestrial and Aquatic Systems in the United States, Springer, Cham. vol. 231, **2014**.

50. Cáceres, T.; He, W.; Naidu, R.; Megharaj, M. *Water Res*., *41*, 4497, **2007**.

51. Cáceres, T.; He, W.; Naidu, R.; Megharaj, M. *Water Res*., *41*, 3297, **2007**.

52. Song, Y. *J. Integr. Plant Biol*., *56*, 106, **2014**.

53. Garabrant, D.H.; Philbert, M.A. *Metab. Clin. Exp*., *32*, 233, **2002**.

54. Charles, J.M.; Hanley, T.R.; Wilson, R.D.; Van Ravenzwaay, B.; Bus, J.S. *Toxicol. Sci*., *60*, 121, **2001**.

55. Ganguli, A.; Choudhury, D.; Chakrabarti, G. *Toxicol. Res.*, *3*, 118 **2014**.

56. Shin, K.; Ascunce, M.S.; Narouei-Khandan, H.A.; Sun, X.; Jones, D.; Kolawole, O.O.; Goss, E.M.; van Bruggen, A.H.C. *Crop Prot*., *90*, 106, **2016**.

57. Kurenbach, B.; Marjoshi, D.; Amábile-Cuevas, C.F.; Ferguson, G.C.; Godsoe, W.; Gibson, P.; Heinemann, J.A. *MBio*, *6*, 00009-15, **2015**.