Effect of Two Commonly used Insecticides On Some Physico-Chemical Parameters and Microbial Load of a Farm Soil

A. D. V Ayansina [1*] • B. O. Atobatele [2] • A. A. Sobowale [3]

[1] Department of Biological Sciences, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria
[2] Department of Biological Sciences, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria
[3] Department of Botany, University of Ibadan, Ibadan, Oyo State, Nigeria
ayandvt@yahoo.com

Abstract: Pesticides are generally used in agriculture to eliminate un-wanted growths and reduce productivity cost with little concern for non-target organisms. Studies were carried out on the effect of two commonly used insecticides (common names-DD force & Scorpio) on some soil physicochemical parameters and microbial loads at recommended rate (x1.0) and twice the recommended rate (x2.0) over a period of 8 weeks. Generally, insecticides treatments resulted in soil pH reduction from 7.23 for the control soil to 5.98 for DD force and 7.03 for Scorpion. At recommended application rates (x1.0) there was a decrease in bacterial counts at week 0 (6 hours after treatment)-control soil = 6.90 x10^6 cfu/ml; DD force = 3.09 x10^6 cfu/ml and Scorpio = 3.09 x 10^6 cfu/ml. Thereafter, there was an increase in bacterial counts reaching a maximum at week 4. This was followed by a general decrease in bacterial counts. Bacteria counts in soils treated with DD force and Scorpio at twice the recommended rates (x2.0) were higher compared to counts obtained from the two insecticides treated at the recommended rates (x1.0). However, fungal counts from soils treated with the two insecticides at recommended rates (x1.0) were higher compared to counts obtained from soils treated at twice the recommended rates. A total of 55 bacterial species were isolated from the insecticide treated and control soils which are Bacillus sp (30.9%), Proteus sp (12.7%), Flavobacterium sp (14.5%), Pseudomonas sp. (1.8%), Lactobacillus sp (10.9%), Staphylococcus sp (10.9%), Antinomycetes sp (12.7%). A total of 20 fungi isolated were isolated from insecticides treated soil and control soil which includes Aspergillus sp (40%), Penicillium sp (20%), Rhizopus sp (20%).

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1. Introduction:

The Food and Agricultural Organization (FAO, 2007) has defined pesticides as any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human and animal diseases, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies (FAO, 2007).

Many modern pesticides do not persist for long in the environment. They act quickly and are then degraded to non-toxic substances by environmental and microbial processes. This helps prevent their build-up in crops or non-target organisms. How quickly a pesticide breaks down depends on its chemical properties, how much is applied and how it is distributed, as well as environmental factors such as temperature, moisture, pH and the availability of microorganisms (USEPA, 2013). Microorganisms such as bacteria and fungi are very important ecologically as decomposers in the soil (Taylor, 2002). Microorganisms are of prime importance in the soil recycling of elements essentially for biological processes and thus the maintenance of soil fertility.

Pesticides are often applied directly to the soil. They may also reach the soil through application to foliage via spray drift, run-off or wash-of vectors (Racke and Coats, 1990). Pesticides in soil partition between at least three phases: soil air, soil solution and soil rocks (Gunter and Joseph, 2013).

Insecticides are substances used to kill or control insects. They are used in agriculture, medicine, and the industry. Nearly all insecticides have the potential to significantly alter the ecosystem; many are toxic to man and some may concentrate along the food chain (USEPA, 2014). A major concern to pesticide use is the changes they may have on microbial populations and activities of individual species of microorganisms (Bollag et al., 2002; Ayansina & Oso, 2006).

Microorganisms are of prime importance in the recycling of elements essential for many biological processes and thus maintenance of soil fertility. In this study, we set out to know the effect of two commonly used insecticides soil pH, microbial counts and isolations.

2. Materials and Methods:

2.1. Sampling and insecticide treatment:

Soil samples were collected from the Bowen University, Agric farm, sieved through 2.0mm sieve to remove stone and plant debris. One kilogram each was placed in plastic bowls and treated with the 2 insecticides (DD force-2,2-dichlorovinyl dimethyl phosphate & Scorpio-dimethoate + cypermethrin) at manufacturers recommended rate (x 1.0) and twice recommended rate (x 2.0). Recommended rates of application for the two insecticides was done by mixing 10.5ml of each in 100ml of de-ionized water per 1.0kg of the soil sample. Another bowl treated with 100ml de-ionized water only served as the control. Soil treatments were replicated. Soil samples were analyzed on a weekly basis over 8-week sampling periods – for soil pH, total microbial counts, and isolations.

2.2. Determination of soil pH:

Twenty grams from each of the soil treatments was mixed with 20ml of de-ionized water and stirred thoroughly in 100ml baker. The soil-water mixture was allowed to settle for 30 minutes with intermittent mixing and stirring. The coarse particles were allowed to settle and pH was determined using the pH meter (Jenway model 3540).

2.3. Microbial counts and Isolations:

One from each of the soils treated was mixed with 9ml sterile de-ionized water in a test tube to obtain 10-1 dilution. Several dilutions were made to the 10-6 by pipetting 1ml from previous dilutions to fresh 9ml sterile de-ionized water.

One millilitre was pipette from each of the dilutions and transferred on to sterile Petri dishes. Nutrient agar (for bacterial growth) and potato dextrose agar (for fungal growth) was poured into the Petri dishes and allowed to set. The plates were replicated and labeled appropriately. Nutrient agar plates were incubated at 350C for 24 hours while potato dextrose agar plates were incubated at 250C for 48 hours. Discrete colonies were counted from which estimation was done on the microbial counts from the treated and control soils. Microbial counts were done at week 0 (6 hours after initial treatments) and fortnightly over 8 weeks. Discrete colonies were sub-cultured on fresh sterile agar plates to obtain pure cultures representative of each treatment. Conventional identification steps included Gram's staining, catalase test, oxidase test, citrate test, sugar fermentation test, microscopic observation etc.

3. Results and Discussion:

Generally, soil treatment with the two insecticides resulted in a pH reduction from a mean value at 7.23 for the control soil to 5.98 for DD force and 7.03 for Scorpio Table 1. This result contrast Ayansina and Oso (2006) who reported that there were no significant changes in soil pH of soils treated with two different pesticides. The effectiveness of pesticides can be affected by soil pH, moisture contents and humidity, temperature, organic matter and the addition of organic amendments (Akobundu, 1987).

Compared to the untreated (control) soil, there was an initial decrease in mean bacterial counts in DD force treated soils at week 0 (6.90 x 10^6 cfu/ml to 3.09 x 10^6 cfu/ml) and for Scorpio treated soil (from 6.90 x 10^6 cfu/ml to 3.00 x 10^6 cfu/ml)-all at recommended rates. Thereafter, there was a relative increase in bacterial counts reaching a maximum (3.0 x 10^6 cfu/ml and 3.50 x 10^6 cfu/ml) at week 4 in DD force treated soils (Fig 1). A general decrease in bacterial counts was obtained in Scorpio treated soils as shown in Figure 2. Generally, bacterial counts in soils treated with DD force and Scorpio at twice the recommended rates (x 2) resulted in higher counts compared to those treated at recommended rates.

However, fungal counts were higher in soils treated at the recommended rates compared to those treated at twice the recommended rates. DD force treated soils at recommended rate resulted in mean fungal counts of 2.8 x 10^4 cfu/ml while at twice recommended rate mean fungal counts of 2.4 x 10^4 cfu/ml was obtained at week 0. Scorpio treated soil had 3.0 x 10^4 cfu/ml and 2.6 x 10^4 cfu/ml at recommended and twice recommended rates respectively (Tables 3 and 4). It has been shown that pesticides effect on soil microflora could be inhibitory, stimulatory or neutral (Gogotov, 1992: Bollag et al., 2002). Moorman et al. (2001) had reported that distribution in microbial counts, activities and species can be caused by application of pesticides at greater or higher concentrations than the recommended doses. A decline in microbial counts after each peak must have been due to the fact that microbial populations that were tolerant of the treated pesticides were susceptible to the products of soil-pesticide interactions, which could have been possibly bactericidal or fungicidal (Taiwo and Oso, 1997).

A total of 55 bacterial species was isolated from the insecticide treated and control soils which comprise Bacillus sp. (30.9%), Proteus sp. (12.7%), Flavobacterium sp. (14.5%), Pseudomonas sp. (1.8%), Lactobacillus sp. (10.9%), and Staphylococcus sp. (10.9%), Actinomycetes (12.7%) as presented in Table 2. On the other hand, a total of 20 fungi was isolated and these includes Aspergillus sp (40%), Penicillium sp. (20%), and Rhizopus sp. (20%)-as shown also in Table 2. These microorganisms are mainly indigenous to the soil and are capable of metabolizing insecticides provided other environmental conditions are right Mervat, 2009).

Indiscriminate uses of insecticides, when applied to soils, can have several effects on soil microbial community. A major way of improving agricultural production to meet human demands is the use of insecticides to control insects. In achieving sustainable agricultural production, environmental implications of these insecticides should be considered and the miss-use of these insecticides should be discouraged due to damages to the soil ecosystems and environmental hazards.

Table 1: *PH measurements from insecticide-treated soils and control soil*

Treatment/Week	Week 0	Week 2	Week 4	Week 6	Week 8	Mean
DD Force x 1.0	6.2	5.4	6.4	6.1	5.9	6.00
DD Force x 2.0	5.6	5.0	5.4	5.2	5.4	5.98
Scorpio x 1.0	7.3	6.7	6.7	6.6	6.8	6.82
Scorpio x 2.0	7.4	7.0	6.9	6.8	6.8	7.03
Control	7.9	6.9	7.0	7.1	7.1	7.23

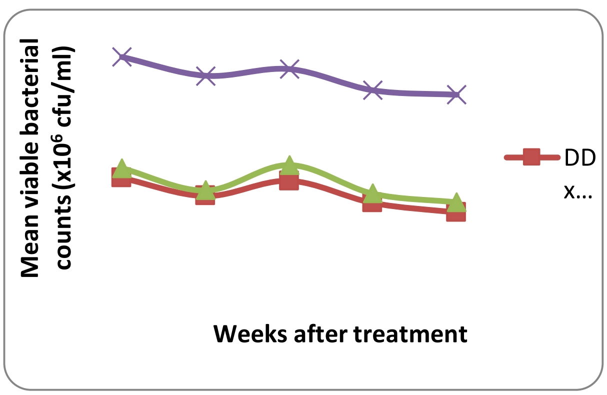

Figure 1: mean viable bacterial counts at recommended rate (x1.0) and twice recommended rate (x2.0) for the insecticide DD Force

Table 2: *Microbial isolations from insecticide-treated soils and control soil*

Microorganisms	Amount	%
Bacterial		
Bacillus sp	17	30.9
Proteus sp	7	12.7
Flavobacterium sp	8	14.5
Lactobacillus sp	6	10.9
Staphylococcus sp	6	10.9
Pseudomonas sp	1	1.8
Actinomycetes	7	12.7
Unidentified	3	5.5
Fungal		
Aspergillus sp	8	40
Penicillium sp	4	20
Rhizopus sp	4	20
Unidentified	4	20

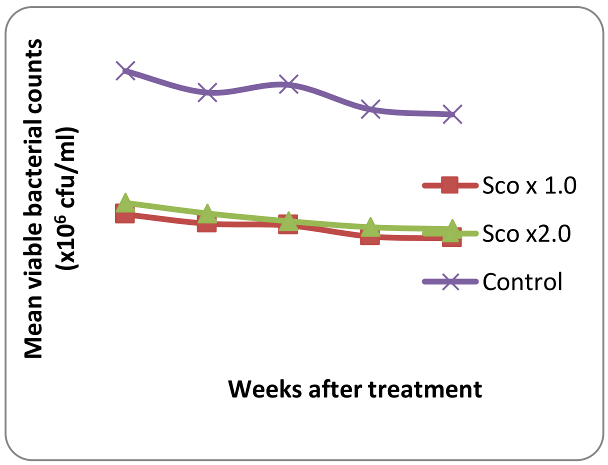

Figure 2: mean viable bacterial counts at recommended rate (x1.0) and twice recommended rate (x2.0) for the insecticide Scorpio

Corresponding Author:
A. D. V. Ayansina,
Department of Biological Sciences, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria.
E-mail: ayandvt@yahoo.com

References:

1. Akobundu, I.O. (1987). Weed Science in the Tropics: Principles and Practice. *Wiley Inter-Science Publ*. P. 179-205.
2. Ayansina, A. D. V. (2006). Effect of two commonly used herbicides on soil microflora at two different concentrations. *African Journal of Biotechnology*, 5(2), 129.

3. Ahn, M. Y., Dec, J., Kim, J. E., & Bollag, J. M. (2002). Treatment of 2, 4-dichlorophenol polluted soil with free and immobilized laccase. *Journal of Environmental Quality*, 31(5), 1509-1515.
4. FAO (2007). Food and Agricultural Organization of the United Nations*: International Code of conducts on Pesticides Distribution and Use of Pesticides.*
5. Gunter, Z. and Joseph, S.E. (2013). Imperial Chem. Industry. *Pesticides and the Environment-Plant Protection Div*., *Hill Research station*. P.1-16.
6. Gogotov, I.N. (1992). Degradation of xenobiotic by phototropic microorganisms. *In-Fate of Pesticides and Chemicals in the Environment* (Schnoor, J.L.-ed). John Wiley & sons. P234-258.
7. Mohamed, M. S. (2009). Degradation of methomyl by the novel bacterial strain Stenotrophomonas maltophilia M1. *Electronic Journal of Biotechnology*, 12(4), 6-7.
8. Moorman, T. B., Cowan, J. K., Arthur, E. L., & Coats, J. R. (2001). Organic amendments to enhance herbicide biodegradation in contaminated soils. *Biology and Fertility of Soils*, 33(6), 541-545.
9. Racke, K.D., Coats, C.D. (1990). Pesticides in the soil microbial ecosystem in enhanced biodegradation. In Pesticides in the Environment (Racke, K.D., and Coats, J.R.-Eds). Symposium 198th of American Chem. Soc., Sept. 10-15, 1989-ACS, *Washington*, DC P.1-12
10. Taiwo, L.B. and Oso, B.A. (1997). The influence of some pesticides on soil microflora in relation to changes in nutrient levels, rock phosphate solubilization and release under laboratory conditions. Agric. *Ecosystem and Environ*. 65: 59-68
11. Taylor, D.J., Green, N.P.O., Stout, G.W. and Soper, R. (2002). *Biological Science- Pesticides and the Environment* 10: 334-338
12. U.S Environmental Protection Agency (USEPA) (2013). http://www.epa.gov/pesticides/about/index.html - Retrieved September 15, 2005
13. U.S. Environmental Protection Agency (USEPA) (2014). http://www.epa.gov/pesticides/insecticides/about/index.html -retrieved on Sept. 15, 2015. Accessed 11 April 2015.

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