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ANALYSIS OF THE EFFECT OF SPRAY APPLICATION PARAMETERS ON SPRAY DEPOSITION IN ORCHARD TREE CANOPIES

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ABSTRACT

Scientific studies were carried out to analyze the relationship of spray application parameters namely; sprayer ground speed, acceleration (due to gravity) spray mass flux and tree characteristics such as tree height, canopy diameter on spray deposition in orchard tree canopies. Result showed that, Deposition increases from 0.171-0.199 (mg/cm^2) with an increase in sprayer speed from 0.8km/hr-2.4km/hr. The maximum deposition was obtained at 0.199 with a sprayer speed of 8.0km/hr at canopy diameter of 6.5m, spray mass flux of 6.9kg/m^{2}s respectively. Canopy diameter did affect the predicted deposition. The regression analysis as obtained an excellent relationship with the coefficient of determination for spray mass flux, canopy diameter, tree height and sprayer speed as 0.87, 0.99, 0.99, and 0.98 respectively.

KEYWORDS: Sprayer, Spray Mass Flux, Height & Canopy Diameter

1. INTRODUCTION

Pesticide application describes the practical way where pesticides, (such as Compounds, fungicides, insecticides, or nematode control representatives) are sent to their own biological goals (e.g. pest organism, harvest or another plant). Public concern with the use of pesticides has emphasized the requirement to make this process as effective as possible, so as to minimize their discharge to the environment and human exposure (such as operators, bystanders, and customers of produce). [1] The custom of pest control by the logical application of pesticides is supremely multi-disciplinary, combining numerous facets of biology and chemistry together: agronomy, technology, meteorology, socioeconomics, and general health, jointly with newer areas like biotechnology and data science.

Among the most typical kinds of pesticide program, particularly in agriculture that is traditional, is using mechanical sprayers. Sprayers convert a chemical formula, frequently containing a combination of water (or some other liquid compound provider (like fertilizer) and compound, into droplets, which is big rain-type drops or miniature almost-invisible particles. This transformation is achieved by pushing the spray mix under stress by means of a spray nozzle. The dimensions of droplets could be changed through the use of nozzle dimensions, or by changing even a combo of both, or the strain under which it's forced. Droplets have the benefit of being less vulnerable to spray drift but need more water per unit of property. End conditions are demanded, although Because of static electricity droplets can optimize contact with a target organism. Air blast sprayers or air delivery have been utilized to use foliar nutrition, plant growth regulators and pesticides. These substances are applied by them as fluids. Air blast sprayers have alterations in air delivery methods and the fluid which allow tailoring the software to match a range of orchard requirements.

The cost and Efficacy effectiveness of orchard Pest Control The abilities of sprayer operators and supervisors that assess orchard requirements and change operating methods and machine configurations to maximize the performance of sprayers influence Management applications. A mixture of timing, equipment functionality, ability, and compound selection is vital for optimum outcomes.

Airflow characteristics that affect coverage Include air volume (CFM: cubic feet per second) and speed (FPM: ft per second). Enthusiast type and rate, size design influences these parameters so on. As previous and such remarks indicate, several variables, most Interactive are included with air shipping sprayer performance. Performance data regarding Several of These variables for sprayers Aren't Generally offered.

All spraying requires care and attention to details to achieve good results, but orchard spraying is generally more challenging and difficult to perform well than boom spraying in fields. Field spraying tends to be a two-dimensional problem involving an area to be covered. Orchard spraying adds a third dimension—height—and concern for the volume in the target area (i.e. the size of trees). Shani 2008, Other significant differences are the much greater distances between nozzles and target in orchard spraying and the amount of air used to carry spray to the tree.

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Research activities of the project are to ascertain system operating parameters and transportation systems impacting supply uniformity for air. Deposition diminished with dept in citrus tree canopies, and the rate of reduction was influenced by spray volume and sprayer airflow speed (Farooq and Salyani, 2002). Some properties like tree construction flux, droplet size, spray volume rate speed, wind speed, air flow speed condition, temperature, and humidity are essential from the processes. It was discovered that these factors influence spray transportation to and inside. For harvest applications employing standard sprayers, spray sediment in the plant canopy is dependent upon droplet size, droplet speed, spray volume rate (Salyani, 2002), wind speed, and tree construction). Droplet size is dependent upon atomizer form, nozzle pressure/atomizer rate, liquid flow rate, liquid components (Miller and Ellis, 2000), and atmospheric temperature and relative humidity. Whilst Crop structure could be characterized by the canopy shape, volume, and density speed is a function of droplet size, wind speed, sprayer floor speed, and air flow velocity. This study's target was to determine shrub attributes and sprayer program parameters and their impact on orchard tree canopies on spray residue.

2. METHODS

The tools have been an anemometer, a tachometer, a measuring tape documents or tracers, a sprayer, a stop-watch and footprints of different sizes in the orchard farm. The sprayer was calibrated at the Department of Crop and Soil Sciences, National Open University Nigeria's harvest protection machines lab.

The gear is made up essentially of pesticide and gas tank (tank component) of 25 liters capabilities respectively and tank components operated by little powered four stroke motors. Extending in the fan casing are air release hoses, which expand into the energy nettles that are gaseous. Pesticide moves down through restrictors into the nozzles where the high-velocity air atomizes it from the fan and via shipping tubes. The trees are Guava shrub of the identical selection and various heights and situated in the University orchards farm, Rigachikun Nigeria (see figure two). The experiments were conducted at orchard farm and the lab.

Figure 1: Picture of the Motorized Mist Blower

Figure 2: Picture of Experimental Site of the Orchard Trees

2.1 Experimental Procedure

2.1.1 Measurement of Sprayer Parameters

Ground Speed: The ground speed of the sprayer at different settings was arbitrarily selected and measured using the tachometer (model: Machley).

Wind Speed: An end cup anemometer (version: Smith) was utilized to gauge the quantity of wind speed and wind direction. The average wind speed was 2.89m/s along with the wind direction east.

Other Variables determined were the Rows in grove (north to south), Spray Published direction: east-west and West operator's Leadership: north to south

2.1.2 Measurement of Tree Characteristic

Some specific characteristics of the tree were measured as follows.

Tree Height: A standard Stanley model tape rule was used in measuring the tree height. The measurement was done by releasing a rope from the topmost part of the tree to the ground level, and then the position was marked out on the rope before measurement of the length on the rope was done. The measurement was done on the selected tree to obtain variation in height.

Canopy Diameter: The canopy diameter of the tree was determined by direct measurement using the single rope technique (Moffet and Lowman, 1995). Using a rope that was anchored to the main trunk of the tree, the canopy spread after spraying was measured to give the radius of the circumference (taking into consideration the shape of the canopy spread). (See figure **3**)

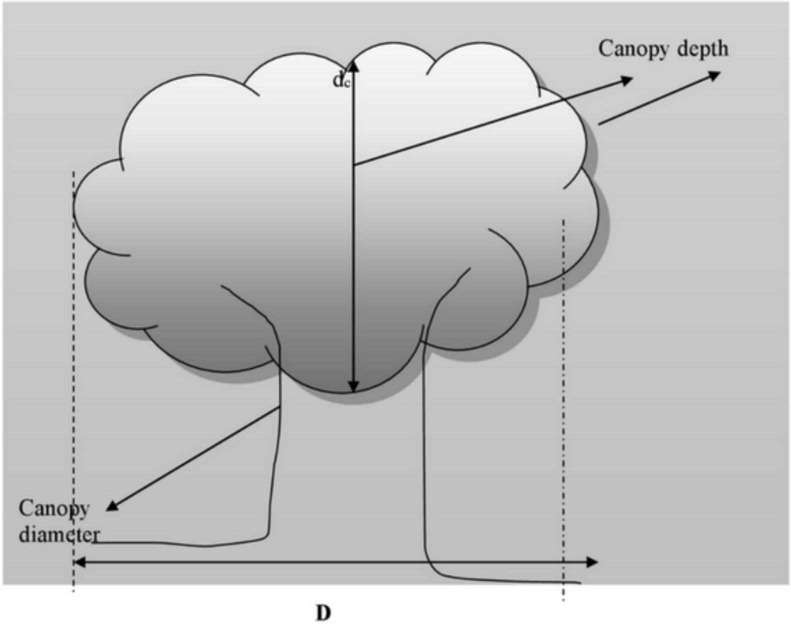

Figure 3: Schematic Diagram of Measurement of Canopy Depth and Diameter

2.1.3 Determination of Spray Mass Flux

The sprayer was operated in a chosen rate of 0.8km/h rafter which spraying has been performed first on the floor to acquire the swath width in the rate than at precisely the exact same rate, spraying was completed for the 20s while the spray had been collected and quantified to be aware of the sum of spray accumulated. The process introduced and also was repeated for readings of rate. At length, calculation determined the spray mass flux following the region taking that spray mass level is a function of the quantity of spray at kilogram over the region at a time and of spray was decided.

2.3 Data Analysis

The information gathered from the lab and field measurements were examined using the technique of regression analysis as explain by Gomez and Gomez (1984) to characterize the connection between the respective program parameters and spray deposition. Coefficient of determination (r2) was utilized to describe the potency of the parameters on the dependent variables. Even though the regression equation and curves clarified the relationships' kind.

3. RESULTS

The result of the analysis conducted on the effect of spray application parameters and tree characteristics (canopy diameter and sprayer speed) and spray mass flux on spray deposition are presented in Table 1 and presented in Figures 4,5,6 and 7.

Table 1: Variation of Spray Deposition with Some Selected Spray Application Parameters

S/No	Spray Deposition (Mg/cm^2)	Spray Mass Flux ($Kg\backslash m^2s$)	Sprayer Speed (Km/Hr)	Canopy Diameter (M)	Tree Height (M)
1	0.17	1.46	0.8	2.0	3.5
2	0.175	3.04	1.6	2.5	4.0
3	0.178	4.62	2.4	3.0	4.5
4	0.18	5.20	3.2	3.5	5.0
5	0.185	5.24	4.0	4.0	5.5
6	0.187	5.69	4.8	4.5	6.0

Table 1: Contd.,					
7	0.19	6.08	5.6	5.0	6.5
8	0.196	6.62	6.4	5.5	6.75
9	0.198	7.20	7.2	6.0	7.0
10	0.199	6.90	8.0	6.5	7.5

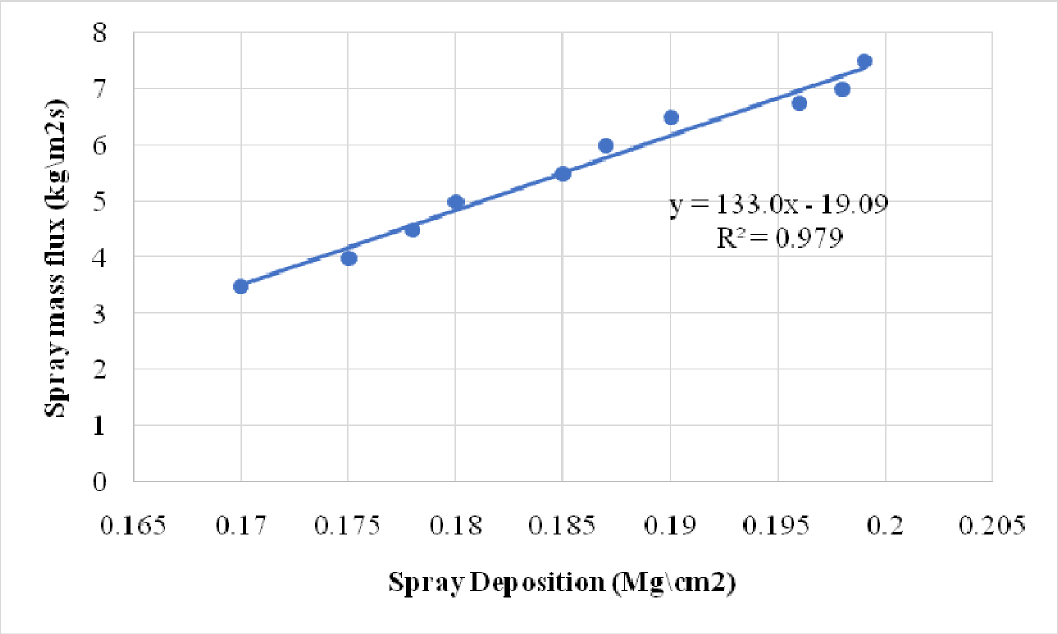

Figure 4: Graph of the Effect of Spray Mass Flux on Spray Deposition

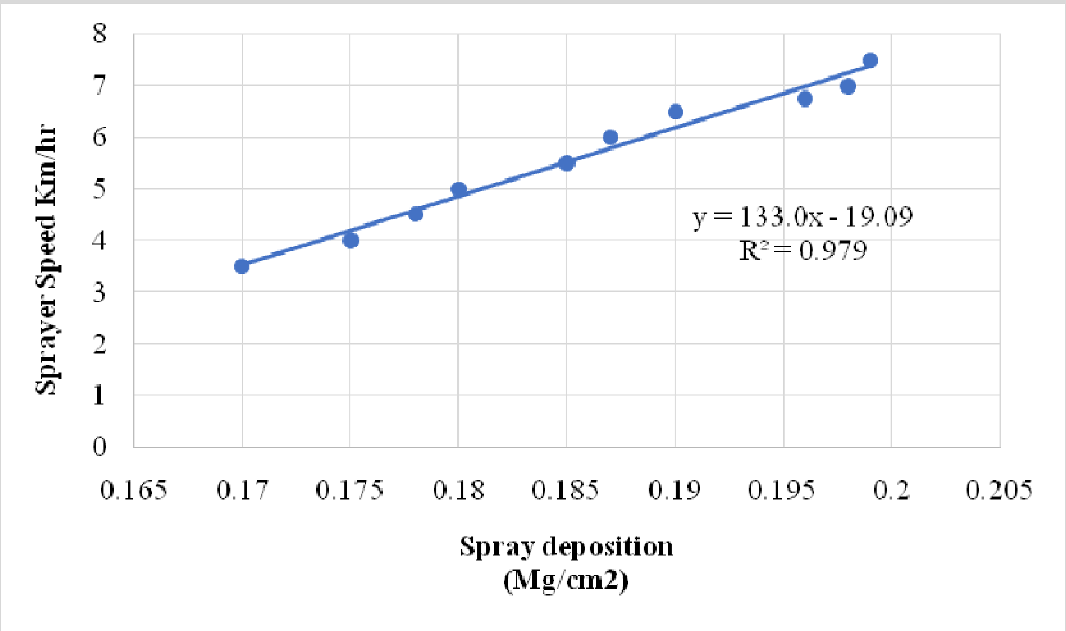

Figure 5: Graph of the Effect of Sprayer Speed on Spray Deposition

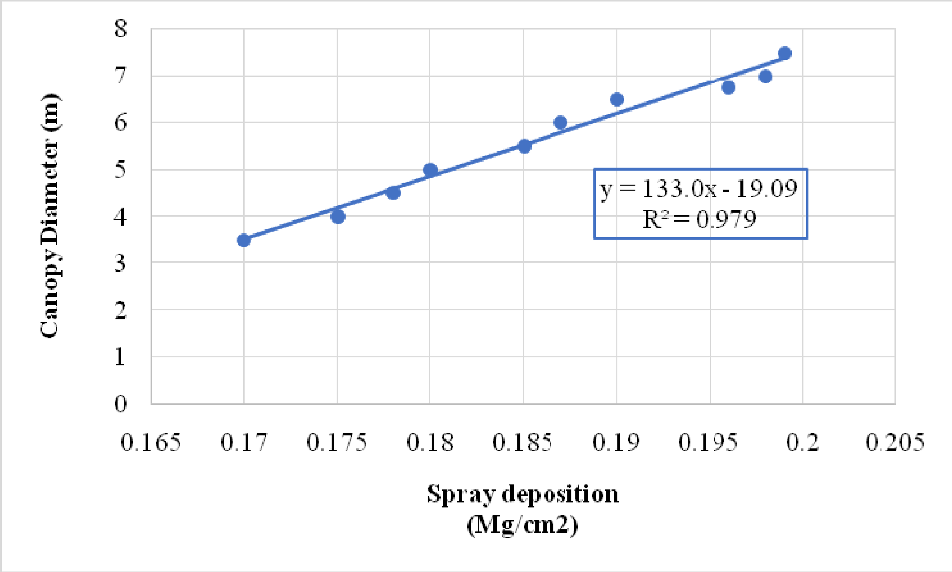

Figure 6: Graph of the Effect of Canopy Diameter on Spray Deposition

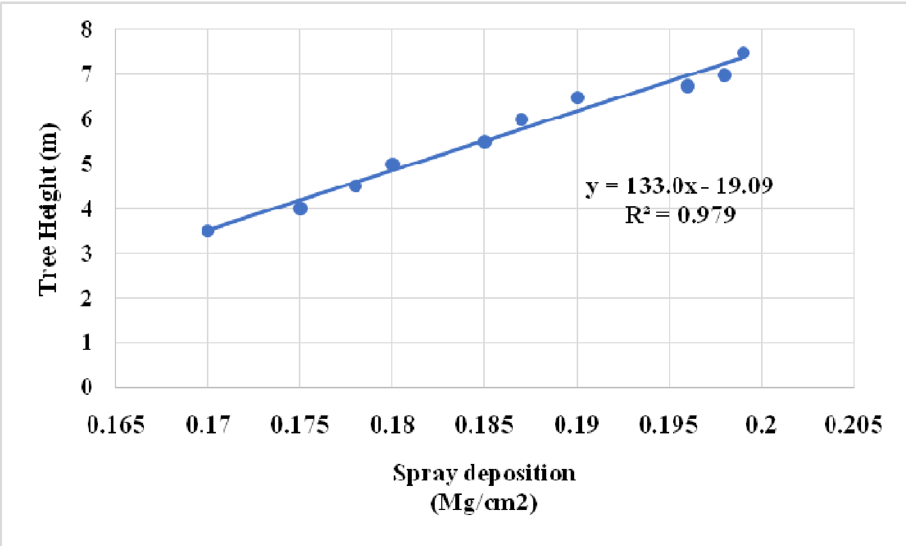

Figure 7: Graph of the Effect of Tree Height on Spray Deposition

The regression analysis as obtained from the graphical presentation in Figures 4, 5, 6 and 7 showed the coefficient of determination for spray mass flux, canopy diameter, tree height and sprayer speed as 0.87, 0.99, 0.99, and 0.98 respectively. Deposition increases from 0.171 -0.199 (mg/cm^2) with an increase in sprayer speed from 0.8km/hr-2.4km/hr. The maximum deposition of 0.199mg/cm^2 was obtained at a tree height of 7.5, with a sprayer speed of 8.0km/hr at a canopy diameter of 6.5m spray mass flux of 6.9 kg/m^{2}s. It is, however, convenient to say that the deposition in the thin canopy (6.5m) showed deeper penetration of spray (0.199mg/cm^2). Canopy diameter did affect the deposition directly as other parameters. This is in agreement with Farooq and Salyani (2002) and Salyani et al. (2002).

4. CONCLUSIONS

Deposition increases from 0.171-0.199 (mg/cm^2) with an increase in sprayer speed from 0.8km/hr-2.4km/hr. The maximum deposition was obtained at 0.199 with a sprayer speed of 8.0 km/hr at canopy diameter of 6.5m, spray mass flux of 6.9 kg/m^{2}s respectively. The regression analysis as obtained an showed excellent relationship with a coefficient of determination for spray mass flux, canopy diameter, tree height and sprayer speed as 0.87, 0.99, 0.99, and 0.98 respectively. This study has shown the relationships between shrub attributes and sprayer performance parameters. The analysis helps in: getting effective control of pest and disease, in above and below ground applications; targeting the very desired method of sending to the websites of activity when the management agent arrives in the goal; reducing off goal loss of management broker and determining the destiny of substance that will go off goal; feeling, detection and monitoring of pest populations to find out whether, when, where and how to control therapy ought to be implemented; and maximizing interactions in pest control applications to orchard nursery crops with decreased production cost and enhanced environmental improvement.

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