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Review Article

Pesticides and World Covid-19 Deaths

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Abstract

In July 2021 at the time the World registered 3.5 million coronavirus deaths, the author completed and in depth evaluation of the relationship of pesticide use by country and the regions of coronavirus deaths and concluded that pesticide use was a major pollutant involved in creating high death rate regions. Ample evidence was presented showing that pesticide use, sprayed or ingested, was involved. Pesticides are well known to be toxic to humans. In 2017 United Nations released a sponsored a study, which indicated that 200,000 deaths a year occurred due to the use of pesticides worldwide, and that the primary people affected were farmers, particularly in the Global South. This paper updates the author's earlier evaluation at the milestone of six million World coronavirus deaths to determine if the outcome has changed.

Introduction

This paper is a follow-up to the evaluation conducted from April 2020 through December 2021 on the "World's Coronavirus Death Regions and Why" (Craven, 2021). The full evaluation, based on a 20 month data analysis of World coronavirus deaths recorded by the Worldometer [1], as power point presentations in a WordPress.com website created November 2021. Part 4 of that evaluation, completed at the 3.5 million Covid-19 death milestone, determined that the vast majority [2] occurred in countries using the most pesticides.

Pesticide producers [3] emphasize that pesticides play an important role in (a) ensuring the people of the World's good health and well-being, (b) protecting vital and economically important food resources, (c) protecting crops from threats of disease and other health hazards, (d) providing the right environment for farmers to earn a sustainable livelihood by minimizing damage and crop loss, (e) preventing mass epidemics in crops, allowing for sustainable healthy food stocks to feed expanding global population. World population [4] has exploded from one billion in 1800 to two billion in 1930 to greater than 7.9 billion March 2022.

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A United Nations study ([5] DuVall) estimated that 200,000 World deaths per year resulted from pesticide usage. An article in Nature in January 2022 ([6] Adam, Karlinsky, Kobak) provided a legitimate basis that "The Pandemics True Death Toll: Millions More Than Official Counts" is more likely in range 12-22 million.

This paper focuses on the connection between World pesticide usage and its relationship to the World's coronavirus deaths at the six million registered death milestone and considers the implication of magnitude of Covid-19 deaths vs pesticide use at the more realistic 12-22 million.

Discussion

In February 2022, Craven authored a paper entitled *East-Central Europe – World's Deadliest Coronavirus Center* [7] and in March 2022 another paper entitled *Lands Abutting Seas and Oceans, 85% of Covid-19 Deaths* [8]. Both of these published papers updated the data evaluation at the six million death milestone, reached on March 3, 2022 and emphasized the role of fine sized pollutants from a variety of sources under temperature inversion conditions as carriers of coronavirus aerosols as the principal mechanism for the transmission of coronavirus among people [9,10]. Pesticide use primarily from spraying, but also from consumption from crops with residual pesticides, and pesticide runoff from agricultural lands into water bodies was cited as playing a significant role in creating coronavirus death regions.

Table 1 summarizes the eight coronavirus death regions, cited in these papers, which account for 99.8% of the World's deaths. Eastern Europe was the Region with highest death rank, with South America a close second. Death ranks in Africa and the Far East remained at 5% of Eastern Europe and South America.

Region	Ave Death Rate	Deaths	MM pop	% Urban pop
Eastern Europe	2,952	917,645	311	64%
South America	2,915	1,273,654	437	75%
North America	2,512	1,377,722	549	73%
Western Europe	1,525	867,563	569	75%
Middle East	807	350,335	434	71%
Southwest Asia	331	621,525	1,880	30%
Africa	175	244,129	1,394	46%
Far East	151	333,669	2,207	63%
Totals	769	5,986,242	7,780	
3-Mar-22		6,000,753	7,800	
Percent of World		99.8%	99.7%	

Table 1: Total Covid-19 Pandemic Deaths, Death Ranks, Population by Region – March 3, 2022 [2].

Table 2 summarizes total coronavirus deaths, death ranks, and accumulated percent of World deaths for the forty-two deadliest coronavirus countries, 90% of pandemic deaths on March 3, 2022. The deaths in these countries descended from near one million in the USA to near 20,000 in Myanmar. Ninety countries of the 224 tracked by

Worldometer Coronavirus had over 4,000 deaths, and accounted for 98% of the World's total. Twenty-one countries accounted for 80% of the total. Six countries accounted for 50% of the World's deaths- USA, Brazil, India, Russia, Mexico, and Peru. The pandemic is world-wide, but the bulk of coronavirus deaths are concentrated into narrow regions of the World.

Rank	Country	Deaths	Death Rate	Acc vs World
1	USA	981729	2937	16%
2	Brazil	650646	3025	27%
3	India	514620	367	36%
4	Russia	354011	2424	42%
5	Mexico	318835	2430	47%
6	Peru	210851	6250	51%
7	UK	161898	2364	53%
8	Italy	155399	2577	56%
9	Indonesia	143361	517	58%
10	France	138942	2121	60%
11	Colombia	138939	2683	63%
12	Iran	137439	1602	65%
13	Argentina	126531	2757	67%
14	Germany	124265	1475	69%
15	Poland	112130	2968	71%
16	Ukraine	105505	2437	73%
17	Spain	100239	2143	75%
18	So Africa	99499	1643	76%
19	Turkey	95025	1107	78%
20	Romania	63782	3353	79%
21	Philippines	56538	505	80%
22	Chile	42683	2201	81%
23	Hungary	42211	4596	81%
24	Vietnam	40547	410	82%
25	Czechia	38787	3611	83%
26	Canada	36843	962	83%
27	Bulgaria	35716	5205	84%
28	Equador	35264	1949	84%
29	Malaysia	33028	999	85%
30	Pakistan	30237	133	85%
31	Belgium	30217	2588	86%
32	Bangladesh	29058	174	86%
33	Tunisia	27857	2317	87%
34	Greece	26036	2518	87%
35	Iraq	25028	600	88%
36	Egypt	24149	229	88%
37	Japan	24092	191	89%
38	Thailand	23073	329	89%
39	Netherlands	21589	1255	89%
40	Bolivia	21433	1796	90%
41	Portugal	21141	2083	90%
42	Myanmar	19379	352	90%

Table 2: Total Covid-19 Pandemic Deaths, Death Ranks, Accumulative by Country – March 3, 2022.

The earlier evaluation [2] proposed the hypothesis that a "Pathway to Creation of Deadly Coronavirus Regions" existed. This Pathway is shown on Figure 1 and is fundamental to this paper. Critical factors affecting coronavirus deaths identified in the initial evaluation (Craven, 2021) were (a) massive emissions of pollution from a variety of well-known sources (refineries, coal-powered generation, diesel transportation land and sea, pesticides spraying, consumption, runoff) in (b) congested regions of population under (c) meteorogical weather conditions of temperature inversions.

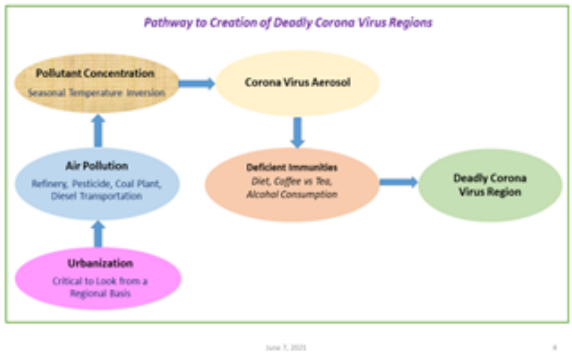


Figure 1: Pathway to Creation of Deadly Coronavirus Regions.

In Part 1 of the evaluation [2], it was determined that spraying of pesticides in North Dakota (Minnesota, Florida et al) were known to cause pollution and health issues, and could result in particulates drifting hundreds of miles. US States stringently regulate spraying vs periods of temperature inversions.

In Part 4 of the evaluation [2], the explosion of coronavirus deaths in Mexico and South America prompted the author to focus on pesticide usage as a potential cause. The following considerations led to this evaluation.

- From the end of March through the first week of June 2021, major changes in coronavirus death occurred in Mexico and South America. Mexico acknowledged underreporting deaths by 120,000; Peru acknowledged underreporting by 113,000; Colombia passed Germany in total deaths; Argentina passed Spain and Iran in total deaths.
- Pesticide use was considered across Mexico and South America as large quantities of coffee and fruits are grown and exported to the USA and elsewhere.
- Research of the growing conditions determined that coffee and fruits are generally grown on mountain sides to take advantage of the warmer temperatures caused by temperature inversions.

Research further determined that this applies to grape growers and wine producers in Italy, France, and Spain.

- The population centers are located in the mountain valleys below the temperature inversions, and these centers have extensive manufacturing and resulting pollution.
- Temperature inversions are seasonal, peculiar to each region, and are well known to concentrate pollutants. Based on the literature associated with pesticide spraying, temperature inversions occur during more or less specific time periods during the day. Timing for spraying is critical to avoid "drift" hundreds of miles.

Figure 2 is a map of the Global Pesticide Use [11] by the United Nations Food and Agricultural Organization (FAO). The World's countries are shaded in increasing darker green in proportion to their increased average pesticide application per unit of cropland, measured in kilograms per hectare. Comparison of the World Covid-19 deaths in Tables 1 and 2 with the World's Global Pesticide Use by Country indicates that essentially all of the Covid-19 deaths have occurred in these pesticide using countries. The mainland continent of Africa and Asian Russia are shown to use very little pesticides and have very few COVID-19 deaths. North America and South America, heavy pesticide users, account for 44% of the World's Covid-19 Deaths. Europe plus the Northern Africa countries surrounding the Mediterranean Sea account for 30%. The Middle East plus Southwest Asia, bounded by the Black Sea and Arabian Sea, account for 16%. The Far East (South China Sea and East China Sea), South Africa (Atlantic and Indian Oceans) and Australia (an island) account for 7%. This totals to 97% of the World's Covid-19 deaths. China is the heaviest pesticide using Country as well as a heavy industrial polluting country, but reports very few Covid-19 [2] deaths. It is beyond the scope of this paper to second guess reported data.

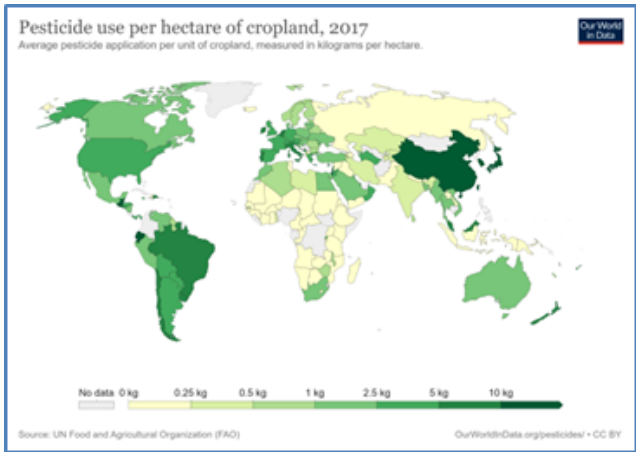


Figure 2: Global Pesticide Use, UN Food and Agricultural Organization (FAO).

However, in January 2022, in an article in [11] Nature "The pandemic's true death toll: millions more than official counts" David Adam in reviewing work by Karlinsky and Kobak, projected based on "Excess World Deaths" during the pandemic, that the actual Covid-19 death toll is likely in the range of 12 to 22 million vs the recorded 6 million. Figure 3 is taken from that report. It focuses on 10 Countries. The article further addresses India's actual death toll as 5-10x their 515,000 total reported on March 3, 2022 and has a goal in the future to fully assess the actual death numbers in China. Comparing these countries to the map of Global Pesticide Use and to this paper's assessment that 97% Covid-19 deaths are in countries using most pesticides, means that the actual number of Covid-19 deaths related to pesticide usage World-wide may be tens of millions.

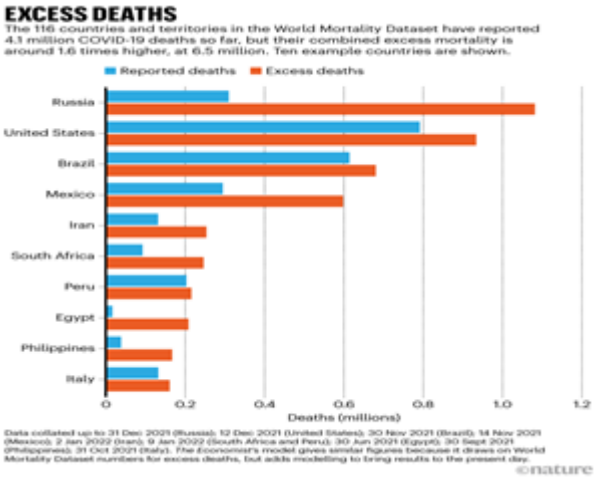


Figure 3: Excess Pandemic Deaths based on World Mortality Dataset.

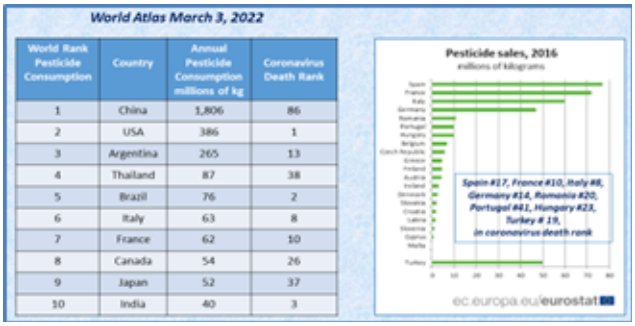
A search for articles relating Covid-19 deaths to pesticide exposure provided an article [12] on *Pesticide Exposure and Covid-19 Susceptibility* (Lamontagne, 2021) identified a potential link between exposure to organophosphates and increased susceptibility to Covid-19 infection. This work focused on veterans of The Gulf War, 25% of whom suffer from chronic symptoms of fatigue, headaches, joint pain, indigestion, insomnia, dizziness, respiratory disorders, and memory problems. Saurabh Chatterjee, PhD, of University of South Carolina and research health specialist at Columbia VA Medical Center led research team.

A second article from *Beyond Pesticides* [13] "Much Higher Rates of Covid-19 Infections and Deaths in Farm Workers and Landscapers, May Be Enhanced by Pesticide Exposure" provided the following: "According to a report published by the University of California Los Angeles, Latino Californians aged 50 to 64 have died from the virus at rate five times higher than white people of the same age. The poor working conditions farmworkers and landscapers are subject to already put them at disproportionate risk of pesticide induced diseases. Alongside other hardships such preexisting health problems, family obligations, cramped housing and transportation, threat of deportation, and communication difficulties, the risks of these essential workers contracting and dying from Covid-19 are compounded exponentially."

Appendix A provides an article entitled "Pesticides – General" by the [14] Canadian Centre for Occupational Health & Safety, Pesticides General OSH Answers. It identifies dozens of pesticides in use, characterizes them by chemistry, explains hazards, and states "With a few exceptions, most are highly toxic" to humans because "pesticides are designed to 'kill'".

Appendix B provides a mandated annual communication by the Maryland Department of Agriculture from the author's Lawn, Tree and Shrub Care provider [19]. Forty-one pesticides are listed with their associated Precautionary Statements and Environmental Hazards. The author challenges all readers to fully read and ponder the facts of Appendices A & B.

Figure 4 provides a table and graph of "Highest Pesticide Consumption & Sales" for the World and for Europe. For each the coronavirus death rank for each country has been added. Nine of the ten highest World pesticide consumers are in the top 42 deadliest coronavirus countries. The anomaly is China. For Europe seven of the eight highest countries in pesticide sales are in the top 23 deadliest coronavirus countries.



World Rank Pesticide Consumption	Country	Annual Pesticide Consumption millions of kg	Coronavirus Death Rank
1	China	1,806	86
2	USA	386	1
3	Argentina	265	13
4	Thailand	87	38
5	Brazil	76	2
6	Italy	63	8
7	France	62	10
8	Canada	54	26
9	Japan	52	37
10	India	40	3

Figure 4: Highest Pesticide Consumption & Sales vs Coronavirus Death Rank.

Figure 5 is a Global map of countries by Soybean production in 2016. Table 3 provides the thirteen World Countries producing over one million Soybean tonnes in 2018. Their corresponding coronavirus death rank has been added to Table 3. All of these countries are in the top 44 deadliest coronavirus countries except China and Uruguay. Brazil, USA, India are top five in soybean production and coronavirus deaths.

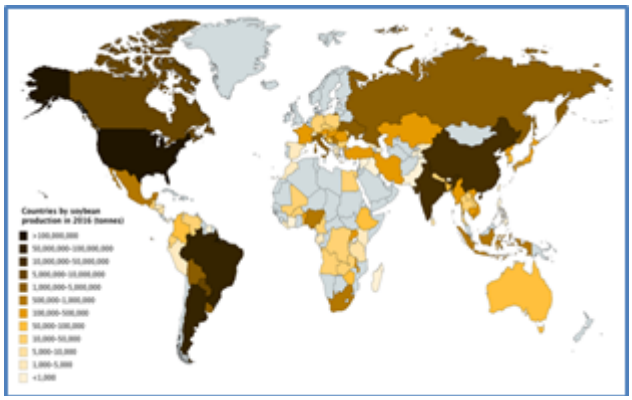


Figure 5: Countries by Soybean Production 2016 tonnes.

Table 4 provides a summary of the top sixteen Worlds wheat producing countries, although first on list is European Union (27 countries). Fourteen of these listed entities are in the top 41 deadliest coronavirus countries. Exceptions are Kazakhstan at #55 and Australia at #82.

The results of the information contained in these Figures and Tables is that the countries consuming and producing the World's most pesticides are almost all in the top 42 deadliest coronavirus countries, accounting for 90% of the World's coronavirus deaths.

Figure 6 summarizes the growth in World production and imports of pesticides from 1940 through 2000 and also shows the size of this business in billions of 1996 US dollars. According to RESEARCHANDMARKETS [16] the market outlook for pesticides global sales

Rank	Country	2018	Covid-19 Death Rank
1	Brazil	125,887,672	2
2	United States	123,664,230	1
3	Argentina	37,787,927	13
4	China	14,193,621	86
5	India	13,786,000	3
6	Paraguay	11,045,971	44
7	Canada	7,266,600	26
8	Ukraine	4,460,770	16
9	Russia	4,026,850	4
10	Bolivia	2,942,131	40
11	South Africa	1,540,000	18
12	Uruguay	1,334,000	73
13	Italy	1,138,993	8

Table 3: Soybean Production by Country vs Covid-19 Death Rank.

in 2023 will be $130 billion, with herbicides gaining $27 billion. This growth is staggering.

World Wheat Production

	World	776,418,000	778,522,000	2,104,000
Rank	Country	February	March	Difference
1	European Union	138,900,000	139,000,000	100,000
2	China	136,946,000	136,946,000	0
3	India	109,520,000	109,590,000	70,000
4	Russia	75,500,000	75,158,000	(342,000)
5	United States	44,790,000	44,790,000	0
6	Australia	34,000,000	36,300,000	2,300,000
7	Ukraine	33,000,000	33,000,000	0
8	Pakistan	27,000,000	27,000,000	0
9	Canada	21,652,000	21,652,000	0
10	Argentina	20,500,000	20,500,000	0
11	Turkey	16,250,000	16,250,000	0
12	United Kingdom	14,000,000	14,000,000	0
13	Iran	12,000,000	12,000,000	0
14	Kazakhstan	11,814,000	11,814,000	0
15	Egypt	9,000,000	9,000,000	0
16	Brazil	7,700,000	7,700,000	0

Source: FAS/USDA (metric tons)

Table 4: World Wheat Production (Ranking By Country), Published on: Mar 22, 2022.

In March 2021 *Civil Eats* published an article [15], summarizing an interview of Anna Lappe with Wolfgang Boedeker, an epidemiologist and board member of Pesticide Action Network – Germany. They cited that pesticide use skyrocketed by 81% over past 35 years. Regions like South America had a 500% increase vs Europe's 3%. Nearly 300 HHPs are on market, known to be highly toxic to humans, linked to cancer or endocrine disruption or have shown to be

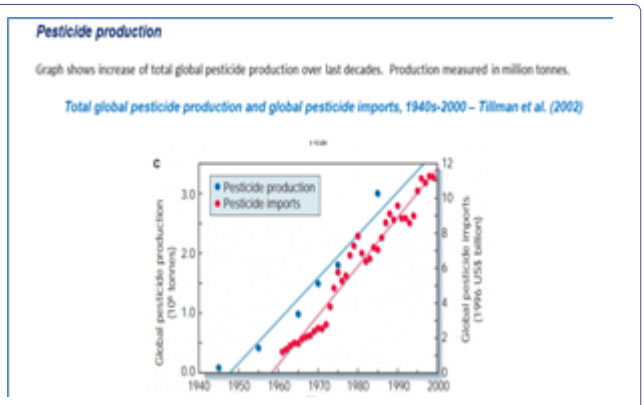


Figure 6: Growth in World Production and Imports of Pesticides from 1940 to 2000.

particularly damaging to the environment. Counties in the Global South are at highest risk as there are fewer protective measures against exposure. These HHPs are banned for use generally in the Global North.

A paper by Renee Loux in *Prevention* November 3, 2011 entitled [16] "The Dirty Dozen – Contaminated Foods" reports "FDA and USDA research shows high levels of pesticide and chemicals in these commonly contaminated foods…The "dirty dozen" are the most commonly and highly contaminated foods with pesticides and chemicals, even after washing and peeling. The chemical pesticides detected are known to cause cancer, birth defects, nervous system and brain damage, and developmental problems in children. These foods include beef, pork, poultry, milk, cheese, butter, strawberries, raspberries, cherries, apples, pears, tomatoes, potatoes, spinach, coffee, peaches, nectarines, grapes, celery, red and green peppers [17-21].

An article in SuccessfulFarming August 25, 2020 described a [17] "Sweeping U.S. Pesticide Reform Bill Introduced, Banning Some Chemical Agents. This article indicates that pesticide regulations have not been updated for 25 years during the period of substantial pesticide sales. Health studies during this period have discovered a range of neurodevelopmental effects and have provided overwhelming evidence that pesticide use is causing harm to people and the environment. The USA alone allows use of dozens of pesticides, 1/3 of its total use, banned in the European Union.

Conclusion

This paper has revisited the relationship between pesticide production, application, and use vs World coronavirus deaths at the six million Covid-19 death milestones. From the aspects of global pesticide production to consumption to individual country production and consumption to countries producing the most soybeans and wheat to the products retaining residual pesticides versus World coronavirus deaths, the relationship appears to be critical. Pollution from pesticide use, like pollution from refineries, coal-fired power plants, and diesel transportation on land and sea, during periods of seasonal temperature inversions correlate with the countries and regions experiencing high coronavirus deaths. In fact this paper has shown that 97% of Covid-19 deaths occurred in countries using the most pesticides. All regulatory organizations acknowledge that pesticides are designed to kill and/or maim in order to function, and humans and animals as well as pests are susceptible to these effects. The need to feed the currently 7.9 billion World populations growing to 10 billion by 2057 is a major challenge. The pesticide industry is critical to success and the size of the pesticide industry is staggeringly approaching $130 billion dollars from a tenth of this a generation ago. But regulations have not been adjusted to meet the demands of this staggering pesticide industrial growth. The United Nations and other World Class epidemiologists understand the dilemma of feeding versus ensuring the environmental health of society. 200,000 deaths a year, pre-pandemic, is a horrific price to pay. This paper further suggests that once the full impact of the pandemic is complete in a couple years, the actual coronavirus death toll will be tens of millions and a very large proportion of these will be related with exposure to pesticides.

Appendix

https://www.heraldopenaccess.us/fulltext/Community-Medicine-&-Public-Health-Care/Appendix.docx

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