A SURVEY OF WOOD PROTECTION CHEMICALS, TREE KILLERS AND SPRAYERS IN AGROCHEMICAL STORES WITHIN MAKURDI METROPOLIS, BENUE STATE, NIGERIA

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Abstract
There is dearth of information on the variety and action spectrum of most agro-chemicals used in wood protection (preservation) within Makurdi metropolis. A purposive, non-random sampling was undertaken in Makurdi metropolis to identify wood protection chemicals/tree-killers available in agrochemical stores, to document the active ingredients and prices of the chemicals as well as the types and prices of sprayers obtainable in the stores. A total of thirty -two contact and systemic agrochemicals were identified. The chemical preservatives severally had single or multiple avicidal, herbicjdal, insecticidal, nematicidal or rodenticidal effects. The selling prices of the wood protection chemicals ranged from N1200 to N2000 per litre for Cyberforce and Daksh respectively. One kilogramme of the granular/wettable powders of the preservatives sold at between N600 to N10, 000 for Furadan and Commando, respectively. Twenty types of sprayers were documented. Prices of sprayers ranged from N300 (for the handy sprayer) to N120, 000 (for the motorised Swan sprayer). Prices of both sprayers and inorganic wood preservatives varied seasonally from 0-20% during the dry and wet seasons, with prices being generally higher during the rainy season. Selection of chemicals for use in wood preservation should necessarily be preceded by risk assessments concerning the physical and biological environmental effects of the chemicals on land, water, atmosphere, humans and non-target flora and fauna populations.

Key words: Survey, wood protection, agrochemicals, environment.

Introduction

Wood is an inorganic material produced as secondary xylem in the stems of trees (Hahn and Cannon, 2001) [and other woody plants]. In a living tree it transfers water and nutrients to leaves and other growing tissues; ands has a support function, enabling woody plants to reach large sizes or to anchor themselves in the soil. However, wood may also refer to other plant materials with comparable properties and to material engineered from wood, wood chips or fibre (Hahn and Cannon, 2001). Contrary to widely held beliefs, wood does not refer solely to non-living or harvested tissue of trees. Wood is also defined as the hard material that the braches and trunk of a (living) tree are made up of; it is an area of trees, smaller than a forest (Hornby, 2000). Living tress use carbon dioxide and are capable of fixing it permanently into wood and return oxygen to the atmosphere (Oluwadare, 2008).

In Nigeria, wood-based industries rely heavily on trees from natural forests and maintain their continuous line of production (Oluyege, 2007). Thus living trees in forest woodlands are also made up of woody tissue. For the purpose of this survey, wood protection chemicals refer to chemicals applied to wood in service, logged-over, converted timber, furniture or other non-living wood product(s). Tree killers on the other

hand are toxic chemicals that terminate all physiological functions of an erstwhile living tree when such chemicals are applied directly to the tree tissue or to the soil on which the tree is growing.

Ogbogu (1996) and Akinyemi *et.al* (2004) defined wood preservation as the art of introducing a toxic chemical into wood or non-forestry wood, artificially to make the wood resist attacks and deterioration from non-biological agents such as fire and sunlight in order to prolong the service life of the wood. The need to protect wood against biological attack with the objective of prolonging its useful services has made wood preservation an integral component of wood industry (Fuwape, 2000; Oluyege, 2007). Organic and inorganic chemicals that are toxic to insects and fungi for treatment of wood against attack by these biological agents are commonly called wood preservatives. FAO (1986) in Ogunbiyi (2005) defined wood preservatives as chemical substances which when suitably applied to wood, make it resistant to attack by decaying agents such as fungi, insects or marine borers.

Suitable wood preservatives such as copper chrome arsenate (CCA), Soligum and others have been found to be effective. However, one of their disadvantages is the release of noxious gases to the ozone layer; this is unfriendly to the environment. The ever-increasing awareness of toxicity of synthetic preservatives to the environment has necessitated a renewed interest in the use of bio-preservatives that are environmentally friendly such as extracts from *Parkia biglobosa* (Elijah, 2002). Adetogun *et. al.*(2009) investigated the fungicidal activities of cashew nut extract against wood rotting basidiomycetes in a preliminary work on organic fungicides development from cashew plant. The shell of the nut obtained from seeds of cashew tree (*Anacardium occidentale*) iis the source of the liquid extract known as cashew nut shell liquid (CNSL).

Common wood preservation methods used in Lagos and Ibadan Metropolis-Nigeria include: cold and hot immersion, pressure, brushing, spraying and diffusion; chemicals used for wood protection include: Creosote oil, chromate zinc chloride, coal-tar creosote petroleum, celure C33, acid copper arsenate, ammoniacal copper arsenate, fluorchlorine, pentachenol and condemmed (used) engine oil (Adejola, *et. al.,* 2010). The method of preservation, and chemicals used for preservation are influenced by the scale of operation as well as the type of wood.

Most wood protection chemicals are pesticides. Pesticides as defined by National Agency for Food and Drug Administration and Control of Nigeria (NAFDAC), are chemical substances or mixture of substances intended for preventing, destroying, repelling or mitigating the effect of any pest on living woody plants (including service wood by extension) and animals. They include herbicides, rodenticides, fungicides nematicides, acaricides, mulluscicides, defoliants and deciccants, avicides, (Adesiyan 2005), repellents, attracticeds and insect growth regulators used in agriculture, public health, storage or chemical substances used for similar purposes. The intensity of pesticide use began to increase with establishment of various agricultural, veterinary and public health research institutes across Nigeria (Kola-Oladiyi and Tolawo, 2008). With time toxic residues from the pesticides would begin to accumulate in soils, water, air, foods, non-target organisms and general environment (Akinyuli and Ivbijaro, 2006). The continuous

use of these chemicals has detrimental effects on the environment (Adegbola, 1995).

The main causes of deterioration of wood in service, as distinct from deterioration during seasoning, include chemicals failure, fire, termite and other insect borers, and fungal infection. The resistance of timber to these agents of destruction may frequently be increased by the application of a suitable chemical as preservative (Desch, 1988). Preservation is believed to positively influence the service life of a woody structure since it reduces he need for maintenance and frequency of replacement of wood despite the general perception of wood as a perishable material when compared to other building materials. Wood preservation broadly covers protection from fire, chemical degradation, chemical wear and weathering as well as biological attack on timber. Protection of wood with chemicals is for the purpose of prolonging the value of the wood. The service life of wood can hardly be ignored as defects in wood tend to eventually affect the market value, decrease the tensile strength of the wood, or limit its spectrum of specified uses.

The high demand for wood as a construction material rests on the versatility of wood as a raw material for different major and minor products which can be obtained by processing wood manually, mechanically, chemically, or biologically (Aigbefo, 1987). Some of these wood products include: crates, wooden boxes, logs, poles, sawn timber, building construction, house and furniture timbers, veneer and woods. This diversity of wood products necessitates wood protection so as to enhance longevity of its service life. Wood protection technology has the potentials to guarantee the sustainable management of global wood resources.

The selection of the most suitable chemical and methods of treatment is of utmost importance to preservation industries. Adequate and effective penetration of preservatives into wood is a vital criterion for preservation. The survey of wood protection chemicals will thus identify wood protection chemicals available in the market. Based on the findings, the desirability of continued use of some of the chemicals can enhance future environmental legislation in the study area. The survey was undertaken primarily to identify forest protection chemicals, tree killers and sprayers marketed in agro-chemical stores within Makurdi metropolis. The secondary objectives of the studies were to (1) take an inventory of wood protection chemicals and tree killers sold in ago-chemical store in Makurdi metropolis, (2) Identify the active ingredients in the agro-chemicals, and (3) assess the prices (and any variation in the prices) at which wood production chemicals, trees killers and sprayers are sold.

Methodology

***The Study Area*:**

This study was conducted in Makurdi town, the headquarters of Benue State, Nigeria. Makurdi Local Government Area has a population of 344, 620 projected in 2010 from 2006 National Population Census figures (at an annual growth rate of 3.5 per cent) (NPC, 2006). Makurdi lies between latitude 7° 21' and 8° and longitude 8° 21' to 9° E. One important feature is the presence of the River Benue which divides the town into the Northern and Southern parts. The area lies within the Guinea Savannah ecological zone. The town has an annual mean temperature of 32.5^{0}C and an average annual rainfall of 400mm (BNARDA, 2006).

The trees and grasses are very green during the rainy season while the grasses turn brown during the dry season. The plants have several ways of adopting themselves to the seasons and constant bush fires that occur here. Trees here have long tap roots that extend far into the soil to draw water, Tree barks are thick, a phenomenon which protects them from annual bush fires.

Survey and data collection techniques

A purposive sampling of sixteen out of twenty-three agro-chemical stores was conducted in Makurdi Metropolis,. This represented a sampling intensity of 70.0 per cent. The study took place in rainy season and dry season so as to observe any possible seasonal variations in the prices of agrochemicals and sprayers. Agro-chemical stores were surveyed along Iyorchia Ayu Road, Old Otukpo Road, Railway Bye-pass, Onitsha Street, Modern market Road, Wurukum Market, and the Benue State Ministry of Agriculture, Makurdi.

Information on the trade names, current prices, the active ingredients, the marketers/manufacturers and the cidal effects of all the agro-chemicals were collected by oral interview of the staff of all the sampled agro-chemical stores. The packages of the agrochemicals were also physically examined. Similarly, information on the prices of sprayers was obtained. Average prices and percentage increases/decreases in prices of chemicals, were used in analysing and presenting the data in tables.

Results/ Discussion

A total of 32 wood protection chemicals were documented (Table 1). The prices of the wood protection chemicals ranged from ₦1200 per litre to ₦2, 000 per litre for emulsifiable concentrates or suspensions. The cost of one kilogramme of the granular/wettable powder/tablets of the wood protection chemicals ranged between ₦600 to ₦10, 000.

Prices of wood protection chemicals generally varied between the rainy and dry seasons annually. Seasonal variations in prices were between zeros to 20 per cent, generally being higher during the wet season compared to wet season prices. Agrochemical stores within Makurdi metropolis were observed to market wood protection chemicals which have insecticidal, herbicidal, nematicidal, rodenticidal, avicidal effects as indicated in Table 2. The chemical Furadan 3-G or10-G) exhibited a multiple cidal effect (insecticidal, nematicidal and avicidal effects). The chemical Treekiller was observed to possess both tree-killing and herbicidal effects.

From the list of wood preservatives indicated in Tables 1 and 2, most of the preservatives are toxic synthetic chemicals (such as treekiller, zap and furadan) that may be toxic to the environment (Adegbola, 1995). This calls for renewed interest in bio-preservatives that are environmentally friendly, such as extracts from boiled *Parkia biglobosa* seeds (Elijah, 2002) and cashew nut extract used against wood rotting basidiomycetes (Adetogun, 2009)

The same applies to sprayers. For example, 15-litre and 20-litre Jacto and Cooper Pegler (CP) sprayers had higher selling prices (N14, 000 and N13000.00) on account of product durability and popularity of the marketing companies, respectively. Perhaps the relatively lower selling prices for 16- liter Easy Spray brand of sprayers emanated from their lesser durability or lack of popularity of the brand/ marketing company.

TABLE 1. WOOD PROTECTION CHEMICALS AND THEIR PRICES WITHIN MAKURDI, BENUE STATE, NIGERIA

S/No	Name of agrochemical	Makerter/ Manufacturer	Active Ingredients	Average prices per unit (₦)
1	Best Action	African Agri/Meghmani Organics	Cypermethrin 10% +Dimethoate	1200/l
2	Clean-up	Vertex Agro	cypermethrin 10%	1300/l
3	Commando	Excel Crop Care Ltd.	Zinc phosphide	10,000/kg pact.
4	Cyclone	Bethsaida Agrochemicals Ltd.	Aluminium Phosphate 57%	9000/tin of 16 tubes; 600/ tube of 30 tablets
5	Cyper Force	Jubaili Agrotech	Cypermethrin10%EC	1250/l
6	Cypertex	Saro	Cypermethrin 100g/l EC	1250/l
7	Daksh	West African Cotton Co. Ltd.	DDVP 1000g/l EC	2000/l
8	DD Force	Jibaili Agrotec	DDVP 1000g/l EC	1800/l
9	Decis EC-12	Bayer	Deltamethrin 5g/l	!200/l
10	Dizvan	Diezengoff WA Ltd	DDVP 1000g/l EC	2000/l
11	Furadan 3-G	FMC Corp./ Agric-Chemical Group	Carbofuran	600/kg
12	Furadan 5-G	FMC Corp./Agric-Chemical Group	Carbofuran	600/kg
13	Glovan	Century Global Agricultural Company Limited, Kano	Dichlorvos 0-(2,2-Dichlorvinyl Dimethyl Phosphate (DDVP)	2000/l 1000g/l
14	Icons Iocs	Syngenta	Lambdacyhalothrine 100%/l	1800/62.5 ml pkt
15	Klerat	Industrial Chemicals Intnl.	Brodifacoum 9.05g/kg	50/10g
16	NoPest	Chemical and Allied Products Plc	DDVP 1000g/l	1800/l
17	Pestox	NA	Cypermethrin 100g/l EC	1200/l

18	Phostoxin	NA	Zinc phosphide	9000/tin of 16tubes; 600/ tube of 30 tablets
19	Polytrin	NA	KA 315 EC ULV	1200/l
20	Rambo-Rambo	Rambo	Permethrin 0.60% powder	1400/kg
21	Rocket	Crop Care	Chlorpyrifos 20% EC	1200/l
22	Serosate	Saro Agrochemicals	glyphosate 300g/l	1200/l
23	Shogun	Nanjing Redsun Co Ltd.	Lambda-cyhalothrin 25% EC	
24	Shooter 1000EC	Miagro	DDVP 1000g/l	1800/l
25	Smash Super	African agro	2-2-dichlorovinyl dimethyl phosphate (DDVP) 1000g/l EC	1900/l
26	Snipper	African Agricultural Products Ltd.	DDVP (Dichlorvinyl Dimethyl Phosphate) 1000g/l	1800/
27	Store Force	Afcott	Primiphos-methyl 25% EC	1100/l
28	Termicid	Candel Coy. Ltd.	Chlorpyriphos 480g/l EC	2000/l
29	Termicott	Afcott Nig. Plc.	Chlorpyriphos 20% EC	1250/l
30	Treekiller	Jubaili Agrotec	2,4,5-Trichlorophenoxy Acetic acid	1500/l
31	VIP	African Agricultural Products Ltd.	Dichlorvos(DDVP) 100% w/v	1800/l
32	Zap	Candel	Lambda cyhalothrin 2.5 EC	1200/l

NA=Not Available

TABLE 2: CIDAL EFFECTS/USES OF WOOD PROTECTION CHEMICALS /TREE KILLERS SOLD IN AGROCHEMICAL STORES WITHIN MAKURDI METROPOLIS, BENUE STATE, NIGERIA.

S/No	Name of agrochemical	makerter/ manufacturer	Active Ingredients	Cidal effect/ Use
1	Best Action	African Agri/Meghmani Organics	Cypermethrin10% +Dimethoate	Insecticide
2	Clean-up	Vertex Agro	cypermethrin 10%	Insecticide
3	Commando	Excel Crop Care Ltd.	Zinc phosphide	Rodenticide
4	Cyclone	Bethsaida Agrochemicals Ltd.	Aluminium Phosphate 57%	Insecticide
5	Cyper Force	Jubaili Agrotech	Cypermethrin10%EC	Insecticide
6	Cypertex	Saro	Cypermethrin 100g/l EC	Insecticide
7	Daksh	West African Cotton Co. Ltd.	DDVP 1000g/l EC	Insecticide
8	DD Force	Jibaili Agrotec	DDVP 1000g/l EC	Insecticide
9	Decis EC-12	Bayer	Deltamethrin 5g/l	Insecticide
10	Dizvan	Diezengoff WA Ltd	DDVP 1000g/l EC	Insecticide
11	Furadan 3-G	FMC Corp./ Agric Chemical Group	Carbofuran	Insecticide/ avicide/ nematicide
12	Furadan 5-G	FMC Corp./Agric Chemical Group	Carbofuran	Insecticide/ avicide/ nematicide
13	Glovan	Century Global Agricultural Company Limited, Kano	dichlorvos[0-(2,2-Dichlorvinyl Dimethyl Phosphate (DDVP) 1000g/l	Insecticide
14	Icons Iocs	Syngenta	Lambda cyhalothrine 100%/l	Insecticide
15	Klerat	Industrial Chemicals Intnl.	Brodifacoum 9.05g/kg	Rodenticide
16	NoPest	Chemical and Allied Products Plc	DDVP 1000g/l	Insecticide
17	Pestox	NA	Cypermethrin 100g/l EC	Insecticide
18	Phostoxin	NA	Zinc phosphide	Rodenticide/ insecticide
19	Polytrin	NA	KA 315 EC ULV	Insecticide
20	Rambo-Rambo	Rambo	Permethrin 0.60% powder	Insecticide

21	Rocket	Crop Care	Chlorpyrifos 20% EC	Insecticide
22	Serosate	Saro Agrochemicals	glyphosate 300g/l	Insecticide
23	Shogun	Nanjing Redsun Co Ltd.	Lambda-cyhalothrin 25% EC	Insecticide
24	Shooter 1000EC	Miagro	DDVP 1000g/l	Insecticide
25	Smash Super	African agro	2-2-dichlorovinyl dimethyl phosphate (DDVP) 1000g/l EC	Insecticide
26	Snipper	African Agricultural Products Ltd.	DDVP (Dichlorvinyl Dimethyl Phosphate) 1000g/l	Insecticide
27	Store Force	Afcott	Primiphos-methyl 25% EC	Insecticide
28	Termicid	Candel Coy. Ltd.	Chlorpyriphos 480g/l EC	Insecticide
29	Termicott	Afcott Nig. Plc.	Chlorpyriphos 20% EC	Insecticide
30	Treekiller	Jubaili Agrotec	2,4,5-Trichlorophenoxy Acetic acid	Treekiller/ herbicide
31	VIP	African Agricultural Products Ltd.	Dichlorvos(DDVP) 100% w/v	Insecticide
32	Zap	Candel	Lambda cyhalothrin 2.5 EC	Insecticide

NA=Not Available

TABLE 3: PRICES OF SPRAYERS IN AGRICULTURAL CHEMICAL STORES WITHIN MAKURDI METROPOLIS

S/no	Type of sprayer (knapsack sprayers)	capacity (litres)	unit cost (N)
1	Bicky	15	11000
2	Century	20	12,500
3	Cooper Pegler (CP)		
(a)	CP-3	20	13,000
(b)	CP-15	15	12,000
4	Easy Spray	16	6500
5	Farm Guard	15	11,500
6	Greenfield Knapsack Sprayer	16	10000
7	Guder	15	12000
8	Handy Sprayer	0.5	300
9	Inter	20	12,000
10	Jacto	16	14000

11	Jacto	20	14000
12	Prime-V	20	10500
13	Pumic Plus (Viton)	20	10,500
14	Record	15	11000
15	SL-Pressure Sprayer	2	6000
16	Super-Action	18	12,000
17	Swan Motorised Sprayer	20	120,000
18	Springfield	16	10,000
19	Target Sprayer	18	10000
20	VIP Knapsack Sprayer	16	9500

The active ingredients in some of the chemicals like Daksh, DDForce, Dizvan, NoPest, Shooter 1000 EC, Smash Super and VIP were the same, but the chemicals were marketed under different trade names. The concentration of the common active ingredients under different trade names was also variable. This may call for different rates of application of the chemicals even under an apparently similar situation. It is also possible that variation in the concentration of the active ingredient could give rise to variation in prices of these groups of chemicals. Some of the wood protection chemicals marketed under popular trade names like Chemical and Allied Products Limited appear to be more costly than the same chemicals marketed under a different trade name by relatively new and perhaps less popular companies. The same applies to sprayers. For example, 15-litre and 20-litre Jacto and Cooper Pegler (CP) sprayers had higher selling prices (₦14000.00 and ₦13000.00) on account of the product durability and popularity of the marketing companies, respectively. Perhaps the relatively lower selling prices for 16-litre Easy Spray brand of sprayers emanated from their lesser durability or lack of popularity of the brand/marketing company.

A total of 20 types of sprayers were identified. Knapsack sprayers available in the agro-chemical stores had capacities ranging from 0.5 litres to 20 litres (Table 3). Prices of sprayers ranged from ₦300 (for handy sprayers) to ₦120, 000 (for Swan motorised sprayers), depending on the capacity, brand, durability (life expectancy), and technological advancement(s).

The implications of these price changes are that there may be peak seasons of the year when chemicals and sprayers are used the most. At peak of farmers' operations, prices may rise on acconnt of inelastic demand. Farmers may pay higher prices for these agrochemicals to preserve their wood /wood products. High prices of agrochemicals could arise from inability of sellers of these chemicals to match demand with supply. Manufacturers of agrochemicals may also deliberately fail to produce more of the agrochemicals so as to force prices up and realize a higher profit margin per production effort. During

the season of reduced wood preservation activities, prices may be forced down since the demand for the agrochemicals also goes down. However, if there is speculative buying in anticipation of rising prices of wood preservatives, prices may not fluctuate significantly even during periods of reduced wood preservation work. High prices of chemical wood preservatives may make some people not to use the wood preservatives of their choices since they may not afford to buy their preferred chemicals. As a result of high prices of chemicals, users of very costly chemicals may find cheaper brands of chemicals that are close substitutes to their preferred brands.

Also, the sizes of the sprayers were not very big. This implies that mamual uses of the sprayers are possible. Larger sizes of sprayers would have limited uses of the sprayers to mechanization (typical of large-scale industries/establishments). Large sprayers would have excluded most small-scale sprayer operators.

Whereas it may be possible to easily enumerate the benefits of pesticide usage in wood protection, it is also reasonable to envisage some risks that may result from their use. Pesticides are not targeted against human beings; they may however have several side effects to animals, man and the environment which are deleterious. Apart from their effects on pathogens, many other non-target organisms have also fallen victim to particular chemicals (Adesiyan, 2005); the summary of the side effects include: mortality in many human populations, animal and plant species, a reduced reproductive potential in birds, fish and other organisms, changes in the abundance of species and diversity of ecosystems, a reduction in the productive potential of natural resources, the development of resistance in both target and non-target species, and possible carcinogenic effects on human and animal species. Emerole (1980) reported levels of organochlorine pesticides in human blood, milk and fat. The United States government figures on deaths caused by food and chemicals show that in 1971 pesticide residues in food were responsible for 49% of all deaths. American Scientists claim to have established a link between the killer virus AIDS and the insecticide/nematicide Temik (aldicarb). They claimed that the active ingredient of the insecticide aldicarb can break down the immune system of animals and humans leaving them vulnerable to the AIDS virus as well as any other disease they come in contact with (Adesiyan ,2005),

Conclusion:

Thirty-two diverse wood protection chemicals/treekillers were identified in agrochemical stores within Makurdi Metropolis (Table 1). The active ingredients in the chemicals included: dimethoate, cypermethrin, zinc phosphide, aluminium phosphate DVVP, deltamethrin carbofuran and lambda cyhalothrin.These active ingredients either alone or in combination exhibited a single or multiple avicidal, herbicidal, insecticidal, nematicidal, rodenticidal, and herbicidal/treekilling effect. Chemicals like Furadan 3-G and 10-G had nematicidal, avicidal and insecticidal effects. The wood preservatives contained organochlorides and organophosphates which from literature cited, may be toxic to the environment when used. The survey revealed a general dearth of organic wood preservatives in surveyed stores. The active ingredients of some of the chemicals were the same even though they were marketed under different trade names. Also the concentration of

the active ingredients varied with some trade names while it remained same in others.

Twenty types of sprayers with 90 per cent having capacities of 15 -20 litres were documented in the survey. The capacities of the sprayers indicated that all the sprayers could be manually operated. Five per cent of the sprayers representing Swan brand were motorized but could be operated by mounting them on human back. The manually operated sprayers would entail a waste of many man hours in applying wood preservatives since the operations are not likely to be automated.

Recommended risk assessments to be made by buyers of wood preservatives

- Buyers of chemical preservatives should go through the brochure of the chemical to obtain all pertinent information of claims in respect of the chemical. The authenticity of such claims can always be investigated in a neutral laboratory.
- The user needs information on Acceptable Daily Intake Dose to detect chemicals that may be carcinogenic.
- If indicated Lethal Dose popularly known as LD_{50} is a low figure, it denotes that the chemical is highly toxic.
- The preservative should not adversely affect the quality of the wood.
- More environmentally friendly biocides should be used in preference to extremely toxic inorganic chemical wood preservatives.

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