RURAL APPRAISAL ON THE USE OF PARAQUAT IN NIGERIA

Dr Udensi E. Udensi

IITA
Transforming African Agriculture
CGIAR

International Mailing Address:

IITA Ltd, 7th Floor

Grosvenor House

125 High Street

Croydon CR0 9XP

UK

ISBN: 978-978-131-364-6

Correct Citation: Udensi, U.E. 2020. Rural appraisal on the use of Paraquat in Nigeria. IITA, Ibadan, Nigeria.

Printed by: IITA

Contents

About the AUTHOR V

Acknowledgment VI

About the Cassava Weed Management Project VII

EXECUTIVE SUMMARY 1

INTRODUCTION 2

1.1 Preamble 2

1.2 Global concern about paraquat 2

1.3 Nigeria and cases of paraquat exposure concerns 3

1.4 Purpose and objective of the appraisal and terms of reference of the study 3

Terms of Reference: 4

2.0: METHODOLOGY OF THE STUDY 4

3.0 RESULT 5

3.1 Current supply and list of paraquat products available in Nigeria 5

3.2. Status of current use and users of paraquat 9

3.3. How is paraquat supplied and sold in Nigeria 13

3.4. Perception and status of paraquat in the six states of Nigeria 14

3.5. Information on possible ban of paraquat in Nigeria 17

3.6. Alternatives to paraquat in Nigeria 17

3.7. Evidence of paraquat exposure and poisoning in the six states 17

3.8. Training on safe sale, use and application of paraquat 19

REFERENCES 21

List of Tables

Table 1: List of paraquat products formulations in Nigerian market and registrants in Nigeria **6**

Table 2: Major agrochemical companies, their paraquat product trade name and area of coverage in Nigeria **8**

Table 3: Brands of paraquat marketed across the six states **9**

Table 4: Brands of paraquat and farmers' preference across the six states **9**

Table 5: Distribution of respondents' socio-economic characteristics **10**

Table 6: Distribution of respondents by occupational status **11**

Table 7: States and major use for paraquat (crop and non-crop situation) **12**

Table: 8 Categorization of paraquat use in six states of Nigeria **12**

Table 9: Major crops where paraquat was used across six states of Nigeria **13**

Table 10: Country of Origin of Paraquat Product and number of brands found in Nigeria **13**

Table 11: Paraquat marketing and supply chain across six states of Nigeria **14**

Table 12: Distribution of respondents by years of experience and herbicide use in six States of Nigeria **15**

Table 13: Distribution of certified pesticides applicators and persons using PPE in six states of Nigeria **16**

Table 15: Paraquat application equipment and personal protective Equipment (PPE) **18**

Table 16: Ban on Paraquat importation and use **18**

Table 17: Distribution of respondents with evidence of paraquat exposure and poisoning in six states of Nigeria **19**

Table 18: Sources of paraquat exposure **19**

Table 19: Training on safety sale and application of paraquat **20**

About the AUTHOR

Dr Udensi E. Udensi is a weed scientist and a lecturer at the University of Port Harcourt, Nigeria. Prior to this position, he worked with several development projects in Nigeria on weeds.

Acknowledgment

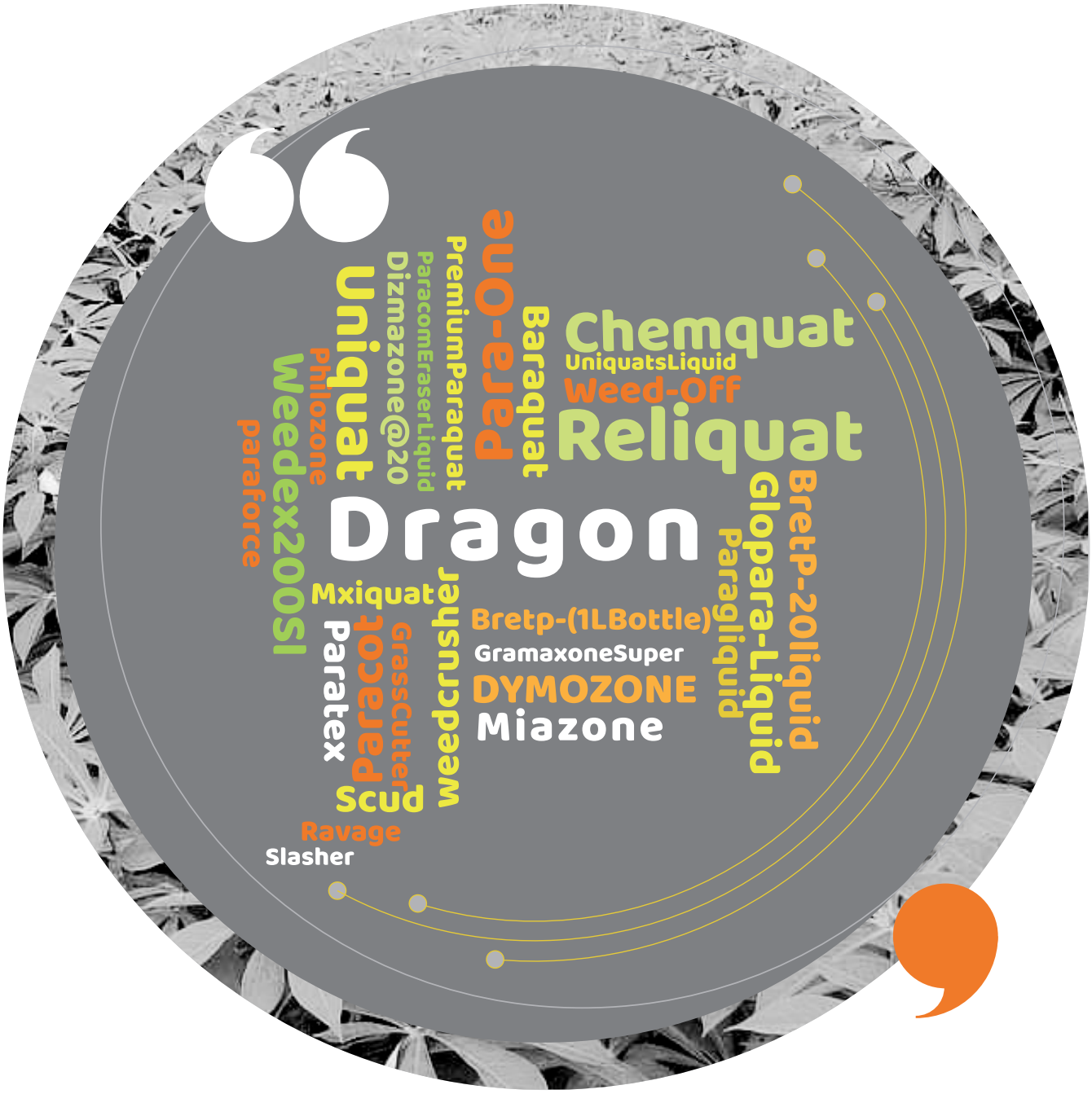
This research was supported by the International Institute of Tropical Agriculture (IITA)- managed Cassava Weed Management Project also known as the Sustainable Weed Management Technologies for Cassava Systems in Nigeria. The author has no conflicts of interest with the publication of the research.

About the Cassava Weed Management Project

The Cassava Weed Management Project also known as the Sustainable Weed Management Technologies for Cassava Systems in Nigeria ended its 5th year in 2018, assessing sustainable weed management technologies for cassava-based farming systems in Nigeria. The project is currently in an extension phase under the African Cassava Agronomy Initiative (ACAI) and is seeking to find solutions to the labor-intensive weeding usually performed by women and children, and also piloting digital extension in Nigeria and Tanzania.

In the last 5 years, the project reached 74,000 farmers through training and farmer-to-farmer contact, 75,000 through print materials, and 222,000 through social media. Radio and Television with viewership of over 2 million were used to air the project's extension toolkit known as the Six Steps to Cassava Weed Management.

Partners in the project included the National Root Crop Research Institute, Umudike; University of Agriculture, Makurdi; Federal University of Agriculture, Abeokuta and private and public sector extension partners including the Agricultural Development Programs in Abia, Benue, Ogun and Oyo States in Nigeria.


Dragon
Reliquat
Chemquat
UniquatsLiquid
Weed-Off
Baraquat
Para-One
PremiumParaquat
ParaconEraserLiquid
Dizmazone@20
Uniquat
Philozone
Weedex200SL
paraforce
GloPara-Liquid
BretP-20liquid
Paraglliquid
Mxiquat
Bretp-(1LBottle)
GramaxoneSuper
DYMOZONE
Miazone
Weedcrusher
Paraquat
GrassCutter
Paratex
Scud
Ravage
Slasher

EXECUTIVE SUMMARY

Paraquat is regarded as one of the most highly acute toxic herbicide to be marketed in the last 60 years. Its use spans more than 100 countries and in more than a hundred crop systems and cropping systems. A rapid rural appraisal study was conducted in six states of Nigeria to assess the current status of use and the perception of farmers and other stakeholders about paraquat, and the possibility of banning it.The study was a descriptive cross sectional rapid appraisal survey which involved the utilization of focus group interview (involving small/large scale farmers, Extension Agents (EAs), Distributors, Retailers, State Ministry of Health Officials), questionnaires, Telephone calls and in-depth interviews. This pilot phase of the study focused on four States where the Cassava Weed Management (CWM) project operates, with the addition of a few states bordering the project State. A total of 61questionnaires were administered. The result of this study showed that there more than 20 different brands or trade names for paraquat with several variants in terms of percentage active ingredient, but the most common is the paraquat ion (200g/L) formulated as Paraquat dichloride with 276 g/L. They are six popular brands of paraquat used by farmers across the state (Dragon, Paraforce, Weed-off, Slasher, Paraquin, and Reliquat). Among the states, Dragon and Paraforce were the most available (100%), followed by Slasher (about 80 %), and Weed-off, Reliquat and Paraquin about 50 % respectively. The survey result further showed that in terms of preference across the states, the brand Dragon accounted for about 34.4 % most preferred by farmers followed by Paraforce (28.1 %). Majority of the farmers interviewed were within the age bracket of 41-50 years, (31.7%); and were mostly male (86.7 %). Majority could read and write (≥ 45 %). Majority across the states were rural farmers (38.9 (). Smallholder farms (45 %) use more paraquat than large scale holders (32 %) and estate owners (22 %). Paraquat application is mostly made by farmers (72 %) themselves than using contract sprayers (SSPs) (28 %); and major crop use for paraquat across the states were cassava (25 %), Yam (21%) and Maize (15.8 %). Paraquat is not manufactured or formulated in Nigeria, and about 60% of paraquat in Nigeria comes from China. The supply chain of paraquat across the six states were as follows: Wholesalers (12 %), Retailers (27 %) and a combination of other sources (46 %); and EAs/SSPs (14 %). Farmers' experiences with paraquat across the states spans beyond 10 years (60 %), and majority (≥ 90 %) have used paraquat in production. Across the states, certified paraquat applicators accounts for only about 35 %; with ≥ 70 % using PPE/PPC during paraquat application. The study revealed that 88.6 % of the farmers will not recommend a ban either on importation or on use and application; for the reason of cost saving, reduction in drudgery and increased area under cultivation if paraquat is used. For farmers' health and public health reasons, 11.4 % across the states will recommend a ban on paraquat. About 56 % of the farmers and others have been unduly exposed to paraquat; and about 33 % of the cases across the states have confirmed symptoms of exposure; and only 10.4% sought for medical advice following exposure. In all the cases of exposure majority (97.6 %) were not hospitalized, while only 2.4% were hospitalized.

Across the states, only 47.8 % have received training on both best practices for sales and application, while 52 .2 % have not received any form of training. More awareness on the long-term effect of paraquat needs to be created, despite the seen benefits by farmers. Training and re-training also need to be conducted involving health and other medical personnel. Agrochemical companies need to champion this process.

INTRODUCTION

1.1 Preamble

Paraquat (1, 1′-dimethyl-4, 4′-bipyridinium dichloride) is a nonselective contact and broad-spectrum herbicide that has been widely used as herbicide for many years. Paraquat was first synthesized in 1882, although its herbicidal properties were not recognized until 1955 (John, 2002). Paraquat was first sold in commercial quantity by the Imperial Chemical Industries (ICI) in early 1962, and it is among the most commonly used herbicides in agriculture. Paraquat is today marketed in well over a hundred (100) countries for use on small and large farms of different crop enterprises and cropping systems for the purpose of weed control, and in non-agricultural lands and estates for amenity weed control. Globally, paraquat is regarded as one of the most highly acute toxic herbicide to be marketed in the last 60 years. Its use spans more than 100 countries and in more than a hundred crop systems and cropping systems. The study will provide information on the present status of use of paraquat in Nigeria, and how it is aligned with the global issues of paraquat. Besides the Zeneca ICI Gramoxone, paraquat is being sold under different trade names in different countries (Watts, 2011). The availability of paraquat on the market triggered the growth of minimum and conservation tillage which is one of the most important environmental innovations in agriculture in recent years. Regardless of the various benefits of the herbicide, paraquat is very toxic to workers applying the chemical, on an acute basis. A report by PAN (2017), indicates that paraquat remains one of the pesticide active ingredient responsible for more fatal poisonings than any other pesticide substance. Workers who are exposed to paraquat over a long period have been found to be at an increased risk of developing Parkinson's disease later in life. Paraquat has endocrine and immunotoxin effects. Based on the numerous health hazards associated with paraquat, toxicologists have questioned the rational of World Health Organization (WHO) for categorizing paraquat as Class II ('Moderately hazardous') instead of assigning it to class I (Nagami et al 2005). PAN and Iserring (2006), also argued that paraquat should be class I because of its acute toxicity, delayed effects, and absence of an antidote. Cal EPA (2010) states that, there may be loss of appetite, thirst, vomiting, abdominal pain, diarrhea, headache, fever, muscle pain, rapid heartbeat, cerebral oedema and brain damage. There has been global call for paraquat to be banned, by the EU and many international organizations, such as Rainforest Alliance, Forest Stewardship Council, Fair-trade. The purpose of this study is to evaluate the cost and benefits of banning paraquat in agriculture in Nigeria.

1.2 Global concern about paraquat

Paraquat herbicide has become a global worry to toxicologists, farmers and the general public. This is due to its acute toxicity and the absence of antitode (cure), health concern and environmental concerns (Joshi, 2002). The body parts identified with high level of exposure in users were hand, wrists, back and scrotum (Joshi, 2002). The sources of exposing paraquat to the body include splashing during preparation of the spray solution and open transportation, discharge of spraying most, contact with spray solution when filling knapsack, leaking of knapsack on back and groin, adjustment of spray equipment, and walking through the sprayed vegetation. Accidental and occupational exposure has been reported in various countries, especially in the developing countries. Accidental and occupational exposure resulting in about 27% death of 700 cases of paraquat poisoning in Malaysia was reported in 10 years (Majid, 1997). Accidental poisoning can occur when paraquat is stored in refreshment, liquor, or medicine bottles. Severe poisoning here occurred with children playing with rinsed spray jets and bottle tops, and empty bottles (Weaseling et *al* 2001). Paraquat is one of the

most common pesticides causing death from suicide. Report shows that it has 60-70% mortality rate (Seok *et al.,* 2009), much higher than other agents. Several cases of paraquat self-poisoning have been reported in Malaysia, South Korea, Taiwan, Thailand and Sri Lanka but less common in India (Agarwal *et al*., 2006). According to the National poison center, the number of poisonings caused by paraquat has been rising in recent years (Whittle, 2010).

1.3 Nigeria and cases of paraquat exposure concerns

Nigeria as a nation cannot be left out on the on-going global call for the ban/restriction of paraquat use. Nigerian agriculture is a tropical agriculture that is characterized by high rainfall which eventually led to a rapid weed growth (Parker, 1972). This has favored the continual use of paraquat herbicide despite its ban and restriction in several countries (US EPA, 2001). A study conducted at the southern part of Nigeria, shows that residues of paraquat was found to be present in *common crops and vegetables* (Akinloye *et al.,* 2011). Paraquat is among five pesticides most frequently used in Plateau State, and the entire Northern Nigeria due to the fragile ecology and sparse vegetation dotted with annual grasses. In a recent study, Gushit *et al*., (2013) examined paraquat poisonings among farmers and pesticide retailers in Nigeria. The study surveyed the practices and risks associated with the use of paraquat by farmers, agrochemical retailers, and agricultural extension workers in Plateau state of Nigeria in 2010. The authors concluded from their findings that, low literacy level and lack of knowledge about proper herbicide use has resulted in an indiscriminate use of herbicides and that their use, if not properly taken into considerations and addressed, may present a threat to public health. While paraquat appears to be banned for use on cocoa in Nigeria (Mokwunye *et al* 2010). It is still a very popular herbicide for various cropping systems; and a major risk to farmers and the public health in Nigeria. In terms of acute poisoning the primary target organ of paraquat poisoning is the lung, however, it is also distributed to the heart, liver, and kidney (Watts, 2011). According to a report by Cal EPA (2010), the brain is now recognized as another target organ for paraquat poisoning effect. In Nigeria, there has been scanty report of cases of paraquat poisoning, due to lack of awareness on the symptoms and the signs to look out after certain time or specified period of exposure. This is made worst by the fact that the majority of the users are rural farmers whose level of literacy does not enable them to be adequately informed on the danger that lies behind the bumper harvest associated with paraquat use. Acute kidney injury has been reported of a 23-year-old female in Nigeria who was exposed to paraquat, hence the authors concluded that patients with paraquat poisoning have a high risk of developing acute kidney injury (Adejumo *et al*., 2016). Self-poisoning with paraquat and other pesticides has been a major source of global concern, and has constituted the major driver for the call to ban paraquat (WHO, 2010). Other cases of paraquat concern in Nigeria have been the effect on aquatic life food chain (Shallangwa and Auta, 2008). A negative effect that can trigger death in fish has been reported in Nigeria for Nile Tilapia (Fidelis *et al*, 2012, Ajani et al., 2007) and cat fish (Kori-Siakpere et al, 2007). Several other reports have also implicated paraquat among other pesticides effect on the aquatic environment and the sustainability of the system (Omitoyin *et al*., 2006; Babatunde *et al;* 2001)

1.4 Purpose and objective of the appraisal and terms of reference of the study

The broad objective of this study are:

- Identify the status of use and perception of paraquat in Nigeria

Terms of Reference:

- List current suppliers and paraquat products available in Nigeria (including formulations); any data on quantities imported – ask NAFDAC? What are market prices?
- Provide overview of current usage of paraquat – crop and non-crop situations (describe), where is main use – small-holders v large scale farms and estates, who is applying. Farmers' v SSPs etc. This may need some interviews at selected market outlets and with knowledgeable people in EPAs.
- How paraquat is sold in Nigeria – Agro dealers with only agri- inputs or in general stores, or on market stalls etc.? Important to document how the product is handled along the supply chain?
- When paraquat is applied do farm workers or SSPs take additional precautions to using other pesticides? What protective clothing, if any is used?
- Perceptions of current users about paraquat and possibility of a ban – how would they be affected? May be talk to a few large farmers in key usage crops – could make phone calls to large growers?
- List any other post-emergence herbicides currently available that could replace paraquat in main usage situations - What are market prices and availability?
- Check with Health Ministry to ask if statistics on poisoning cases are available.
- Is there training for dealers and applicators from companies selling paraquat? Check with Syngenta in particular as a major supplier on their paraquat stewardship. Also check other importers who sell paraquat to ask if they provide any raining on paraquat use.

2.0: METHODOLOGY OF THE STUDY

The study was a descriptive cross sectional rapid appraisal survey which involved the utilization of focus group interview (involving Small/Large scale farmers, Extension Agents (EAs), Distributors, Retailers, State Ministry of Health Officials), questionnaires, telephone calls and in-depth interviews. This pilot phase of the study focused on four States were the Cassava Weed Management (CWM) project operates, with the addition of a few states bordering the project State. A total of 61questionnaires were administered in the study areas, and valid response collated were as follows: Rivers (6) Enugu (4), Abia (11), Ogun (12), Oyo (12) and Benue (16). The questionnaire sought information from respondents in six categorical areas on awareness regarding location of survey; demography and socioeconomic/general paraquat information; Supply Market & value chain; use pattern/application & training; evidence of health risk/hazard and the perception of stakeholders' on plausible ban or alternative to paraquat. Interviews were carried out by means of consultations, visits and phone calls. Visits were scheduled to farmers' locations, agrochemical dealers'/marketers' shops. Questionnaire information were entered into computer and data analyzed using descriptive statistics.

These data were augmented with desk-review of paraquat status globally and in Nigeria.

3.0 RESULT

3.1 Current supply and list of paraquat products available in Nigeria

3.1.1 List of current suppliers and paraquat products in Nigeria

There are many companies that supply and distribute paraquat in Nigeria including the global giants like Syngenta. Although the herbicide is sold under different names by different manufacturers, the paraquat manufactured by Syngenta commonly called Gramoxone is the most common trade name used for paraquat, but in recent time the Nigerian markets have been engulfed with so many trade names as well as different registrants (Table 1). There are several variants in terms of percentage active ingredient, but the most common is the Paraquat ion (200g/L) formulated as Paraquat dichloride with 276 g/L (Table 1). Some the registrants also do market or distribute 2-3 different trade names of paraquat often, depending on their source of importation or manufacture. There are more than twenty (20) trade names registered for paraquat in Nigeria today (Table 1), as well as many registrants of paraquat; however, the major agrochemical companies that deal with paraquat in importation or distribution in the country are listed with their products and distribution channels in Nigeria (Table 2). Paraquat is imported or brought into the country and registered under the Directorate of Registration and Regulatory Affairs of National Agency for Food and Drug Administration and Control (NAFDAC), by the big names or major players in the agrochemical business space like (Table 2):

- Syngenta Nigeria Limited
- Saro Agrosciences Ltd
- The Candel Company Ltd
- Harvestfield Industries Ltd.
- C Zard & Co. Ltd
- Dizengoff West Africa (Nigeria) Ltd
- The Biostadt Company
- Jubaili Agrotec Ltd
- Finepro Manufacturing Company Ltd
- West African Cotton Co. Ltd

Table 1: List of paraquat products formulations in Nigerian market and registrants in Nigeria

S/N	Paraquat Product Trade Name	Active Ingredient	NAFDAC (Nig)/Status Of Registration		Pesticide Registrant/Licence Number/ Country	
			NAFDAC-NO.	Duration	Registrant/Nigeria	Licensed -Country
1.	Paraforce	Paraquat dichloride (PDC) -276g/L	A5-0109	2008-2013	Jubaili Agrotec. Ltd, kano, Nigeria	United Phosphorus Ltd. Ankleshwar, GUJ,
2	Dragon	PDC 24 % (W/W) of PDC	04-8610	2006-2011	West African Cotton Co. Ltd, Oshodi, Lagos	P.R., China
3	Weed Crusher	PDC 276g/L	04-7132	2005-2010	Harvest field Industries Ltd., Lagos, Nigeria	UK
4	Reliquat	PDC 276g/L	None	RUP	Reliable Agro-Allied Ltd, Ikeja Lagos)	China
5	Chemquat	PDC 276g/L	None	RUP		China
6	Weed-Off	PDC 276g/L(200 g/L)	A5-0260	2009-2014	Saro Agroscience Ltd, Apapa, Lagos	China
7.	Bret P-20 Liquid	PDC 276g/L(200 g/L)	A5-0247	2006-2011	Amanik Investment Ltd, Enugu	China
8	Bret P-(1 L Bottle)	Paraquat 279g/L	04-5927	2004-2009	Amanik Investment Ltd, Mary;Land, Lagos	China
9	Baraquat Liquid	276g/L	A5-0283	2010-2015	Purple Buk Co. Ltd. Central Business, Abuja	China
10.	Dizmazone @ 20%	200g/L	04-9406	2009-2014	Dizengoff W. A (Nig.) Ltd Apapa, Lagos	South Africa
11.	Glopara-Liquid	PDC 276g/L	A5-03235	2009-2014	Century Global Agricultural Ltd , Small Scale Industrial Estate, Kano	China
12.	Gramoxone Super	PDC 276g/L	04-5237	2004-2009	Syngenta Nig. Ltd, 387 Agege Motor Road, Mushin Lagos	Switzerland
13.	Gramoxone Super	PDC 276g/L	04-0196	2009-2014	Syngenta Nig. Ltd, Mushin Lagos	Switzerland
14.	Grass Cutter	PDC 20%	A5-0288	2010-2015	Crop Care Ltd 10 Km Gunduwawa District Hadeja Road, Kano	China
15.	Mxiquat	PDC 276G/L	A5-0125	2008-2013	Adebajo Close Avenue Nice Way Idumagbo Avenue Idumota Lagos.	China

S/N	Paraquat Product Trade Name	Active Ingredient	NAFDAC (Nig)/Status Of Registration		Pesticide Registrant/Licence Number/ Country	
			NAFDAC-NO.	Duration	Registrant/Nigeria	Licensed -Country
17.	Paracom Eraser Liquid	PDC 276G/L	A5-0290	2010-2015	Comfort Agro Chemical Nigeria Ltd 7a,Niger Street,Kano	China
18.	Paracot	PDC 276G/L	A5-0024	2007-2012	Afcott Nig. Ltd Plot 122-132, Oshodi-Apapa Expressway, Isolo, Lagos	China
19.	Paragliquid	PDC 276G/L	A5-0193	2010-2015	The Candel Company,Ltd Lekki Phase 1 Lagos	India
20.	Para-One	PDC 200G/L	A5-0123	2008-2013	Vancol, Cropcare Ltd, .G.Leventis Complex, Iddo, Lagos	India
21.	Paratex	PDC 276G/L	A5-0092	2008-2013	Vertex Agro Ltd Km 10 Abuja-Kaduna Road Suleja.	China
22.	Philozone	PDC 276G/L	A5-0181	2009-2014	Floret Trust Ltd, 13 Adejie Osunbanwo Street, Ejigbo, Lagos	Germany
23.	Premium Paraquat	PDC 20% SC	04-9555	2006-2011	African Agro Products Ltd. 37, Niger Street, Kano	China
24.	Ravage	PDC 276G/L	04-7485	2005-2010	Crop Care 3 Are Avenue, Bodija, Oyo State	China
25.	Scud	PDC 276G/L	A5-0026	2007-2012	Fitsco (Nig) 1st Floor Ance Building Jericho, Ibadan	UK
26	Slasher	PDC 276 G/L	A5-0110	2008-2013	Unique Agrochemicals Ltd., 92 Younis Bashorun Street, Victoria Island, Lagos	China
27.	Uniquats Liquid	PDC 20%	A5-0294	2010-2015	H.D.F & Sons Nig.Ltd 24, Unity Road, Kano	India
28.	Uniquat	PDC 276G/L	04-6411	2004-2009	H.D.F & Sons Nig.Ltd 24, Unity Road, Kano	China
29.	Weedex 200 Sl	PDC 276G/L	A5-0010	2007-2012	Osi Agro And Industrial Chemicals Co.Ltd A217 Bsabon Gari Market Kano	China
30	DYMOZONE	276g/\L	A5-0047	2007-2009	Dymota Agro. Nig. Ltd 1 Court. Road, Sabo Gari, Kano	China

Table 2: Major agrochemical companies, their paraquat product trade name and area of coverage in Nigeria

S/N	Agrochemical Company	Paraquat Trade name	States of Nigeria Covered/where products is distributed
1.	Syngenta	Gramoxone Super	Abia, Bornu, Enugu, Delta, Imo, Lagos, Kaduna, Oyo and Zamfara
2.	Saro Agroscience	Weed-off	Bauchi, Enugu, Niger, Oyo and Port Harcourt
3.	West Africa Cotton Company	Dragon	Abia, Abuja, Bauchi, Enugu, Niger, Oyo and Port Harcourt. Kano, Kaduna, Zuba, Ilorin, Lagos, Ibadan. Onitsha, Asaba and Benin City
4.	Jubaili Agrotech	Paraforce	Abuja, Enugu, Ibadan, Rivers, Kano, Akwa-Ibom Lagos, Delta and Ogun
5.	Dizengoff West Africa	Dizmazone-20%	Abia, Bauchi, Enugu, Lagos and Port Harcourt
6.	Harvest Field Industries	Weed Crusher	Enugu, Onitsha, Kaduna, Ondo, Osun, Ekiti, Abuja, Lagos, Port Harcourt
7.	The Candel Company	Paraquat Liquid	Gombe, Ibadan,Kano, Makurdi, Onitsha and Suleja

Besides these major importers, there are currently more than 100 registered crop protection and agrochemicals companies or dealers that are officially sanctioned by NAFDAC and its Directorate of Registration responsible for the registration of all chemicals regulated by law; who may also have one or two formulations of Paraquat in their list of products. In addition to this, there are cases of paraquat smuggled into the country alongside of other agrochemicals by unauthorized dealers. According to Osibanjo (2002), Nigeria imported about 15,000 MT annually between 1983 and 1990 comprising more than 130 pesticide chemistries marketed locally with over 150 different product brands and formulation; thereby listing Nigeria as the highest pesticides users in sub-Saharan Africa.

3.1.2 Types of paraquat brands and preferences across the six states

The survey result indicated that they were many brands of paraquat available in the market for farmers to use. They are six popular brands of paraquat used by farmers across the state (Dragon, Paraforce, Weed-off, Slasher, Paraquin, and Reliquat) (Table 3). Among the states, the brand varies from 4 (in Rivers State) to 7 (in Oyo State). Among the states, Dragon and Paraforce were the most available (100%), Slasher (about 80 %), and Weed-off, Reliquat and Paraquin about 50 % respectively (Table a). The survey result further showed that in terms of preference across the states, the brand Dragon accounted for about 34.4 % most preferred by farmers followed by Paraforce (28.1 %), Slasher (17 %) in that order (Table 4). The popularity of a particular brand in any locality is often driven by a lot of factors including: availability and proximity of market, price of the product, mode of action and efficacy; and to a lesser extent the marketing strategies adopted by the agrochemical company (using promotional items and handouts).

Table 3: Brands of paraquat marketed across the six states

	Availability of the various brand of paraquat in						
Paraquat brands	**Abia**	**Benue**	**Enugu**	**Ogun**	**Oyo**	**Rivers**	**Across (%)**
Dragon	+	+	+	+	+	+	100
Gramoxone					+		16.7
Paraforce	+	+	+	+	+	+	100
Weedoff	+	+		+			50
Slasher	+	+	+	+	+		83.3
Maxiquat					+		16.7
Uniquat					+		16.7
Weedcrusher	+			+			33.3
Paracot						+	16.7
Reliquat		+	+		+		50
Paraquin	+		+			+	50

Source: Field Survey 2018

Table 4: Brands of paraquat and farmers' preference across the six states

	% Person preferring a particular brand of paraquat in						
Paraquat brands	**Abia**	**Benue**	**Enugu**	**Ogun**	**Oyo**	**Rivers**	**Preference Across (%)**
Dragon	3 (25)	5 (31.25)	2 (50)	2 (16.67)	6 (50)	2 (33.33)	34.38
Paraforce	2 (16.67)	3(18.75)	1(25)	6 (50)	3 (25)	2 (33.33)	28.12
Weedoff	1 (8.33)	5 (31.25)	0	2 (16.67)	0	0	9.38
Slasher	2 (16.67)	3(18.75)	1(25)	2 (16.67)	3 (25)	0	17.02
Weedcrusher	3 (25)	0	0	0	0	0	4.17
Paracot	0	0	0	0	0	1 (16.67)	2.78
Paraquin	1 (8.33)	0	0	0	0	1 (16.67)	4.17

Source: Field Survey 2018

3.2. Status of current use and users of paraquat

3.2.1 Socioeconomic characteristics of respondents or paraquat users

A total of 61 respondents were interviewed across the six states (Abia, Benue, Enugu, Ogun, Oyo and Rivers) visited. Most of the respondents were males accounting for about 86.7 %, and the rest were females (13.3%) (Table 5). The distribution of the respondents according to their ages were as follows: aged < 30 years, (1.6 %); aged 31-40 years, (26.7%); aged 41-50 years, (31.7%); and ages above 50 years summed up to 40%. This implies that the majority were in their active age and therefore had the strength required to engage in all farm activities. Majority of the respondents (49.2

%) were literate with tertiary education background; 45.9% completed both primary and secondary education, while 1.6 % had adult literacy, and 3.3 % had no formal education. This mean that ≥ 40 % of the respondents could read and right, and can be adjudged to be able to read the label instruction of the herbicides container. Considered also during the survey was the body weight (BW) of the farmers, and the majority (55.2 %) were within the range of 61-70 kg BW while minority (8 %) were within 40-60 kg BW (Table 5).

Table 5: Distribution of respondents' socio-economic characteristics

Variables	Frequency	Percentage
Age		
<30	1	1.64
31-40	18	29.51
41-50	18	29.50
51-60	17	27.87
>60	7	11.48
Gender		
Male	52	86.67
Female	8	13.33
Educational Level		
No formal education	2	3.28
Adult Literacy	1	1.64
Primary School	14	22.95
Secondary School	14	22.95
Tertiary	30	49.18
Body Weight (kg)		
<40	0	0
40-50	6	10.3
51-60	8	13.8
61-70	32	55.2
>70	12	20.7

Source: Field Survey 2018

3.2.2 Distribution of respondents by occupational status

The respondents across the six states fall under different use status, basically according to their respective activities. They were as follows: ownership of farm enterprise, spray service providers (SSP), farm managers, rural farmers or farmer, employee of a farm business, agrochemical dealers, EAs, Health workers and others (not listed). Majority of the respondents were rural farmers (38.9 %); followed by agrochemical dealers (22 %) and farm enterprise owners (15.3 %) (Table 6.). The rest, including extension agents, spray service providers (SSP), Farm Managers and farm employees and health workers were each < 10 % (Table 6)

Table 6: Distribution of respondents by cccupational status

Occupational Status of Respondents	Frequency	% Distribution Respondents Status
Farm Enterprise owners	9	15.3
Spray Service Providers	3	5.1
Farm Manager	2	3.4
Rural Farmer or Farmer	23	38.9
Employee of farm or Agribusiness	1	1.7
Agrochemical Dealers/Supplier	13	22.0
Extension Agent	4	6.8
Health worker	1	1.7
others	3	5.1

Source: Field Survey 2018

3.2.3: Crop and non-crop situation

The use pattern of paraquat fall into two main categories as follows:

- On-farm use (Crop use -weed control or vegetation management for other agricultural activities)
- Off-farm use (Non-crop use: such as estate weed management and public amenities weed control)

Major crop use for paraquat in Nigeria include: maize, rice, cassava, cowpea, yam, plantain and banana, and in plantation crops such as oil palm, citrus, and some vegetables. Maize, cassava and yam appear to have the highest frequency of use compared to the other crops (Table 7). Its use in these crops varies from pre-plant for the purpose of desiccating the vegetation for planting, mixed with pre-emergence herbicides for the control of post-early weed that emerged before planting or before crop emergence; and finally for post-emergence control in the long season annual and biennial crops. In non-crop situations, paraquat has been used for weed control in right-of-ways, public utility facilities, government, public and private amenities. Paraquat formulations or products are commonly used both in domestic and agricultural production to provide crop protection and boost up the yield in agricultural productivity. Field survey across the states, showed that there is equally non-crop use (+) use for paraquat, although such use may vary across state (Table 7). From the field survey across the states, on-farm (crop use) use of paraquat varied from 66.7 % (in Rivers State) to 83 % (in Oyo State), averaging 73. 2 % across the states while only 26.8 % mentioned the use in off-farm activities (non-crop use) (Table 8); comprising estate maintenance, lawns and public and village amenities.

3.2.4 Category of use and users/applicators of paraquat

Field survey showed that the use pattern of paraquat is tilted towards the small holder farmers than any other category of user. Across the states, smallholder farmers constituted about 45.1 % of paraquat consumers compared to large holders (32.3%), and estate owners constitute about 22.6 % users (Table 8). In terms of application of paraquat, most farmers do the application themselves, instead of engaging a spray service provider. The survey result showed that farmers (72.1 %) across the states, prefer to apply their own paraquat than engaging spray service providers (27. 9%) to do same (Table 8).

Table 7: States and major use for paraquat (crop and non-crop situation)

States	Major use of paraquat across six States Of Nigeria	
	Crop system and Cropping system	NON-CROP
Abia	Cassava, Yam, Maize/cassava intercrop, Plantain/Banana; Vegetables & fruits; Rice; Oil Palm Plantation	+
Benue	Cassava, Soybean, Maize/Cassava, Yam, Yam/Maize,	+
Enugu	Yam, cassava, Maize, Maize/cassava	+
Ogun	Yam, cassava, maize/cassava, Plantain/banana, oil Palm	+
Oyo	Yam, cassava, maize/cassava, Plantain/banana, oil Palm,, cashew, okra, tomatoes	+
Rivers	Cassava, Yam, Plantain, oil palm, maize/cassava	+

Source: Field Survey 2018

Table: 8 Categorization of paraquat use in six states of Nigeria

	Place where paraquat is used (%)					Persons applying paraquat (%)	
States	**On-farm use (Crop use)**	**Off-farm use (Non-crop use**	**Small-holder farms**	**Large-holder farms**	**Estates**	**Farmers**	**SSPs**
Abia	70	30	50	37.5	12.5	63.6	36.4
Benue	69.2	30.8	37.4	31.3	31.3	69.2	30.8
Enugu	75	25	50	25	25	75	25
Ogun	83.3	16.7	25	58.3	16.7	83.3	16.7
Oyo	75	25	75	8.3	16.7	75	25
Rivers	66.7	33.3	33.4	33.3	33.3	66.7	33.3
Across State	73.2	26.8	45.1	32.3	22.6	72.1	27.9

Source: Field Survey 2018

3.2.5 Types of crops where paraquat is commonly used

Farmers in the study zone grow both arable, horticultural and plantation crops, and they use paraquat to control weeds. Their use of paraquat in weed management is dependent upon the weed control need, weed crop situation, weed flora type, crop systems and cropping systems. Across the six states, the surveyed result showed that paraquat was prominently used in Cassava (25.6 %); Yam (21.1%), Maize-Cassava intercrop (20.3 %) and Maize (15.8%) (Table 9). The reason given by farmers for the high consumption rate of paraquat in these crops was that they are crops of high commercial value in the states, especially cassava and yam which cuts across the states as the most important crop in terms of paraquat use (Table 9). Also, the mode of action makes it most preferred especially for post emergence weed suppression in cassava and yam.

Table 9: Major Crops where paraquat was used across six states of Nigeria

	Percentage of farmers using paraquat in the production of:

States	Maize	Cassava	Yam	Palm Plantation	Banana/ Plantain	Maize/Cassava intercrop
Abia	1(5)	7(35)	3(15)	2(10)	3(15)	4(20)
Benue	9(23.08)	10(34.48)	13(33.33)	3(7.69)	0	4(10.26)
Enugu	2(40)	1(20)	1(20)	0	0	1(20)
Ogun	1(5.88)	1(5.88)	3(17.65)	1(5.88)	1(5.88)	10(58.82)
Oyo	8(19.51)	12(29.27)	7(17.07)	6(14.63)	2(4.88)	6(14.63)
Rivers	0	3(27.27)	1(9.09)	3(27.27)	2(18.18)	2(18.18)
Across State	21(15.79)	34(25.56)	28(21.05)	15(11.28)	8(6.02)	27 (20.30)

Source: Field Survey 2018. Figures in parenthesis ( ) are percentages

3.3 How paraquat is supplied and sold in Nigeria

3.3.1 Sources of paraquat products in Nigeria

Paraquat is not manufactured or formulated in Nigeria but imported mostly from developed countries. In Nigeria, close to 90% of Paraquat and other pesticides are imported as finished pre-packed or completely packaged products mainly from Germany, United Kingdom, Switzerland, India and China among others. Today, China is the world's largest manufacturer of paraquat, producing several thousand tons per year, and of the 30 different paraquat trade marks in Nigeria; products from China constitutes about 63 % and India 17 % (10).

Table 10: Country of Origin of paraquat Product and number of brands found in Nigeria

S/N	Country of product	No. brands of country's paraquat product	% of Country's product in Nigeria
1.	China	19	63.3
2.	India	5	16.7
3.	United Kingdom	2	6.7
4.	Switzerland	2	6.7
5.	Germany	1	3.3
6.	South Africa	1	3.3

Source: Modified or Adapted from NAFDAC directorate of registration & regulatory affairs List of Approved Pesticides in Nigeria, 2018

3.3.2 The supply of paraquat along with other agrochemicals are as follows:

Paraquat is supplied in Nigeria through the following channels:

- Country of manufacture or origin
- Multinational Agrochemical Companies or their representatives in Nigeria
- Indigenous Company Distributors or Off-Takes importing through the Agrochemical

companies

- Intermediary wholesalers or Certified Input or Licensed agrochemical dealers
- Open market
- Retailer

However, the marketing classically falls into the following: Wholesalers, Retailers and a combination of both depending on the location. Majority of the local companies double as both wholesalers and retailers. Other sources of paraquat used by the farmers include Agricultural Development Programme (ADP) and cooperatives in Nigeria (Mokwunye, et al., 2012). In Nigeria it is readily available to farmers, through these channels, and sometimes through spray services provides who sell and also provide the service. There are also small retail agrochemical or input detailers at the village and town levels, and it is also the cheapest non-selective post emergence herbicide for weed control. It is also packaged in 1Litre bottle, and recently in 500ml bottle, which is easily affordable by the farmers. The result of the field survey conducted showed that across the states visited, majority (76.6 %) involved in marketing paraquat were certified agrochemical or input dealers; other marketers and those assisting dealers at the farm or village level accounted for about 51% and 29.6 % respectively while import were about 1.85 % (Table 11). Also across the states, the actors in the supply chain involvement were as follows: wholesalers (12.4%), retailers (27.2%), others (EAs/SSPs, 14.4 %) and any of the combination (46 %).

Table 11: Paraquat marketing and supply chain across six States of Nigeria

	Involvement in marketing Paraquat (%)				Actor in Paraquat supply chain (%)			
State	**Import**	**Market of Paraquat**	**Certified or authorized dealers**	**Assistance in marketing**	**Wholesalers**	**Retailers**	**Others (EAs/ SSP)**	**Combination**
Abia	11.1	60	70	11.1	0	12.5	12.5	75
Benue	0	13.3	23.1	50	7.7	30.8	53.8	7.7
Enugu	0	100	100	0	0	0	0	100
Ogun	0	100	100	66.67	66.7	0	0	33.3
Oyo	0	0	100	0	0	100	0	0
Rivers	0	33.3	66.7	50	0	20	20	60
Across State	1.85	51.1	76.6	29.6	12.4	27.2	14.4	46

Source: Field Survey 2018

3.4 Perception and status of paraquat in the six states of Nigeria

3.4.1 Farmers experience with paraquat and preference among other herbicides

The mean number of years from the result of the survey that the respondents or farmers had been using paraquat was 12.27 years, accounting for 60 % of persons across the states with paraquat experience that spans beyond 10 years while 40 % had years of experience between 1 and 10 years. Across the states, about 96 % of the farmers have had one form of experience or another

with paraquat. Although it varies with state all states had experience ≥ 90 % with paraquat use (Table 12). For the purpose of this study we looked at only paraquat and any other readily available post-emergence herbicides, which was glyphosate. All other herbicides actives encountered in this study area were mainly pre-emergence herbicides (Primextra; Atrazine, Butachlor, Metolachlor, Pendimethalin, Orizo-plus and all their brands etc.) and were grouped as others. The result of this study revealed that majority of the herbicides used by the farmers were Paraquat and Glyphosate (49.2% and 42.8 % respectively), and the other herbicides accounted for about 8 % use across the six states (Table 12). Paraquat and Glyphosate have been reported as most commonly used herbicides by farmers, accounting for about ≥ 70 % when compared to other herbicides (Issa, 2016). The weed flora composition often is a determinant of the type of herbicide active to be used. The result of this study, when grouped according to geopolitical (NC, SE, SS and SW) and contiguous ecological zone (NC and SE) showed that Glyphosate was more popular on the average in the North Central (≥ 80 %) and South East (60 %) zones. By contrast, paraquat was more popular in the SW (75 %), SS (60 %) and SE (35 %) (Table 12). The observation here may not be unconnected with the fact that SE and the adjoining states/communities are in the humid agroecology characterized by perennial broadleaf and some stubborn grasses; compared to SW which is more in the derived savanna and partly in the forest transition zone with less precipitation. More annual and less stubborn weeds in the SW favor the use of paraquat, while more perennial weeds in the SE favor the use glyphosate. Also over the years, it has been observed that the type of ecosystem, amount and duration of precipitation may determine the choice of these two herbicides in a given area, especially during the peak of the rains and planting season. Information gathered from farmers over the years suggest that farmers in the core south-south zone, especially in the wetlands prefer paraquat over glyphosate, because of the fast-burn down action within an hour, and the short rainfall interval required efficacy. Therefore, it was not surprising to see preference for paraquat in Rivers State (60 %) more than glyphosate (20 %) (Table12)

Table 12: Distribution of respondents by years of experience and herbicide use in six States of Nigeria

		Number of Years			% Paraquat use among other herbicides		
State	**Persons with Paraquat use experience (%)**	**1-5**	**6-10**	**>10**	**Paraquat**	**Glyphosate**	**Mixed herbicides (not paraquat or glyphosate)**
Abia	90.1	1 (11.1)	3 (33.3)	5 (55.6)	5 (50)	4 (40)	1 (10)
Benue	93.8	3 (20)	3 (20)	9 (60)	2 (11.1)	15 (83.3)	1 (5.6)
Enugu	100.0	1 (25)	2 (50)	1 (25)	1 (20)	4 (80)	0.0
Ogun	91.7	1 (9.1)	6 (54.5)	4 (36.4)	12 (75)	2 (12.5)	2 (12.5)
Oyo	100.0	0.0	2 (16.7)	10 (83.3)	11 (78.6)	3 (21.4)	0.0
Rivers	100.0	0.0	0.0	4 (100)	3 (60)	1 (20)	1 (20)
Across State	95.9	6 (10.9)	16 (29.1)	33 (60)	34 (49.2)	29 (42.8)	5 (8.0)

Source: Field Survey 2018

3.4.2 Awareness of paraquat product formulation in Nigeria and certified applicators

The farmers and the other respondents were asked if they were aware of any brand of paraquat formulated in Nigeria, and about 19.1 % were aware while about 80.9 % were not aware of any brand formulated in Nigeria. Among the farmers and others surveyed across the states, 35.2 % were person certified as applicators while 64.8% were not. The survey result also showed that the percentage of farmers, SSPs and certified applicators generally using PPE/PPC during the handling and application of paraquat across the six states were 79.8 % compared to 20.2% that did not use or wear PPE/PPC when applying paraquat. (Table 13)

Table 13: Distribution of certified pesticides applicators and persons using PPE in six states of Nigeria

States	Awareness of paraquat formulated in Nigeria (%)	Not Awareness of paraquat formulated in Nigeria (%)	Persons that are certified applicators	Persons Not certified applicators (%)	Persons using PPE during application (%)	Not using PPE/PPC during application (%)
Abia	14.3	85.7	11.1	88.9	77.8	22.2
Benue	0	100	0	100	79.9	21.1
Enugu	0	100	25	75	75	25
Ogun	33.3	66.7	80	20	83.3	16.7
Oyo	0	100	75	25	83.3	16.7
Rivers	66.7	33.3	20	80	80	20
Across State	19.05	80.95	35.2	64.8	79.8	20.2

Source: Field Survey 2018

3.4.3. Types of application equipment and Personal Protective Equipment and Clothing (PPE/PPC) used for paraquat in the six States

The result of this survey showed that majority of the paraquat application across the states, were made mostly by the use of knapsack sprayers (92.4%) and only about 7.6 % applications were made using other types or methods of application (Table 14) . The type of equipment used by farmers is often dependent on the affordability by the users and the type of training received according to the farmers. On the use of personal protective equipment (PPE) and personal protective clothing (PPC), the majority (71.2 %) of the users (farmers, spray service providers, certified applicators and others) at least use one of the PPE/PPC during application of paraquat; 25.3% of the applicators used a combination of 1-3 of the PPE/PPC listed; less than 5 % (3.4 %) used all listed and less than 1% (0.1%) never used it (Table 14). Across the states, the survey result also showed that most popular PPE/PPC used by farmers and paraquat applicators were gumboot (17.1 %); gloves (12.7 %); respirators (10. 7 %); face shield/ google (9.7 %) and coverall (9.4 %)(Table). The result showed that rarely will a farmer use all or complete PPE/PPC, and that is why only about 2.8 % across the states used all required PPE/PPC. This implies that the farmers were still prone to undue exposure to paraquat, due to lack of due diligence to the use of complete PPE/PPC or compliance to the best practice in this regard.

3.5. Information on possible ban of paraquat in Nigeria

Based on some of the health implications and issues relating to the use of paraquat which some of the farmers mentioned. The farmers and the cross section of the respondents were asked, if they will recommend the ban on importation and use of paraquat. All (100 %) of the respondents would not recommend ban on importation of paraquat; and 96.5 % also did not recommend ban on use and application of paraquat; while only 3.5% did recommend ban on paraquat. Field survey result across the states suggest that majority (88.6 %) will not recommend ban on importation and use of paraquat for weed management in crop production while the minority (11.4%), will recommend ban on paraquat (Table 16). Recommendation for ban across the states varied from 0 % (in Oyo State) to 25 % (in Enugu State), while all recommendations across the states for not banning was not lower than 75 %. Farmers had the following reasons for not recommending ban on paraquat:

- It makes farming easier and cheaper
- It reduces drudgery and increases hectares under cultivation
- It is quick to kill weeds
- It saves cost of farm operation.

3.6. Alternatives to paraquat in Nigeria

The herbicide alternative to paraquat today in Nigeria that is readily available is only Glyphosate and the variants in Nigeria. The prices ranges from N3,000 to N3,500 per liter, and it may vary with location. It may also vary in a given month depending on the exchange rate of naira to dollar. The other alternatives are:

- Glufosinate-ammonuim (Basta), but it is not readily available yet.
- Fusilade (Fluazifop-p-butyl) mode of action not permitted in cereal crops cropping systems

3.7. Evidence of paraquat exposure and poisoning in the six states

The result of this study revealed that 56.5% of the farmers and other respondents across the states have been unduly exposed to paraquat during use and application while 43.5 % have not been unduly exposed to paraquat (Table 17). About 25.1 % of the persons exposed agreed that it was due to the absence due diligence to PPE or other precautionary measures while 74.9% said otherwise. During such exposure reported, our result across the states indicated that 33.1% cases were symptomatic; and about 37.1% cases of intoxication or poisoning were reported; while 66.9 % cases had no symptoms; and 62. 9% cases did not result to any fatality or intoxication. About 10.4 % of the poisoning cases across the states agreed to have consulted a doctor or sought a medical advice, while 89.6% did not seek medical advice. Across the states, only 2.4 % undue exposure cases where hospitalized while 97.6 % were not hospitalized. This result implies that farmers have been unduly exposed to paraquat but poisoning cases were not taken seriously, probably because of the fact that some the manifested symptoms are not different from everyday symptoms of normal life stress.

3.7.1. Sources of paraquat exposure

Farmers and agro-dealers listed major sources of paraquat exposure as: when the product is being transported, mixing/loading, during application, field residues, and repair of sprayer and other spraying equipment and drift during application. The majority across the states mentioned application (57.6

%), repair of equipment (12.8 %) and mixing and loading before application (12.1%) respectively as the main sources of paraquat exposure (Table 18). The list sources of exposure for them was field residues (2.9%), and followed by during transportation and drift respectively (7.3%). Oyo State was not captured in these likely sources of exposure, as they were no entry for Oyo.

Table 15: Paraquat application equipment and personal protective Equipment (PPE)

	% of persons applying paraquat with			% of Persons applying paraquat with PPE								
State	**Knapsack or back pack**	**Hand held spray line**	**Dip tank or tray**	**Gum boots**	**Overall**	**Apron**	**Respirator**	**Face shield or google**	**Hat or Cap**	**Gloves**	**Combi-nation**	**All**	**None**
Abia	87.5	0	12.5	12.82	10.26	10.26	10.26	12.82	10.26	10.26	12.82	10.26	0
Benue	100	0	0	26.70	3.30	0	6.70	23.30	13.30	16.70	3.30	6.70	0
Enugu	100	0	0	30	10	0	30	0	0	20	10	0	0
Ogun	100	0	0	7.14	7.14	7.14	0	0	0	7.14	71.4	0	0
Oyo	100	0	0	10.71	10.71	7.14	7.14	7.14	7.14	7.14	39.29	0	3.57
Rivers	66.67	33.33	0	15	15	5	10	15	10	15	15	0	0
Across State	92.4	5.60	2.08	17.06	9.40	4.92	10.68	9.71	6.78	12.70	25.30	2.83	0.60

Table 16: Ban on paraquat importation and use

	Persons not recommending ban on paraquat (%)		Persons recommending ban on paraquat (%)	
States	**Importation**	**Use and application**	**Importation**	**Use and application**
Abia	90.9	81.8	9.1	18.2
Benue	100	93.8	0.0	6.2
Enugu	75	75.0	25.0	25.0
Ogun	83.3	100	16.7	0.0
Oyo	100	100	0.0	0.0
Rivers	83.3	80	16.7	20.0
Across State	88.8	88.4	11.2	11.6

Source: Field Survey 2018

Table 17: Distribution of respondents with evidence of paraquat exposure and poisoning in six states of Nigeria

	% Cases of exposure and experience across the six states											
	Experienced incidence from undue exposure to paraquat		Exposure based on use of PPE		Poisoning Case (intoxication)		Symptoms with exposure		Consulted Medical doctor		Hospitalization after exposure	
State	Exposed	Not exposed	Due to absence of PPE	Not due to absence of PPE	Due to exposure	Not due to exposure	Symptoms	No symptoms	Consulted	Did not consult	Hospitalized	Not hospitalized
Abia	22.2	77.8	14.3	85.7	50	50	45.5	54. 5	16.7	83.3	0	100
Benue	76.9	23.1	69.2	30.8	38.5	61.5	75	25	27.3	72.7	14.3	85.7
Enugu	66.7	33.3	0	100	50	50	0	100	0	100	0	100
Ogun	66.7	33.3	27.3	72.7	9.1	90.9	50	50	18.2	81.8	0	100
Oyo	66.7	33.3	0	100	8.3	91.7	8.3	91.7	0	100	0	100
Rivers	40	60	40	60	66.7	33.3	20	80	0	100	0	100
Across States	56.5	43.5	25.1	74.9	37.1	62.9	33.1	66.9	10.4	89.6	2.4	97.6

Source: Field Survey 2018

Table 18: Sources of paraquat Exposure

	Sources of paraquat exposure mentioned					
State	In transit	Mixing/ loading	Application	Field residues	Repair of equipment	Drift during application
Abia	1(20)	1(20)	0	0	2(40)	1(20)
Benue	0	1(7.1)	10(71.4)	2(14.3)	1(7.1)	0
Enugu	0	0	2(100)	0	0	0
Ogun	0	0	5(83.3)	0	0	1(16.7)
Rivers	1(16.7)	2(33.3)	2(33.3)	0	1(16.7)	0
Across State	2(7.3)	4(12.1)	19(57.6)	2(2.9)	4(12.8)	2(7.3)

Source: Field Survey 2018

3.8. Training on safe sale, use and application of paraquat

The result of this survey showed that some of the respondents, majority of whom were rural farmers have received training on the safe use, precaution and application of pesticides generally, which includes paraquat. Across the states, 47.8 % have received such training while 52.2% were yet to undergo or receive such training (Table 19). Among the states, the number of persons that have received training varied from 7.1 % in Benue to about ≥ 80 % in Oyo State; and by contrast those not trained varied from 16.7 % in Oyo to about 92 % in Benue (Table 19). Similarly, those that received training on best practices for sales or safe sale or marketing for paraquat were about 29 % while 71% had no such training. The safe sale training varied from (0%) in Oyo state to about 50 % trained in Benue and Enugu respectively; while those that had no safe sale training for paraquat

varies from 50 % in Benue and Enugu to 100 % in Oyo state (Table 19). Among the 47.8 % and 29 % that have received the two types of training respectively across the states, are the ones often classified as the certified SSP or applicators. These category of applicators and some farmers we gathered were trained by both national (National Agricultural and Extension Systems (NARES, which includes ADPs and research institutes), international agencies and NGOs (IITA, USAID, DFID, CRS and Crop Life) and agrochemical companies and dealers.

Table 19: Training on safety sale and application of paraquat

States	Safe Use and application training received (%)		Safety sale precaution training received (%)	
	Trained	Not trained	Trained	Not trained
Abia	33.3	66.7	25	75
Benue	7.1	92.9	50	50
Enugu	33.3	66.7	50	50
Ogun	70	30	16.7	83.3
Oyo	83.3	16.7	0	100
Rivers	60	40	33.3	66.7
Across State	47.8	52.2	29.0	71.0

Source: Field Survey 2018

REFERENCES

Adejumo OA, Akinbodewa AA, Olafisoye OJ, Afolabi ON (2016). Acute kidney injury following paraquat poisoning: An uncommon case of acute toxic nephropathy in Nigeria. *J Med Trop; 18:51-3.* ([Downloaded free from http://www.jmedtropics.org on Thursday, May 17, 2018, IP: 47.35.97.140]

Agarwal R, Srinivas R, Aggarwal A.N, Gupta D. (2006). Experience with paraquat poisoning in a respiratory intensive care unit in North India. Singapore Medical Journal. 47(12); 1033-1037.

Ajani F, Olukunle OA, Agbede SA (2007). Hormonal and Haematological Responses of Clarias gariepinus (Burchell, 1822) to Nitrate Toxicity. J. Fisheries Int., 2(1): 48 – 53.

Akinloye, O. A.1, Adamson, I., Ademuyiwa, O.1 and Arowolo, T. A.(2011). Occurrence of paraquat residues in some Nigerian crops, vegetables and fruits. Journal of Environmental Chemistry and Ecotoxicology 3(7), pp. 195-198, (Available online http://www.academicjournals.org/jece)

Babatunde MM, Oludimiji AA, Balogun JK (2001). Acute toxicity of Gamaxone to Oreochromis niloticus (Treweva) in Nigeria. Water, Air, Soil Pollut., 13(1 - 4): 1 – 10.

Cal EPA (2010). Development of Health Criteria for School Site Risk Assessment Pursuant to Health and Safety Code Section 901(g): Child-Specific Reference Dose (ChRD) for paraquate

Fidelis Bekeh Ada, Edet Ekpenyong and Ezekiel O. Ayotunde (2012). Haematological, biological and behavioural changes in *Oreochromis niloticus* (Linne 1757) juveniles exposed to Paraquat herbicide Journal of Environmental Chemistry and Ecotoxicology Vol. 4(3), pp. 64-74, 2 February, 2012 Available online at http://www.academicjournals.org/JECE DOI: 10.5897/JECE11.067

Gushit J.S, Ekanem E.O, Adamu H.M. (2013). Utilization pattern and risk assessment of herbicides usage by farmers, marketers and agricultural extension workers (AEWs) in Plateau state Nigeria. Journal of Agricultural Science Research.

Isenring R (2006). Paraquat: Unacceptable health rish for users. Berne Declaration 2006.

Joshi A, Fernandez I, Mourin J, Rengam SV (2002). Poisoned and silenced: A Study of pesticide poisoning in the plantations. PAN Asia Pacific.

Kori-Siakpere D, Adamu KM, Madukelum IT (2007). Acute Haematological effect of Sub lethal levels of Paraquat on the African Catfish, Clarias giriapinus (Ostechthyes: Claridae). J. Res. Environ. Sci., 1(6): 335 – 331

Majid, M.I.A (1997). Know your pesticide: paraquat. Toxicology Laboratory, National Poison Centre, Universiti Sains Malaysia, Penang.

Mokwunye, I.U., Babalola, F.D., Ndagi, I., Idrisu, M., Mokwunye, F.C., and Asogwa, E.U. (2012). Farmers' compliance with the use of approved cocoa pesticides in cocoa producing States of Nigeria. Journal of Agriculture and Social Research (JASR), 12(2): Pp 44 – 60

Nagami H, Nishigaki Y, Matsushima S, Matsushita T, Asanuma S, Yajima N, Usuda M, Hirosawa M. 2005. Hospital-based survey of pesticide poisoning in Japan, 1998--2002. Int J Occup Environ Health 11(2):180-4.

Omitoyin BO, Ajani EK, Fajim OA. 2006. Toxicity of Gramoxone (paraquat) to Juvenile African Catfish, Ciarias gariepinus (Burchell, 1822). Am Euras J Agric & Environ Sci 1(1):26-30.

PAN UK (2017). Adverse health effect caused by paraquat.

Parker, C. (1972). The role of weed science in developing countries. Weed Science 20, 408-13.

Shallangwa SM, Auta J (2008). Sub Lethal Effect of 2, 4 – Dichlorophenoxy Acetic Acid on Growth and Food Utilization of the African Cat Fish. Bull. Fisheries Int., 3(3): 65 – 67

Seok SJ, Gil HW, Jeong DS, Yang JO, Lee EY, Hong SY. 2009. Paraquat intoxication in subjects who attempt suicide: why they chose paraquat. Korean J Intern Med 24(3):247-51.

Wesseling C, van Wendel de Joode B, Ruepert C, Leon C, Monge P, Hermosillo H, Partanen T. 2001a. Paraquat in developing countries. Int J Occup Environ Health 7:275-286.

Wesseling C, van Wendel de Joode B, Monge P. 2001b. Pesticide-related illness among banana workers in Costa Rica: A comparison between 1993 and 1996. Int J Occup Environ Health 7:90-7.

Whittle B. 2010. Communities in Peril: Asian regional report on community monitoring of highly hazardous pesticide use. Pesticide Action Network Asia & the Pacifi c, Penang. http://www.panap.net/en/p/post/pesticides-cpam/80.

WHO. 2010. The WHO Recommended Classifi cation of Pesticides by Hazard and Guidelines to Classifi cation 2009. World Health Organisation, Geneva. http://www.fi jitimes.com.fj/story.aspx?id=141776.