

# Cassava weeds and management in Nigeria



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## Executive summary

Cassava is fast becoming a potential engine of growth in many developing countries including Nigeria and exerting great influence on world trade due to the efforts of government and the private sector in developing unique, value-added, cassava-based products for human consumption and industrial purposes. However, the attack of weeds has continued to plague cassava producers causing severe loss in yield; and leading to low income, soil degradation, food insecurity, and severe rural poverty among cassava growing farm families. This study seeks to identify and catalog the weeds that affect cassava production in the different cassava producing ecological zones of Nigeria, assesses the management options, and identify constraints and opportunities for the use of improved weed management techniques by farmers in the cassava growing ecologies of the country.

Data were collected through survey of communities across the cassava producing agro-ecological zones of Nigeria in 2004. Results show that 24 common weeds affect cassava in the wetland or forest savanna and derived savanna zones of the country. These are mostly monocotyledonous perennial grass weeds of the Poaceae family, namely guinea grass (*Panicum maximum*), spear grass (*Imperata cylindrica*), broad carpet grass (*Axonopus compressus*), fearthy pennisetum (*Pennisetum polystachion*), itch weed (*Rottboella conchinchensis*), ganber grass (*Andropogon gayanus*), bull grass (*Eleusine indica*), and rice grass paspalum (*Paspalum commersonii*). Others are dicotyledonous herbaceous annual or perennial weeds of the Commelinaceae family; scrambling perennial herbs (Haemorrhage plant—*Aspilia africana*); perennial shrubs (Siam weed—*Chromolaena odorata*), etc. The most widely distributed weed is *Imperata cylindrica* and occurs in 53.5% of the sampled communities. *Imperata cylindrica*, *Commelina bengalensis*, and *Chromolaena odorata* occur in all the zones. While *Imperata cylindrica* is predominant in the north central (68.2%), southeast (63.6%), and south-south (47.1%) zones, *Chromolaena odorata* and *Panicum maximum* are the major weeds of cassava in the southwest zone and occur 66.7% and 38.1%, respectively, in the zone. *Pennisetum polystachion* is found only in the north-central zone (36.4%). *Rottboella conchinchensis* is present in the north-central (13.6%) and south-south (8.8%) zones only, while *Axonopus compressus* is found only in the southeast (36.4%) and south-south (12.1%) zones. Results further indicate that the south-south zone has the highest variability in occurrence and distribution of weeds. Cross River State has the highest concentration (30.6%) of cassava weeds in the south-south zone, Oyo and Osun states in the southwest, Abia State in the southeast, and Nasarawa State (29.8%) and Kogi State (28.1%) in the north-central zone.

The nonchemical approach involving manual and mechanical slashing, mowing, and use of the rotary hoe is the most common method used by farmers to control cassava weeds. Other methods include cultural practices like cultivating land with low weed infestation, crop rotation, good crop combination, adequate fertilizer application, mulching and good management of pest and diseases, and biological control such as planting cover crops to suppress the weeds. Chemical control is the most effective method of controlling cassava

weeds, particularly *Imperata cylindrica*. But its use is limited by non-availability of the right herbicides at the right time and place, high costs, inexperience, fear of crop damage, and health and environmental hazards. Economics of different *Imperata* control techniques in cassava show that herbicide-based control techniques produce higher yields and income, and saves labor (of women and children in particular) thereby leading to overall improvement in farmers' livelihood. Generally, integrated weed control is most effective in the control of weeds in cassava. Proper calibration of sprayers and observance of safety precautions in the handling and use of herbicides are essential to enhance herbicide efficacy and avoid environmental hazards. Lack of labor, capital, and skills are major constraints to the use of improved weed control strategies. Participatory research involving scientists, farmers, and agrochemical entrepreneurs have developed integrated technologies to manage weeds. Linkage of farmers with agrochemical markets, training on the right use of herbicides, institutional support for credit, and adoption of integrated approaches by farmers are vital to enhance sustainable control of cassava weeds in Nigeria.

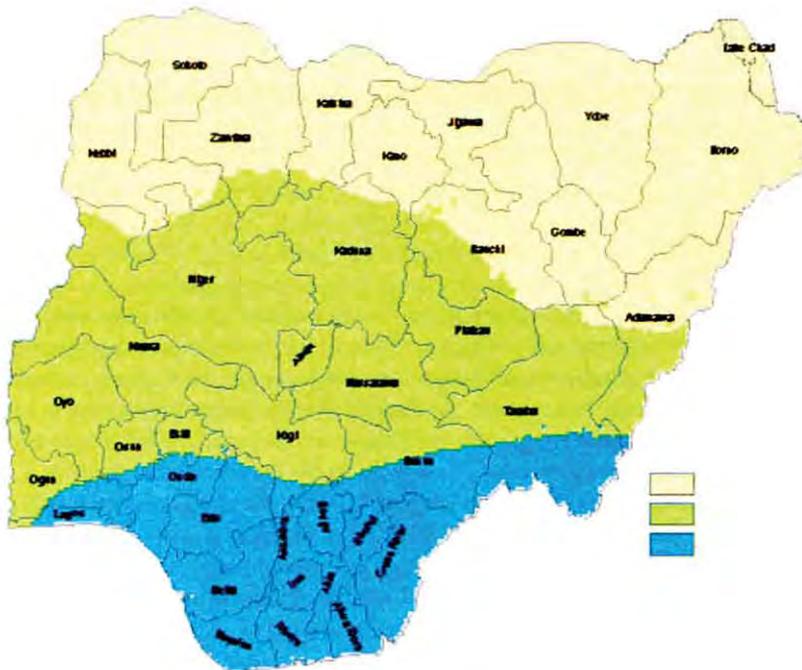
# Cassava weeds and management in Nigeria

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## Introduction

In recent times, cassava is fast becoming a potential engine of growth in many developing countries and exerting great influence on world trade due to the efforts of government and the private sector in developing unique, value-added, cassava-based products for human consumption and industrial purposes. The Federal Government of Nigeria and other agencies (national and international) have established various programs for the development of the cassava agribusiness subsector. These include: the Presidential Initiative on Cassava, the Cassava Mosaic Disease Prevention Program (CMD), the Cassava Enterprises Development Program (CEDP), the Cassava Multiplication Program (CMP), etc; all working in tandem to increase productivity and processing, and promote wilful consumption of cassava products through increased marketing opportunities. Policy focus such as the ban on the importation of maize and wheat flour has further created enough motivation for farmers to increase cassava production to meet the rising demands from households and industries. However, the average production of cassava in Africa and Nigeria in particular is below the world average (IITA 1990), with limited scope for sustainable growth in output due largely to production constraints occasioned by pests and disease infestations (including weed attacks), low use and investment in yield increasing technologies, poor production input delivery mechanism, etc.

One major goals of the CMD project in terms of increase in output is to reduce inefficiency, drudgery, low yield, and labor productivity of cassava farmers arising from the attack and control of weeds, in order to generate the desired down-stream effects of job creation, poverty alleviation, and sustainable food security. These became necessary as weeds have been found to be a major pest affecting 25 out of 30 common crops grown in Nigeria (Akobundu 1988); and causing severe decimation of crop yields—by 40–80% (Ayeni 1991), labor use particularly among women and children, and land degradation. These make the control of weeds a critical aspect of cassava production and enhanced livelihood of the rural poor farmers. Research works by IITA and other research institutions have identified promising weed control options for different weeds, but the adoption of these technologies have remained low and unpredictable due to lack of awareness among farmers and inadequate access to weed control inputs. Proper management of pests, such as weeds, depends on the availability of adequate information on the occurrence, distribution, and dynamics of control techniques employed in a given environment or locality. This information is imperative as they form the basis for targeting effective pest management interventions and crop improvement efforts in general.



**Figure 1. Agroecological map of Nigeria showing cassava production regions.**

**Source:** Geospatial Laboratory, IITA, Ibadan

The assessment of cassava production status in Nigeria shows that cassava is produced basically in two out of the three major agroecological belts of the country (Fig. 1). These two agroecological belts comprise the humid south and subhumid north central regions of Nigeria. However, the north-central zone produces the largest quantity of cassava in the country. The north-central states include Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and Taraba states. These states together produce about 29% of the cassava in Nigeria (ICP 2004)

The objective of this document is to identify and catalog the weeds that affect cassava production in the different cassava producing ecological zones of Nigeria, assess the management options, identify the constraints and opportunities for the adoption of improved weed management techniques by farmers, and recommend strategies for creating awareness and uptake of sustainable weed control technologies in Nigeria. This document is important and draws significantly from the resultant increase in cassava cultivation, fuelled by the combined effects of government policies on cassava, the “Presidential Initiative on

**Table 1. Selected states within zones for questionnaire administration.**

North-central zone	Southeast zone	South-south zone	Southwest zone
Benue	Abia	Akwa-Ibom	Ekiti
Kogi	Anambra	Bayelsa	Ogun
Kwara	Ebonyi	Cross River	Ondo
Nasarawa	Enugu	Delta	Oyo
	Imo	Edo	Osun
		Rivers	

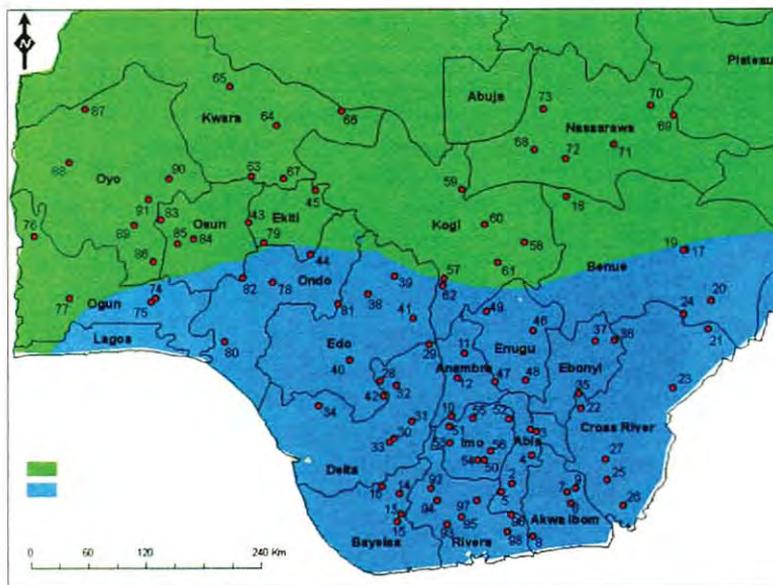
**Source:** Field survey 2004.

Cassava Development”, the “Pre-emptive Management of Cassava Mosaic Disease (CMD) in Nigeria” at the IITA, and need for sustainable improvement in cassava output to meet growing national demands. In line with the framework of the CMD project, a baseline survey of weeds that affect cassava production in villages across the major cassava producing agroecological zones in Nigeria was conducted by the CMD project.

In addition to existing literature and adaptive research information on weeds in crop production, cassava production, and cropping systems in Nigeria, village-level and farm-based questionnaires were used to elicit information on the status of weed infestation on cassava farms, methods of weed control, and sources and access to weed control inputs. Twenty states from agroecologies where the bulk of cassava is produced in the country were selected. This comprises states within the north-central, southeast, south-south, and southwest zones of the country (Table 1).

Villages were randomly selected for the survey following a geospatial method. A total of 98 communities were selected for questionnaire administration (Fig. 2 and Appendix 1). A research team composed of an Agricultural economist, Rural sociologist, Agronomist (crop protectionist), and a technician administered the questionnaires to an assembly of community members and three individual households in each of the villages visited. The questionnaires, which were in two parts: village- and household/field-level, elicited information on the common weeds of cassava found in the community, methods of control, perceived constraints to effective control, cassava cropping system, etc. While the village-level questionnaire elicited information on the community’s perspective of the situation, the household-field level questionnaire provided insight into individual farmer’s perception of the problems and opportunities for cassava production generally, and weed management in particular. The team took records of the geographical location of each community and individual farm-fields that were visited. The survey was conducted from April to August 2004.

The questionnaires were analyzed using simple descriptive statistical tools, such as frequency counts, averages, and percentiles. These were done in order to make deductions and draw possible conclusions on the occurrence, distribution, and management of weeds as well as the constraints and opportunities for adopting improved weed control options to increase the yield of cassava in Nigeria.



1	Akoli Imenye	17	Andoor	33	Ozoro	49	Nimbo	65	Bode Saadu	82	Itanla
2	Avo Nriha	18	Obagaji	34	Ugberilkoko	50	Eziala	66	Ghado	83	Adana
3	Isegbu Bende	19	Tse-Zwa	35	Abaomega	51	villag	67	Isolo Opin	84	ifeno
4	Okwe	20	Usar-Adikpo	36	Ndingele	52	Obinikpa	68	Ajaga	85	Wasinmi
5	Umuckechi	21	Busanfong	37	Nwofe	53	Obokofia	69	Alogani South	86	Akanran
6	Ikot Ambon	22	Ediba	38	Afuze	54	Obibiezena	70	Gona	87	Idi Apa
7	Ikot Ekwerne Itam	23	Oninekpang	39	Apana Ebue- nehien	55	Owerri-Ebiri	71	Doma	88	Igbojaye
8	Ikot Ndien	24	Gakem	40	Ugboha	56	Umuokile	72	Udege Kasa	89	Ijaye
9	Mbiaya Uruan	25	Ikot Nyong	41	Urhonigbe	57	Angba	73	Zakun-Bello	90	Owode
10	Villag	26	Ikot Ofiong	42	Efon Alaaye	58	Emekutu	74	Gbawojo	91	Tokun Idode
11	Igbariam	27	Uyanga	43	Eporo	59	Gbarada	75	Idona	92	Ehuda
12	Nkwele Ogidi	28	Abavo Aganika- Ehu	44	Oke Ako	60	Odu-Ogbo- aga	76	Matale	93	Degema
13	Elebele	29	Ellu	45	Agboagazi	61	Ofabo	77	Onikoko	94	Ekutche Rum- uekpe Rumuada
14	Ogboloma	30	Obetim-uno	46	Akpugocze	62	Ugwuoda	78	Apefo - Idare	95	Ogbakiri
15	Otuoke	31	Amoji	47	Amoji	63	Arandun	79	IBUJI	96	Umuagbai
16	Tungbo	32		48		64	Babanla	80	Ikoyi	97	Chokocho
								81	Imoru	98	Yeghe

Figure 2. Sampled villages across the states in the major cassava producing belts of Nigeria.

## Results

### Occurrence and distribution of cassava weeds of cassava in Nigeria

Generally, 24 common weeds are found across the main cassava growing agroecological zones of Nigeria. They comprise both monocotyledonous and dicotyledonous weeds of arable and plantation crops. The most common are weeds from the Poaceae family (Table 2). These are monocotyledonous perennial grass weeds of wetland or forest savanna and derived savanna areas, with erect stems, normally 50–200 cm in height and reproduce from seeds or vegetatively from stem shoots or rhizomes. Those found include guinea grass (*Panicum maximum*), spear grass (*Imperata cylindrica*), broad carpet grass (*Axonopus compressus*), feathery pennisetum (*Pennisetum polystachion*), itch weed (*Rottboella conchinchensis*), ganber grass (*Andropogon gayanus*), bull grass (*Eleusine indica*), and rice grass paspalum (*Paspalum Commersonii*) (Appendix 2). Also found are herbaceous annual or perennial weeds of the Commelinaceae family. These are dicotyledonous weeds of forest zones with succulent stems, between 30 and 110 cm high and reproduce from seeds and vegetatively from creeping stems. Common ones found are tropical spiderworth (*Commelina bengalensis*) and *Commelina erecta*. Other weeds of cassava found in the area are erect, fleshy perennial herbs found in fallow and waste places (water leaf—*Talinum triangulare*, *Dioda scandens*),

**Table 2. Common weeds of cassava in Nigeria.**

Code	Common name	Botanical name	Family
1	Tropical spiderworth	<i>Commelina bengalensis</i>	Commelinaceae
2		<i>Commelina erecta</i>	Commelinaceae
3	Siam weed	<i>Chromolaena odorata</i>	Asteraceae
4	Guinea grass	<i>Panicum maximum</i>	Poaceae
5	Spear grass	<i>Imperata cylindrica</i>	Poaceae
6	Broad carpet grass	<i>Axonopus compressus</i>	Poaceae
7		<i>Pennisetum perperum</i>	Poaceae
8	Feathery pennisetum	<i>Pennisetum polystachion</i>	Poaceae
9	Bahama grass	<i>Cynodon dactylon</i>	Poaceae
10	Itch weed	<i>Rottboella conchinchensis</i>	Poaceae
11	Ganber grass	<i>Andropogon gayanus</i>	Poaceae
12	Bull grass	<i>Eleusine indica</i>	Poaceae
13	Rice grass paspalum	<i>Paspalum Commersonii</i>	Poaceae
14	Sensitive plant	<i>Mimosa pudica</i>	Mimosaceae
15	Haemorrhage plant	<i>Aspilia africana</i>	Asteraceae
16	Nut grass	<i>Cyperus rotundus</i>	Cyperaceae
17	Bracken fern	<i>Pteridium aquilinum</i>	Dennstaedbiaceae
18		<i>Dissotis erecta</i>	Melastemataceae
19	Broom weed	<i>Sida acuta</i>	Malvaceae
20		<i>Combretum racemosium</i>	Combretaceae
21		<i>Dioda scandens</i>	Rubiaceae
22	Waterleaf	<i>Talinum triangulare</i>	Portulacaceae
23	Yellow nutsedge	<i>Cyperus esculentus</i>	Cyperaceae
24	Purple witch weed	<i>Striga hermonthica</i>	Scrophulariaceae

Source: Field survey 2004.

rhizomatous tuberous sedges (nut grass—*Cyperus rotundus*), scrambling perennial herbs (Haemorrhage plant—*Aspilia africana*), climbing shrubs that reproduce from seeds and basal shoot regrowth and are troublesome in cassava, maize, and no-till cultivation (*Combretum racemosus*), and the diffuse, rapidly growing perennial shrub (Siam weed—*Chromolaena odorata*) which occurs widely within the coastal fringes of the rainforest to the southern edge of Guinea savanna and constitutes a major problem on open cultivated fields.

The most widely distributed weeds of cassava are *Imperata cylindrica*. It occurs in 53.5% of the sampled communities (Table 3). Next are *Chromolaena odorata* (24.2%) and *Panicum maximum* (24.2%), followed accordingly by *Commelina bengalensis* (18.2%), *Mimosa pudica* (13.1%), *Axonopus compressus* (12.1%), and *Cynodon dactylon* (11.0%). Others are *Pennisetum polystachion* (8.1%), *Dissotis erecta* (7.1%), *Rottboella conchinchensis*, and *Talinum triangulare* with 6.1% each occurrence.

The distribution of the weeds varies across agroecological zones. As shown in Table 3 and Figure 3, *Imperata cylindrica*, *Commelina bengalensis*, and *Chromolaena odorata* occur in all the zones. While *Imperata* is predominant in the north-central (68.2%), southeast (63.6%), and south-south (47.1%) zones, *Chromolaena odorata* and *Panicum maximum* are the major weeds of cassava in the southwest zone and occur in 66.7% and 38.1%, respectively, of the sampled communities in the zone. *Commelina bengalensis* is common mainly in the north-central zone (45.5%), 17.6% is found in the south-south, and less than 5.0% in southwest and southeast zones. *Pennisetum polystachion* is found only in the north-central zone (36.4%). *Rottboella conchinchensis* is present in north-central (13.6%) and south-south (8.8%) zones only while *Axonopus compressus* is found only in the southeast (36.4%) and south-south (12.1%) zones.

**Table 3. Percentage distribution of major weeds of cassava across geographical zones in Nigeria.**

Weeds	Southwest	North-central	Southeast	South-south	General
<i>Commelina bengalensis</i>	4.8	45.5	4.5	17.6	18.2
<i>Chromolaena odorata</i>	66.7	22.7	13.6	5.9	24.2
<i>Panicum maximum</i>	38.1	0.0	22.7	32.4	24.2
<i>Mimosa pudica</i>	19.0	0.0	27.3	8.8	13.1
<i>Imperata cylindrica</i>	38.1	68.2	63.6	47.1	53.5
<i>Axonopus compressus</i>	0.0	0.0	36.4	11.8	12.1
<i>Dissotis erecta</i>	0.0	0.0	0.0	20.6	7.1
<i>Pennisetum polystachion</i>	0.0	36.4	0.0	0.0	8.1
<i>Cynodon dactylon</i>	14.3	9.1	0.0	17.6	11.0
<i>Rottboella conchinchensis</i>	0.0	13.6	0.0	8.8	6.1
<i>Talinum triangulare</i>	28.6	0.0	0.0	0.0	6.1

Source: Field survey 2004.

## Geographical distribution of cassava weeds in Nigeria

There is marked variation in the type and distribution of cassava weeds within states in each agroecological zone (Figure 4). In the north-central zone of Nigeria, *Imperata cylindrica* ranks as the most widely distributed weed. Generally, it is present in 68.2% of the communities, and found predominantly in Benue and Kwara states (80% each) and less in Kogi (66.7%) and Nassarawa (50.0%) states. As shown in Table 4, the next is *Commelina bengalensis*; it occurs in 45.5% of the communities and found only in Kogi (67.0%), Kwara (60.0%), and Nasarawa (50.0%) states. *Pennisetum polystachion* is present in Benue (100.0%) and Kwara (60.0%) states only, while *Chromolaena odorata* is present in Kwara (80.0%) and Nasarawa (17.0%) states only. Other weeds found in the zone occur only in one state. These are *Cyperus rotundus*, *Cynodon dactylon*, *Rottboella conchinchensis*, and *Striga hermonthica* in Nasarawa State, *Sida acuta* in Benue, and *Andropogon gayanus* and *Cyperus esculentus* in Kogi State.

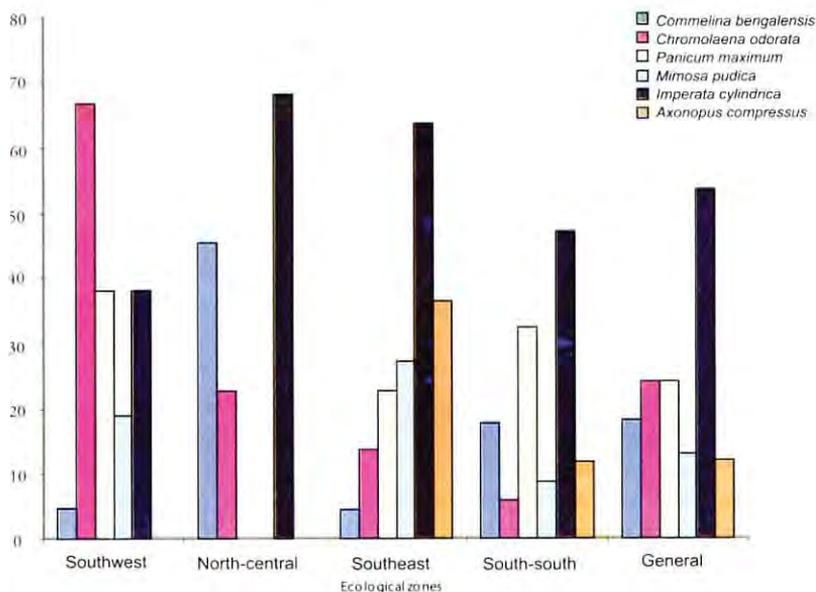
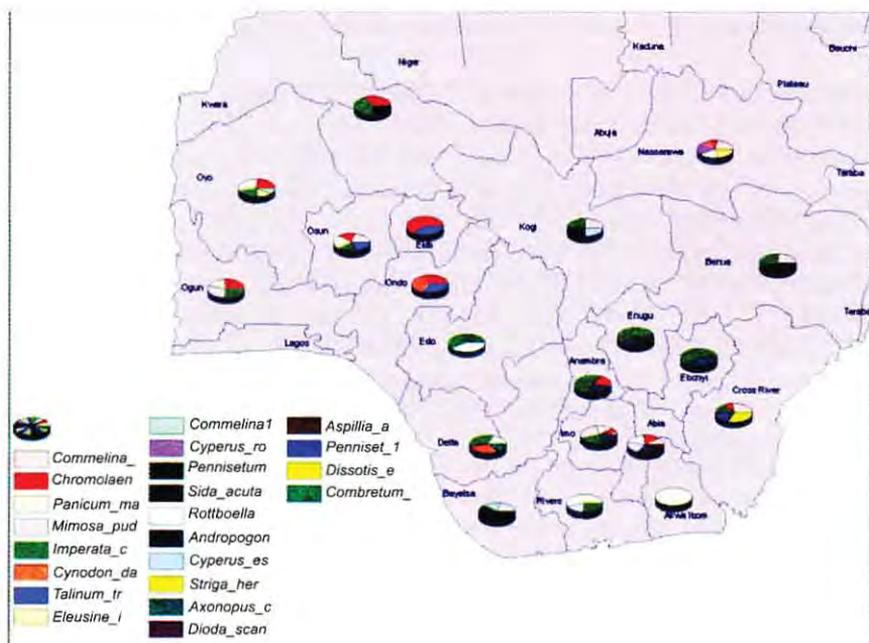


Figure 3. Percentage distribution of major cassava weeds across ecological zone of Nigeria.



**Figure 4. Geographical distribution of weeds in cassava producing agroecological zone of Nigeria.**

With specific reference to states, the major weeds of cassava in Benue are *Pennisetum polystachion* (100.0%), *Imperata cylindrica* (80.0%), and *Commelina bengalensis* (60.0%); Kwara—*Chromolaena odorata* (80.0%), *Imperata cylindrica* (80.0%), and *Pennisetum polystachion* (60.0%); Nasarawa—*Striga hermonthica*, *Imperata cylindrica*, *Rottboella chinchensis*, and *Commelina bengalensis* (50.0% each), and Kogi State— *Commelina bengalensis* (67.0%), *Cyperus esculentus* (67.0% each), and *Imperata cylindrica* and *Andropogon gayanus* (66.7% each) (Table 4 and Appendix 3-1). However, the intensity of occurrence of these weeds is relatively higher in Kogi (28.1%) and Nasarawa states (29.8%) than in Benue (22.8%) and Kwara (19.3%) states (Table 4).

**Table 4. Percentage distribution of cassava weeds among selected states in north-central zone of Nigeria.**

State	Benue	Kwara	Nassarawa	Kogi	General	Rank in occurrence
Number of villages	5.0	5.0	6.0	6.0	22.0	
<b>Weeds</b>						
<i>Commelina bengalensis</i>	60.0	0.0	50.0	67.0	45.5	2.0
<i>Chromolaena odorata</i>	0.0	80.0	17.0	0.0	22.7	4.0
<i>Imperata cylindrica</i>	80.0	80.0	50.0	66.7	68.2	1.0
<i>Cyperus rotundus</i>	0.0	0.0	33.0	0.0	9.1	
<i>Pennisetum polystachion</i>	100.0	60.0	0.0	0.0	36.4	3.0
<i>Sida acuta</i>	20.0	0.0	0.0	0.0	4.5	
<i>Cynodon dactylon</i>	0.0	0.0	33.0	0.0	9.1	
<i>Rottboellia cochinchinensis</i>	0.0	0.0	50.0	0.0	13.6	7.0
<i>Andropogon gayanus</i>	0.0	0.0	0.0	66.7	18.2	5.0
<i>Cyperus esculetus</i>	0.0	0.0	0.0	67.0	18.2	5.0
<i>Striga hermonthica</i>	0.0	0.0	50.0	0.0	13.2	7.0
Total	22.8	19.3	29.8	28.1	100.0	

Source: Computed from field survey data 2004.

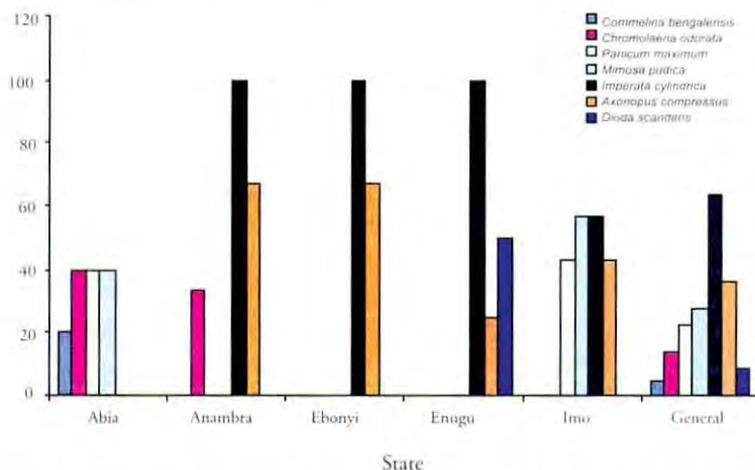
In the southeast zone, *Imperata cylindrica* and *Axonopus compressus* are the only weeds occurring consistently in all the states except in Abia State. *Imperata* is the dominant weed and occurs in 63.6% of the communities. It is found in Anambra (100.0%), Ebonyi (100.0%), Enugu (100.0%), and Imo states (57.1%). As shown in Figure 5, *Axonopus compressus* occurs in 36.4% of the communities and is present in Anambra (67.0%), Ebonyi (67.0%), Imo (43.0%), and Enugu (25.0%) states. *Mimosa pudica* and *Panicum maximum* occur only in Imo (57.0 and 43.0%, respectively) and Abia (40.0% each) states, while *Chromolaena odorata* occurs only in Abia (40.0%) and Anambra states. *Commelina Bengalensis* and *Dioda scandens* are found only in Abia (20.0%) and Imo states (50.0%), respectively (Appendix 3-2).

Out of the seven major cassava weeds found in southeast zone, Imo and Abia states have the highest number of weed species (four each), more than Anambra (3), Ebonyi (2), and Enugu states (3). However, the intensity of occurrence of these weeds is relatively higher in Imo and Abia states (57.1% each) than in Anambra (42.9%), Ebonyi (28.6%), and Enugu (42.9%) states (Table 5).

**Table 5. Percentage distribution of cassava weeds among selected states in north-central zone of Nigeria.**

State	Abia	Anambra	Ebonyi	Enugu	Imo	General	Rank in occurrence
Number of villages	5	3	3	4	7	22	
Weeds							
<i>Commelina bengalensis</i>	20.0	0.0	0.0	0.0	0.0	4.5	7
<i>Chromolaena odorata</i>	200.0	33.3	0.0	0.0	0.0	13.6	5
<i>Panicum maximum</i>	100.0	0.0	0.0	0.0	42.9	22.7	4
<i>Mimosa pudica</i>	100.0	0.0	0.0	0.0	57.1	27.3	3
<i>Imperata cylindrica</i>	0.0	100.0	100.0	100.0	57.1	63.6	1
<i>Axonopus compressus</i>	0.0	66.7	66.7	25.0	42.9	36.4	2
<i>Dioda scandens</i>	0.0	0.0	0.0	50.0	0.0	9.1	6
Total	57.1	42.9	28.6	42.9	57.1	100.0	

**Source:** Computed from field survey data 2004.



**Figure 5. Percentage occurrence of cassava weeds in the southeast zone, Nigeria.**

The south-south zone has the highest variability in occurrence and distribution of weeds. Fourteen weed species affect cassava in the zone. *Imperata* is the most common and dominant weed and occurs in four states (Cross River—43.0%, Delta—86.0%, Edo—80.0%, and Rivers—43.0%) out of the six states in the zone. Next is *Panicum maximum* which is found in Akwa Ibom (50.0%), Delta (42.9%), and Rivers (85.7%) states. Other weeds occur sole in each state (Appendix 3-3). These include *Commelina Bengalensis* and *Chromolaena odorata* in Cross River; *Cynodon dactylon* and *Combretum racemosiumis* in Delta. *Cyperus*

**Table 6. Percentage distribution of cassava weeds among selected states south-south zone of Nigeria.**

State	Akwa Ibom	Bayelsa	Cross River	Delta	Edo	Rivers	General	Rank in occurrence
Number of villages	4	4	7	7	5	7	34	
Weeds								
<i>Commelina bengalensis</i>	0.0	0.0	86.0	0.0	0.0	0.0	17.6	4
<i>Chromolaena odorata</i>	0.0	0.0	29.0	0.0	0.0	0.0	5.9	
<i>Panicum maximum</i>	50.0	0.0	0.0	42.9	0.0	85.7	32.4	2
<i>Mimosa pudica</i>	0.0	25.0	0.0	0.0	0.0	29.0	8.7	
<i>Imperata cylindrica</i>	0.0	0.0	43.0	86.0	80.0	43.0	47.1	1
<i>Axonopus compressus</i>	50.0	0.0	14.0	0.0	20.0	0.0	11.8	5
<i>Aspilia Africana</i>	25.0	0.0	0.0	0.0	0.0	0.0	2.9	
<i>Pennisetum perpetuum</i>	0.0	75.0	43.0	0.0	0.0	0.0	17.6	4
<i>Cyperus rotundus</i>	0.0	25.0	0.0	0.0	0.0	0.0	2.9	
<i>Disotis erecta</i>	0.0	0.0	100.0	0.0	0.0	0.0	20.6	3
<i>Cynodon dactylon</i>	0.0	0.0	0.0	86.0	0.0	0.0	17.6	4
<i>Combretum racemosium</i>	0.0	0.0	0.0	29.0	0.0	0.0	5.9	
<i>Rottboella conchinchensis</i>	0.0	0.0	0.0	0.0	60.0	0.0	8.8	
<i>Paspalum Commersonii</i>	0.0	0.0	0.0	0.0	0.0	57.1	11.8	5
Total	6.9	6.9	30.6	23.6	11.1	20.8	100.0	

**Source:** Computed from field survey data 2004.

*rotundus* in Bayelsa, *Cynodon dactylon* and *Rottboella conchinchensis* in Edo, and *Paspallum commersonii* in Rivers. As shown in Table 6, Cross River State has the highest concentration of cassava weeds (six species—30.6%) than other states (three each in Akwa Ibom, Bayelsa, and Edo, and four in Delta and Rivers). Generally, the intensity of occurrence is higher in Cross River (30.6%), Delta (23.6%), and Rivers (20.8%) than in Edo (11.1%), Bayelsa (6.9%), and Akwa Ibom (6.9%) states (Table 6).

*Chromolaena odorata* is the most widely distributed weed in the southwest zone. It occurs in all the sampled states and is found in 66.7% of the communities. However, it is more predominant in Ogun and Ekiti states (100.0%) than in Ondo (60.0%), Oyo (50.0%), and Osun (33.0%) states. Next are *Imperata cylindrica* and *Panicum maximum*, which are found in Ogun, Oyo, and Osun states (Table 6). *Talinum triangulare* is common only in Ondo (60.0%), Ekiti (67.0%), and Osun (33.0%) states. Other weeds with limited occurrence in only one state are *Commelina bengalensis*, found in Osun State (33.0%), *Mimosa pudica* in Ogun State (100.0%), *Cynodon dactylon* in Ondo State (60.0%), *Eleusine indica* in Oyo State (33.0%), and *Commelina erecta* in Oyo State (17.0%). In addition, there are variations in occurrence across communities in each state (Appendix 3–4).

**Table 7. Percentage distribution of cassava weeds among selected states southwest zone of Nigeria.**

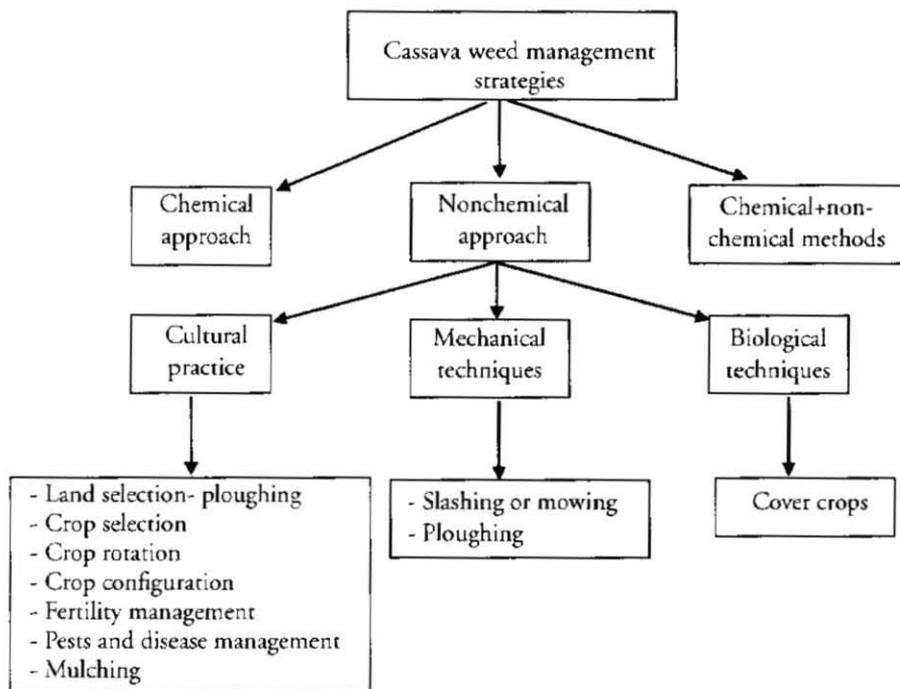
State	Ondo	Ogun	Oyo	Ekiti	Osun	General	Rank
Number of villages	5	4	6	3	3	21	
Weeds							
<i>Commelina bengalensis</i>	0.0	0.0	0.0	0.0	33.0	4.8	
<i>Chromolaena odorata</i>	60.0	100.0	50.0	100.0	33.0	66.7	1
<i>Panicum maximum</i>	0.0	75.0	67.0	0.0	33.0	38.1	2
<i>Mimosa pudica</i>	0.0	100.0	0.0	0.0	0.0	19.0	5
<i>Imperata cylindrica</i>	0.0	100.0	50.0	0.0	33.0	38.1	2
<i>Cynodon dactylon</i>	60.0	0.0	0.0	0.0	0.0	14.4	
<i>Talinum triangulare</i>	60.0	0.0	0.0	67.0	33.0	28.6	4
<i>Eleusine indica</i>	0.0	0.0	33.0	0.0	0.0	9.5	
<i>Commelina erecta</i>	0.0	0.0	17.0	0.0	0.0	4.8	
Total	19.1	31.9	27.7	10.6	10.6	100.0	

**Source:** Computed from field survey data 2004.

Generally, Oyo and Osun states have the highest number of weed species (five each). Conversely, the intensity of occurrence is higher in Ogun State (31.9%) than in Oyo (27.7%), Ondo (19.1%), Ekiti (10.6%), and Osun (10.6%) states. This variation arises because three out of the four cassava weeds found in Ogun are present in all the communities (100.0%) within the state (Table 7).

## Management of cassava weeds

The strategies used by farmers to control weeds in the cassava growing ecologies of Nigeria can be categorized into three broad groups. These are nonchemical, chemical, and various combinations of both chemical and nonchemical techniques. The nonchemical approach can be further subdivided into three groups, namely, cultural, mechanical, and biological practices (Figure 6). The primary aim of the farmers is to manage the weed population within the limits of economic threshold (that is below a level that reduces economic return). This is done through the application of cost saving weed control technologies to increase crop yield and obtain higher economic returns.



**Figure 6. Strategies and techniques for the management of cassava weeds.**

Farmers commonly use nonchemical methods to control weeds in cassava farms. These include mechanical techniques such as slashing with a cutlass, deep tillage, burning, and hand pulling; and cultural practices like cultivating land with low weed infestation, crop rotation, good crop combination, adequate fertilizer application, mulching, and good management of pest and diseases. In recent times, biological control involving the planting of cover crops (e.g., *Mucuna* sp.) have been used to smother *Imperata cylindrica* in cassava farms in the north-central zone of Nigeria. Chemical control has been introduced, but its use has been limited by non-availability of the right herbicides at the right time and place, high costs, inexperience, fear of crop damage, and health and environmental hazards (IITA-DFID 2002).

These techniques are highlighted below.

## **Nonchemical control**

### *Cultural practices*

Farmers select or move to land, mostly virgin land, with a history of low infestation, especially land with perennial weeds such as *Imperata cylindrica*. This is largely due to the prevalence of *Imperata* infestation in most of the cassava growing ecologies of the country. Crops that compete well with weeds are often times used by farmers, particularly the literate and large-scale producers, to control weeds in cassava. These include the planting of leguminous crops such as melon and cowpea in cassava fields shortly after crop establishment. Cover crops such as *Mucuna* sp. are planted in cassava farms after first hand weeding and on land intended for cassava and yam cultivation in the derived savanna zones of Cross River and Benue states in south-south and north-central zones, respectively. Though burning is used primarily as a cheap means of land clearing, it is also used by farmers to control grassy weeds like *Imperata* and *Panicum maximum* in the north-central zone. Legislation against bush burning in some communities within the south-south and north-central zone has helped to reduce the spread of the noxious rhizomatous weed, *Imperata cylindrica*, through the provision of adequate regrowth to shade the weed.

Farmers are gradually adopting the use of crop rotation to control weeds in cassava. Other cultural practices are the use of adaptive, vigorous disease varieties, crop varieties, narrower row spacing, and proper plant densities to assure rapid formation of crop canopy to suppress weed infestation. In addition, farmers have resorted to correct timing of planting to reduce the time lag between seedbed preparation and seeding, to prevent early emergence of weeds to compete with crops. Research institutes are promoting adequate fertilization and appropriate insect and disease control among farmers to enhance crops' competitive ability, and assure rapid, uniform germination and good crop growth. Mulching of crops is a technology being pushed to conserve soil moisture and control herbaceous weeds in cassava.

### *Mechanical practices*

Farmers basically remove weeds mechanically through hand pulling, slashing with a cutlass, hoeing, deep tillage, mowing, and the use of primary and secondary tillage implements

such as the rotary hoe (mainly in mechanized farms). A modern implement used to manage weeds that has emerged in well-spaced crop farms is the row cultivator. A few farms in the north-central zone of Nigeria have used row cultivators to dislodge or cover young weeds and weed seeds may be used to manage emerged weeds. Mowing prevents the production of weed seeds and kills upright weeds, reducing competition. However, it requires careful timing to prevent the growth of biennial weeds when reducing competition from upright plants. Timely, repeated mowing also helps deplete the food reserves of perennial weeds. Mechanical control is not very effective as it relies on relatively dry weather and depends on labor availability for repeated operation.

#### *Biological practices*

Cover crops have been used to suppress the development of weeds, particularly *Imperata cylindrica* in the north-central states of Nigeria. Though cover crop systems hold great potential in adequately controlling small-seeded annual broadleaf weeds such as *Talinum triangulare* and *Commelina* sp., they have not been exploited to control these weeds in cassava. Other biological management systems using diseases or insects to control problematic weeds are not common, and they are still at an experimental stage.

A summary of some of the nonchemical weed-management practices is provided in Table 8.

**Table 8. Nonchemical weed-management practices.**

Practice	Comments
<b>Cultural</b>	
1. Land selection	Avoid fields with a history of weed problems.
2. Crop selection	Grow the most competitive crops in fields with a history of weed problems.
3. Crop rotation	Rotate between cassava and nonrow crops such as cowpea. Rotate between crops in different botanical categories.
4. Adapted crop varieties	Select crop varieties adapted for your area.
5. Proper row spacings and plant densities	Use row spacings and plant densities that assure rapid crop-canopy closure.
6. Correct planting times	Plant crops when soil temperatures favor rapid germination and emergence.
7. Appropriate fertility, disease, and insect management	Vigorous, healthy crops are more competitive against weeds.
8. Mulch	Natural mulches are difficult to use over large acreages. Synthetic (plastic) mulches are useful to manage weeds within the row in warm-season crops. Consider disposal problems when using plastic mulches.
<b>Mechanical</b>	
1. Moldboard ploughing	Can eliminate emerged annual weeds.
2. Rotary hoeing	Not very useful to control weeds in cassava. Effective to manage small-seeded weeds in large-seeded crops such as maize and cowpea.
3. Row cultivating	Dislodge or cover many weed seedlings as possible. Avoid damaging crop root systems.
4. Mowing	Mow weeds as soon as flowers appear so no viable weed seed is produced.
<b>Biological</b>	
1. Cover crops	Still experimental.
2. Insect or disease pests of weeds	No current system uses insects or diseases to manage weeds common to cassava.

**Source:** Adapted from Illinois Agricultural Pest Management Handbook 2003.

## Chemical weed-management strategies

Chemical control of weeds is the most effective method of managing weeds in cassava. A review of it requires that the correct herbicide be used at a given rate to avoid potential environmental hazards such as human poisoning, damage to crops, soil and water contamination, etc. that may arise from misuse of the chemical. Herbicides commonly found and used in Nigeria to control broad-leaved and grass weeds in cassava, the recommended rates and time of application as well as their availability status are shown in Table 9. Farmers particularly in the high cassava producing north-central zone use glyphosate and fusillade to control *Imperata cylindrica*. Though atrazine commonly called primextra has been used to control most annual grasses and broad-leaved weeds of cassava, its variant, rhonazine is particularly effective in the control of itch grass (*Rottboellia conchinchensis*), a major weed of cassava in Nasarawa and Edo states.

In the cassava producing ecologies of Nigeria, farmers also use nonchemical methods to control secondary weeds that emerge after the chemical control of the primary weeds on their farms. This is because cassava is a long season crop. Consequently, integrated weed control is most effective in the control of weeds in cassava. Farmers realize a gross margin of ₦33 813.00/ha from speargrass-infested cassava farms weeded with the combination of glyphosate and *Mucuna* as against ₦12 450.0/ha from hand-weeded farms (Ibana 2005). Besides, 352.2% and 182.8% of family labor are saved when herbicides are used alone and when it is combined with *Mucuna* respectively, instead of hand weeding to control *Imperata* in cassava–yam dominated enterprises in the north-central zone of Nigeria. The best integrated approach recommended for effective control of weeds in cassava is using half of the recommended dose of herbicide, plus good seedbed preparation (if tillage or any other form of cultivation is required), planting cassava cultivars with branching canopy, and a planting density of 10 000 to 15 000 plants/ha (IITA 2003). In addition, farmers are expected to observe safety precautions in the handling and use of herbicides to avoid environmental hazards and enhance herbicide efficacy. These requirements are as follows:

- Use personnel with good skill in chemical weed control application. This is most important for postemergence application in cassava to avoid direct or drift damage to crop.
- Application should be done only under favorable environmental conditions as weather conditions affect herbicide performance. Unfavorable conditions are:
  - periods of temperature inversion, to avoid drift, reduced efficiency and damage to crops,
  - immediately after rainfall or when rain threatens to fall, to avoid dilution of spray volume and reduced efficacy, and
  - when there is an extended or extremely dry spell.
- Use standard spray volume required for each herbicide application. For a spray volume of 200 liters per hectare, the walking speed should be at least one meter per second (1 m/s). This might be difficult to achieve in reality due to differences in individual customary walking pace. Therefore, sprayer calibration is necessary for effective chemical weed control in crops. In sprayer calibration, three variables affect

**Table 9. Herbicides for weed control in cassava.**

Herbicides	Rate (Kg ai/ha)	Time of application	Weed control spectrum	Availability
Metolachlor or Alachlor (Dual Gold -960EC or Lasso)	2.0-3.0	Pre-emergence	Annual grasses only in cassava	Available in Nigeria, Syngenta
Atrazine + metolachlor (Primextra Gold 660SC)	1.0-2.0	Pre-emergence	Controls most annual grasses and broad-leaved weeds except itchgrass, in cassava, cassava/maize/yam	Available in Nigeria, Syngenta
Atrazine+pendimethalin (Atrazine 500S or 80WP or Rhonazine 80WP + Stomp 500EC)	1.0-1.5	Pre-emergence	Most annual weeds including itchgrass	Available in Nigeria, as individual formulations of Atrazine or Rhonazine 80WP and Pendimethalin or Stomp 500EC
Oryzalin + metolachlor (Surflan 480SC + Dual Gold 960EC)	0.75 + 0.75	Pre-emergence	Most annual weeds in cassava	Dual Gold available now. Surflan availability is doubtful
Fluonofuron	2.0-3.0	Pre-emergence	Broad-leaved weeds in cassava, cassava/cocoyam	Availability is doubtful
Metrobromuron + metolachlor	2.0-4.0	Pre-emergence	Broad-leaved weeds and grasses in cassava/maize, cassava/cowpea	Availability is doubtful. Metolachlor available as Dual Gold
Fluometuron + Metolachlor (Cooran multi 500EC)	2.0-3.0	Pre-emergence	Controls most annual weeds except itchgrass	Availability is doubtful
Diuron+paraquat (Gramuron)	2.0-3.0 or 2.0-3.0 + 0.2-0.8	Early post-emergence	Most annual weeds, early post emergence, at 4-8 WAP and direct spray (to the weed) with shield	May be available
Fluazifop-p-butyl (FusiladeForte 150EC)	(a) 0.3-0.5 (b) 0.5-0.75	Postemergence	(a) Annual grasses (b) Perennial grasses including speargrass. Must be applied between 8-10 WAP	Available in Nigeria, Syngenta
Glyphosate (Touchdown forte, Roundup, Sarosate, Delsate)	1.0	Preplant and post to weeds	All annual and perennial weeds. Must be directed spray (to the weed) with shield as from 10 WAP. This is commonly practiced where speargrass is a problem. It is best for preplant vegetation control of both annual and perennial weeds	Available in Nigeria, Syngenta, Candel, Saroagrochemicals, etc.

**Source:** Field survey of agrochemicals in Nigeria 2004.

## Economics of weed control in cassava

Experimental results of gross margin (GM) analysis for the control of *Imperata cylindrica* (dominant weed of cassava in Nigeria) in cassava production under different *Imperata* management technologies in the north-central states are shown in Table 10. The table reveals that *Imperata*-infested cassava farms treated with herbicide produce higher gross margins than hand-weeded farms. Gross margins of ₦38 325.0, ₦33 813.0, and ₦16 800.0 per hectare are obtained from farms treated with glyphosate, glyphosate combined with *Mucuna*, and fusilade respectively; while hand-weeded farms produce an average gross margin of ₦12 450.0 per hectare. The lowest gross margin is from farms weeded with hand weeding and *Mucuna* (₦2788.0 per hectare).

As shown in Figure 7, glyphosate-based farms produce higher gross margin, than those treated with fusilade. This difference could be due to the high yield associated with glyphosate (Table 10), and differences in cost and quantity of fusilade required per hectare (recommended rates and unit cost of herbicides are: 8 liter/ha of fusilade—₦1200.0/liter, 3 liter/ha of glyphosate—₦900.0 per liter<sup>1</sup>).

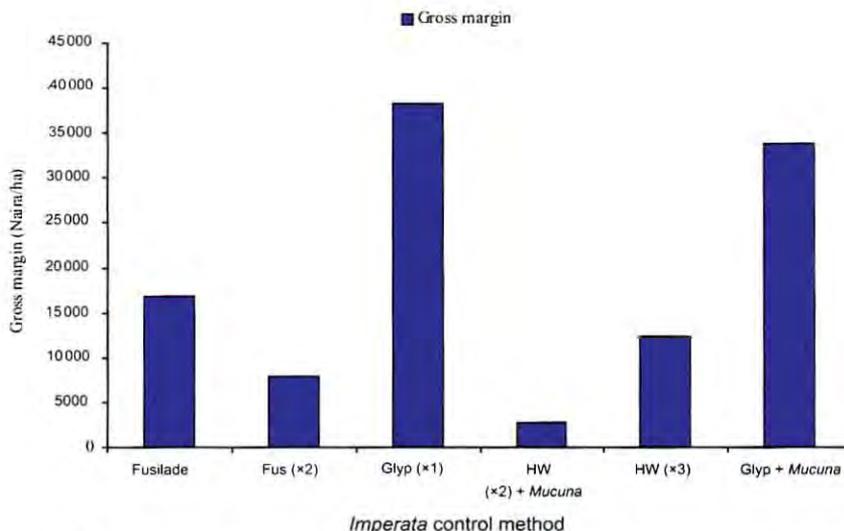
In addition, the herbicide-based farms have lower variation in gross margins than hand-weeded farms. For instance, the coefficients of variation (CV) are 24.89, 23.27, and 55.45% for glyphosate, fusilade (×2) and the combination of glyphosate and *Mucuna*, respectively, while it is 192.80% for hand weeding and 95.35% for the combination of hand weeding and *Mucuna* (Table 10). Implicitly, farmers that use hand weeding to control *Imperata cylindrica* in cassava are more vulnerable to income risk than users of chemical-based methods.

**Table 10. Gross margin in cassava production under different *Imperata* management technologies (Naira/ha).**

<i>Imperata</i> control method	Average yield (Kg/ha)	Mean gross margin (Naira/ha)	Min. value	Max. value	Standard deviation	CV (%)
Fusilade	13 350.00	16 800.00	7 350.00	26 250.00	8 497.47	50.58
Fusilade (×2)	10 358.33	7 825.00	5 250.00	9 750.00	1 820.92	23.27
Glyphosate (×1)	17 625.00	38 325.00	27 150.00	51 450.00	9 539.69	24.89
Hand weeding (×2) + <i>Mucuna</i>	12 433.33	2 788.00	-4512.00	8 988.00	5 375.50	192.81
Hand weeding (×3)	17 483.33	12 450.00	-1000.00	29 600.00	11 870.93	95.35
Glyphosate + <i>Mucuna</i>	17 625.00	33 813.00	13 338.00	56 838.00	18 747.66	55.45

Ibana 2005.

<sup>1</sup>Application rates are optimum rates for *Imperata* in the area (Chikoye et al. 1999), while prices are the average market price of these herbicides in 2002 cropping season in the study area.



**Figure 7. Gross margin in cassava production under different *Imperata* management technologies.**

Dominance analysis reveals that glyphosate is the best technique in the control of *Imperata* in cassava, as the high cost arising from the other treatments did not lead to a higher gross margin. This is followed by the combination of herbicide and *Mucuna* in cassava. Since costs of herbicides and labor for weeding vary across communities in different agroecological zones of the country, chemical control of *Imperata* or other weeds may not necessarily be the best for other agroecological zones. However, it is well known that herbicide-based control techniques produce higher yields and income and saves labor (of women and children in particular) thereby leading to overall improvement in livelihoods.

## Constraints and opportunities for sustainable control of cassava weeds in Nigeria

The major factors affecting the effective control of weeds by farmers in the cassava growing agroecologies of Nigeria are:

- Unavailability and high cost of herbicides.
- Lack of requisite experience and skills in the use of herbicides.
- Limited supply of labour for non-chemical control of weeds.
- Lack of capital to procure modern equipment for weeding.
- Ineffectiveness of herbicides due largely to adulteration.
- Damage to crops caused by improper use of herbicides and other modern weed control methods.
- Negative human and environmental effects from the use herbicides.
- Lack of land to practice fallow, which is effective in controlling *Imperata cylindrica*.
- Lack of knowledge on the use of cover crops to control weeds.
- Lack of improved, high yielding, disease-resistant crop varieties that can compete effectively with weeds.

In spite of these problems identified by farmers, there is great potential and promise for effective control of weeds in cassava. Integrated weed techniques have been developed by research institutes basically through participatory research and extension approaches (PREA) and delivered to farmers in Nigeria, particularly those in the cassava growing zones (IITA 2003). Farmers are already using these options to control weeds in cassava-based enterprises. Agrochemical companies have opened distribution centers in various parts of the country to facilitate availability and use of agrochemicals by farmers (Appendix 4 for contact details of accredited distributors of pesticides including herbicides in Nigeria). Table 11 shows the major herbicide companies, product, institution served, and prices of herbicides in Nigeria.

**Table 11. Major companies, product, and prices of herbicides in Nigeria.**

Name of chemical company	Herbicide (Type and name)	Institutions and organizations served	Other services provided	Current wholesale price (Naira/litre)	Package
Candel	Roundup® (Glyphosate)	Farmers, government agencies, and nongovernmental organization (NGO), accredited wholesalers and retailers	Training on proper use of products	1050	1 liter
	Lasso® GD (Atrazine + Methachlor)	As for Round up above	Training on proper use of products	900	1 liter
Syngenta	Primextra Gold	As for Round up above	Training on proper use of products	1100	1 liter
	Gramoxone	As for Round up above	Training on proper use of products	825	1 liter
	Touchdown Forte	As for Round up above	Training on proper use of products	1100	1 liter
	Fusilade Forte	As for Round up above	Training on proper use of products	1960	1 liter

**Source:** Survey of agrochemical companies 2004.

## Conclusion

Cassava is a potential engine of growth in developing countries due to the efforts of government and the private sector in developing unique, value-added, cassava-based products for human consumption and industrial purposes. However, the attack of weeds has continued to plague cassava producers causing severe loss in yield; and leading to low income, soil degradation, food insecurity, and severe rural poverty among cassava growing farm families. The most widely distributed weed is *Imperata cylindrica* which occurs in 53.5% of the sampled communities. *Imperata cylindrica*, *Commelina bengalensis*, and *Chromolaena odorata* occur in all the zones. While *Imperata* is predominant in the north-central (68.2%), southeast (63.6%), and south-south (47.1%) zones, *Chromolaena odorata* and *Panicum maximum* are the major weeds of cassava in the southwest zone and occur in 66.7% and 38.1%, respectively, in the zones. *Pennisetum polystachion* is found only in the north-central zone (36.4%). *Rottboellia conchinchensis* is present in the north-central (13.6%) and south-south (8.8%) zones only while *Axonopus compressus* is found only in the southeast (36.4%) and south-south (12.1%) zones. The south-south zone has the highest variability in occurrence and distribution of weeds. Cross River State has the highest concentration (30.6%) of cassava weeds in the south-south zone, Oyo and Osun in the southwest, Abia in the southeast, and Nasarawa (29.8%) and Kogi (28.1%) in north-central zone.

Nonchemical and chemical approaches are available to control weeds but they are not being used effectively by farmers due to lack of capital and equipment, insufficient labor, non-availability of the right herbicides at the right time and place, high costs, inexperience, fear of crop damage, and human and crop poisoning as well as other environmental hazards. Integrated weed-management strategies are most effective in the control of weeds in cassava. Economics of different *Imperata* control techniques in cassava show that herbicides-based control techniques produce higher yields and income and saves labor (of women and children in particular) thereby leading to overall improvement in farmers' livelihoods. Proper calibration of sprayers and observance of safety precautions in the handling and use of herbicides are essential to enhance herbicide efficacy and avoid environmental hazards. Farmers are gradually adopting integrated technologies developed through participatory research involving scientists, farmers, and agrochemical entrepreneurs to control weeds in the cassava producing agroecological zones of the country. Therefore, linkage of farmers with agrochemical markets, training on the right use of herbicides, credit, institutional support, and adoption of integrated approaches by farmers are important to enhance sustainable control of cassava weeds in Nigeria. Great potential exists to effectively manage weeds in cassava towards increasing cassava output, income, and the food security status of cassava farmers in the country.

## References

- Akobundu, I.O. 1989 *Weed science in the tropics: principles and practice*: 465 pp.
- Akobundu, I.O. and C.W. Agyakwa. 1987. *A handbook of West African weeds*. International Institute of Tropical Agriculture, Ibadan, Nigeria. 521 pp.
- Ayeni, A.O. 1991. Hand/mechanical weed management as an option in Nigerian agriculture. *Nigerian Journal of Weed Science* 4: 71–77.
- Udensi, E.U., I.O. Akobundu, A.O. Ayeni, and D. Chikoye. 1999. Management of Cogongrass (*Imperata cylindrica*) with velvet bean (*Mucuna pruriens*) and herbicide. *Weed Technology* 13: 201–208.
- Ibana, S.E. 2005. *Economic analysis of Imperata cylindrica weed management systems in the derived savannah zone of Nigeria*. Unpublished PhD thesis, University of Ibadan, Nigeria.
- IITA-DFID. 2002. *Community workshop on Imperata management in Ekumtak village, Ogoja Local Government, Cross River State*. 18–21 March 2002 IDG/02/11. 44 pp.
- Integrated Cassava Project (ICP). 2004.
- Annual report, International Institute of Tropical Agriculture (IITA). 2003.
- Annual report, International Institute of Tropical Agriculture (IITA). 1997.



State	Village Name	GPS lat	GPS long
Ondo	Ibuji	07.45506°	005.06577°
Ondo	Imoru	6.86742	5.75833
Ondo	Apefo - Idare	7.0788	5.14272
Ondo	Itanla	7.12187	4.86644
Ondo	Ikoya	6.50942	4.69062
Ogun	Onikoko	06.93093°	003.24261°
Ogun	Matale	07.51925°	002.91025°
Ogun	Gbawojo	06.92714°	004.05023°
Ogun	Idona	06.89070°	004.00516°
Oyo	Owode	08.07188°	004.17677°
Oyo	Tokun Idode	07.87488°	004.98311°
Oyo	Igbajaye	08.23165°	003.23862°
Oyo	Idi Apa	08.73825°	003.38681°
Oyo	Ijaiye Orile	07.63098°	003.84779°
Oyo	Akanran	07.27830°	004.02616°
Ekiti	Ekporo	07.34007°	005.50066°
Ekiti	Efon Alaaye	07.65117°	004.92188°
Ekiti	Okeako	07.95547°	005.54893°
Osun	Iwaro-Ipetumodu	07.49058°	004.40515°
Osun	Wasinmi	07.44994°	004.25463°
Osun	Adana	07.68075°	004.09897°
Benue	Ankaa	06.79721°	009.02078°
Benue	Kwande	06.89911°	009.24416°
Benue	Andor	07.38445°	009.00956°
Benue	Tse-Zwa	07.37955°	008.98790°
Benue	Obagaji	07.89137°	007.90397°
Kwara	Isolo-Opin	08.07471°	005.24999°
Kwara	Bode Saadu	08.9556°	004.75372°
Kwara	Gbado	08.71905°	005.78571°
Kwara	Babanla	08.57899°	005.18875°
Kwara	Arandun	08.09221°	004.94825°
Nassarawa	Doma	08.39339°	008.34473°
Nassarawa	Arugbadu	08.76745°	008.68775°
Nassarawa	Alogani	08.67513°	008.90253°
Nassarawa	Zakum Bello	08.73138°	007.68229°

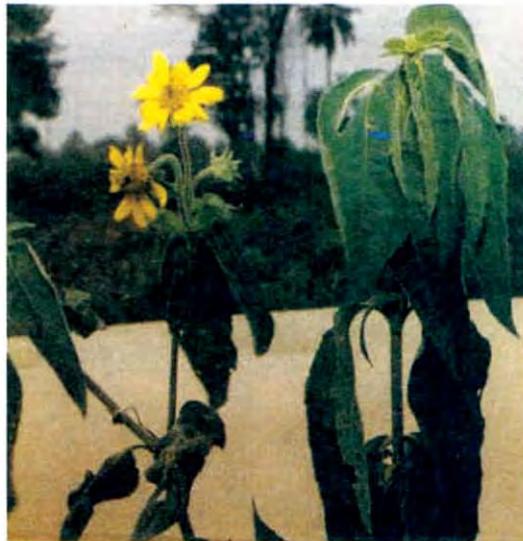
State	Village Name	GPS lat	GPS long
Nassarawa	Udege Kasa	08.25925°	007.89413°
Nassarawa	Ajaga	08.34433°	007.60291°
Kogi	Gbarada	07.96929°	006.91959°
Kogi	Angba	07.11670°	006.75354°
Kogi	Ugwuoda	07.04341°	006.73814°
Kogi	Ofabo	07.26453°	007.25904°
Kogi	Odu Ogboyaga	07.62823°	007.13173°
Kogi	Emekutu	07.45717°	007.50736°
Abia	Okwe	5.42092	7.57363
Abia	Avo Nriha	5.142802	7.38754
Abia	Umuekechi	5.06694	7.28607
Abia	Isegbu Bende	5.6431	7.6127
Abia	Akoli Imenye	5.6716	7.5548
Anambra	Igbariam	6.39527	6.94358
Anambra	Nkwele Ogidi	6.15936	6.87606
Anambra	Amamputu - Uli Village	5.79362	6.81889
Ebonyi	Nwofe	6.51143	8.16396
Ebonyi	Ndingele	6.5175	8.34536
Ebonyi	Abaomega	6.01122	8.00685
Enugu	Agboagazi	6.61064	7.5869
Enugu	Amoji Nenwe Aninri	6.13804	7.51438
Enugu	Nimbo	6.80062	7.14627
Enugu	Akpugoeze	6.12429	7.23075
Imo	Eziala	5.37425	7.12678
Imo	Ogbeke Obibiezena	5.37646	7.06594
Imo	Kalabari beach village	5.69864	6.79805
Imo	Obokofa	5.54027	6.80166
Imo	Owerri-Ebiri	5.77735	7.02181
Imo	Umuokile	5.46298	7.18706
Imo	Obinikpa	5.77083	7.35293
Akwa Ibom	Mbiaya Uruan	5.10545	7.98089
Akwa Ibom	Ikot Ekwerne Itam	5.06677	7.90155
Akwa Ibom	Ikot Ambon	4.096042	7.93483
Akwa Ibom	Ikot Ndien	4.64326	7.57493
Bayelsa	Elebele	4.85627	6.34537
Bayelsa	Otuoke	4.78665	6.31185
Bayelsa	Ogboloma	5.05076	6.33367
Bayelsa	Tungbo	5.12733	6.16775
Cross River	Gakem	06.76951°	008.99152°

State	Village Name	GPS lat	GPS long
Cross River	Uyanga	5.38355	8.26185
Cross River	Emeh Oninekpang	6.06282	8.89095
Cross River	Busanfong	6.62894	9.21684
Cross River	Ediba	5.86754	8.02692
Cross River	Ikot Nyong	5.18204	8.2709
Cross River	Ikot Offiong	4.93721	8.42012
Delta	Aganika-Ebu	6.48111	6.60903
Delta	Oroma-Ekuku Agbor	6.09323	6.30097
Delta	Abavo	6.1339	6.15236
Delta	Obetim-uno	5.74793	6.44602
Delta	Ellu	5.58488	6.28512
Delta	Ozoro	5.54689	6.23648
Delta	Ugberilkoko	5.89843	5.57467
Edo	Urhonigbe	5.99096	6.18442
Edo	Ebue-nehien	6.33117	5.86678
Edo	Afuze	6.96099	6.04013
Edo	Apana	7.13904	6.29126
Edo	Ugboha	6.73202	6.45957
Rivers	Ahoada (Ula-Ehuda)	5.10383	6.62736
Rivers	Ekutche Rumuekpe	4.98939	6.68303
Rivers	Umuagbai	4.8544	7.37546
Rivers	Yeghe	4.68664	7.34407
Rivers	Degema	4.75751	6.77341
Rivers	Umuchoko Chokocho	4.9914	7.05438
Rivers	Rumuada Ogbakiri	4.833	6.91134

A2. Common weeds of cassava in cassava producing agroecological zones of Nigeria.



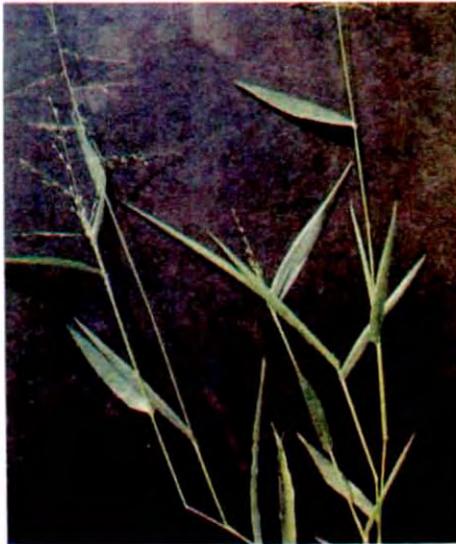
*Andropogon gayanus*



*Aspilia Africana*



*Axonopus compressus*



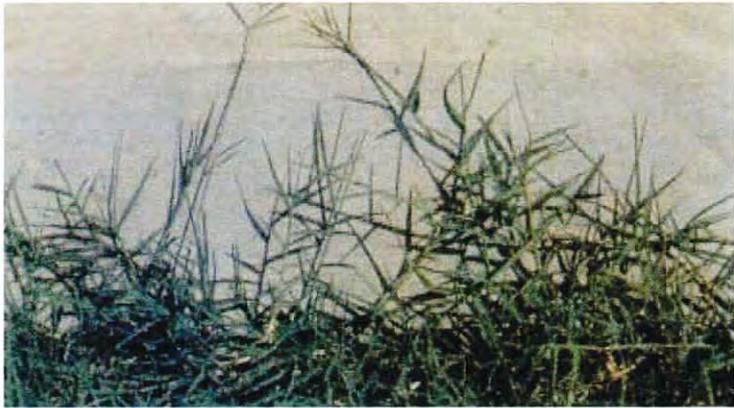
*Brachiaria deflexa*



*Chromolaena odorata*



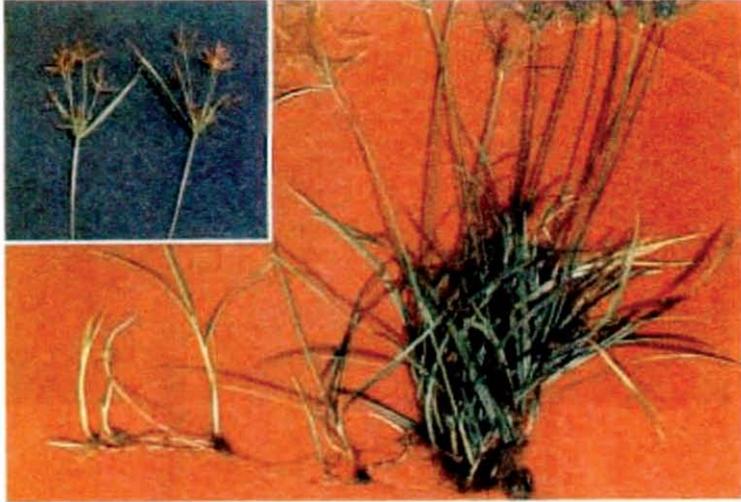
*Combretum racemosium*



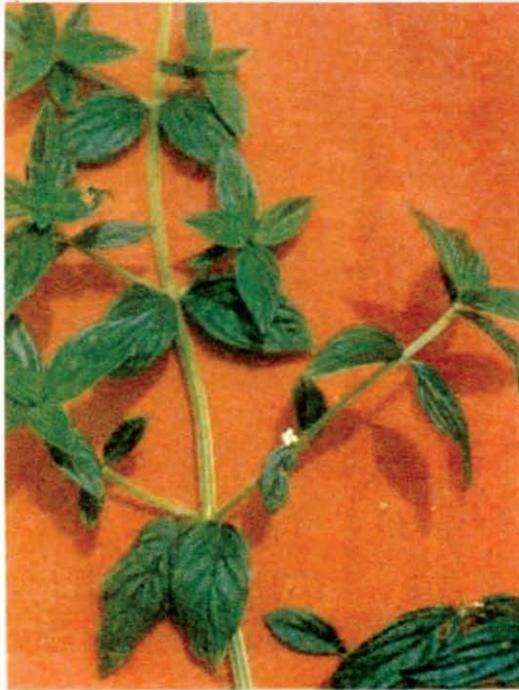
*Cynodon dactylon*



*Cyperus esculentus*



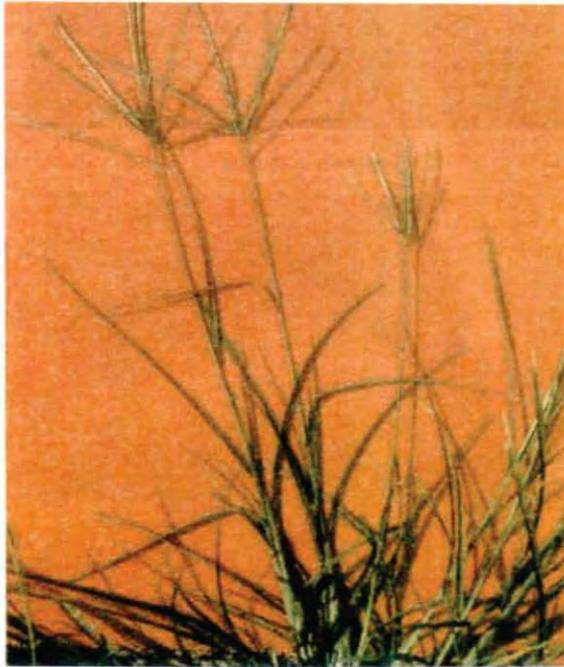
*Cyperus rotundus*



*Diodia scandens*



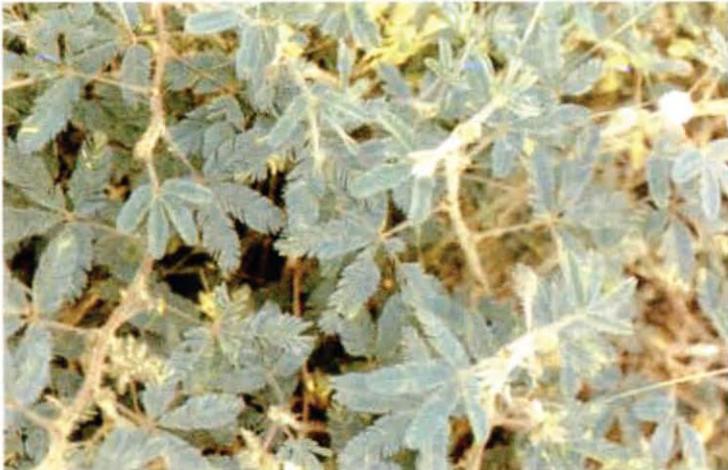
*Dissotis erecta*



*Eleusine indica*



*Imperata cylindrica*



*Mimosa pudica*



*Panicum maximum*



*Paspalum commersonii*



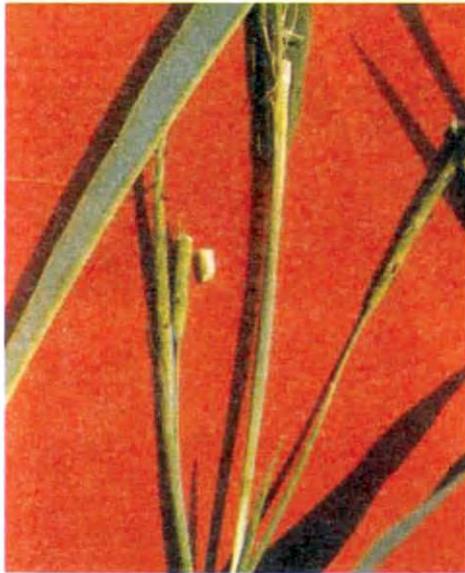
*Pennisetum pedicellatum*



*Pennisetum polystachion*



*Pteridium aquilinum*



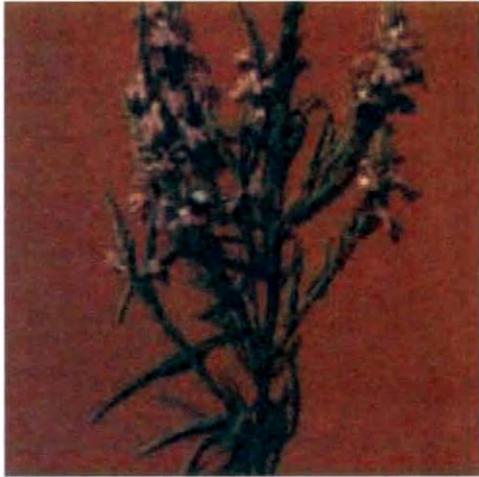
*Rottboellia cochinchinensis*



*Sida acuta*



*Rottboellia cochinchinensis*



*Striga hermonthica*



*Striga hermonthica*



*Talinum triangulare*

**A3-1. Distribution of common weeds of cassava among selected villages in states within north-central zone of Nigeria.**

State	Village number	Village	<i>Commelina bengalensis</i>	<i>Chromolaena odorata</i>	<i>Imperata cylindrica</i>	<i>Cyperus rotundus</i>	<i>Pennisetum polystachion</i>	<i>Sida acuta</i>	<i>Cynodon dactylon</i>	<i>Rottboellia ros. chinensis</i>	<i>Anatropogon gyanus</i>	<i>Cyperus esculentus</i>	<i>Striga hermonthica</i>	Total
Benue		Atkpa	1		1									3
		Kwande			1									2
		Andor	1			1								2
		Tse-Zwa			1									2
Kwara		Obagaji	1					1						4
		Isolo-Opin		1										2
		Bude Saudu		1										2
		Gbado				1								2
		Bahania		1										3
Nassarawa		Arandun		1										2
		Doma						1						2
		Arogbadu				1							1	2
		Alogani				1								4
		Zakum							1					1
		Bello											1	2
		Ulegre Kasa	1						1					4
		Ajaga	1										1	3
		Gbarada	1								1			2
		Ankpa	1								1			2
Kogi		Ugwuoda			1							1		2
		Ofoho			1							1		2
		Odu												
		Oghoyaga	1									1		4
		Emekuru	1									1		4
			10	5	15	2	8	1	2	3	4	4	3	57

**A3-2. Distribution of common weeds of cassava among selected villages in states within southeast zone of Nigeria.**

	<i>Commelina bengalensis</i>	<i>Chromolaena odorata</i>	<i>Panicum maximum</i>	<i>Mimosa pudica</i>	<i>Imperata cylindrica</i>	<i>Axonopus compressus</i>	<i>Dianda scandens</i>	<b>Total</b>
Abia	1	2	3	4	5	6	16	1
Abia	1							1
Abia		1	1	1				2
Abia		1	1					2
Abia				1				1
Anambra					1			1
Anambra					1	1		2
Anambra		1			1	1		3
Ebonyi					1	1		2
Ebonyi					1	1		2
Ebonyi					1	1		1
Enugu					1		1	2
Enugu					1			1
Enugu					1	1	1	3
Enugu					1			1
Imo				1	1			2
Imo			1	1				2
Imo					1	1		2
Imo			1	1	1	1		4
Imo								0
Imo								0
Imo	1	3	5	6	14	8	2	39

**A3-3. Distribution of common weeds of cassava among selected villages in states within southwest zone of Nigeria.**

State	Village number	Village	<i>Commelina bengalensis</i>	<i>Chromolaena odorata</i>	<i>Panicum maximum</i>	<i>Mimosa pudica</i>	<i>Imperata cylindrical</i>	<i>Cynodon dactylon</i>	<i>Tribium triangulare</i>	<i>Eleusine indica</i>	<i>Commelina erecta</i>	Total
Ondo	1	Imoru					1		1			2
	2	Apeho - Idare		1				1				3
	3	Itania		1			1					2
	4	Ikoyi		1					1			2
	5	Ibaji										0
Ogun	1	Ornikoko		1	1							4
	2	Matale		1	1		1					4
	3	Gbawojo		1	1		1					4
	4	Idora		1	1		1					3
Oyo	1	Owode			1		1			1		3
	2	Tokun Idode		1	1		1				1	4
	3	Igbayaye								1		1
	4	Idi Apa									1	1
	5	Ijaiye Orile		1	1							2
Ekiti	6	Akanran		1	1							2
	1	Ekpuro		1					1			2
	2	Efon Alaaye		1					1			2
Osun	3	Okeako		1								1
	1	Iworo-Ipetumodu	1									1
	2	Wasinmi		1			1					2
Adana	3	Adana	1	14	8	4	8	3	6	2	1	47

**A3-4. Distribution of common weeds among selected villages in states within south-south zone of Nigeria.**

	<i>Commelina repens</i>	<i>Chromolaena odorata</i>	<i>Pennisetum maximum</i>	<i>Mimosa pudica</i>	<i>Impatiens ghiesbreghtii</i>	<i>Alouatta compressa</i>	<i>Aspilia africana</i>	<i>Hemistoma peruvianum</i>	<i>Urena maritima</i>	<i>Dioscorea rotunda</i>	<i>Cyperus distachyon</i>	<i>Commersonia bartramia</i>	<i>Portulaca oleracea</i>	<i>Paspalum Commersonii</i>	Total
Akwa Ibom	1														1
Akwa Ibom			1												2
Akwa Ibom															1
Akwa Ibom															1
Bayelsa Onoche															2
Bayelsa Tungbu															1
Cross River Gakem															1
Cross River Uyanga															3
Cross River Enoch Omoikpang															3
Cross River Ruanbung															4
Cross River Ehaha															3
Cross River Ika Nyong															3
Cross River Ika Uffang															4
Delta Agulwa-Lilo															1
Delta Comua Ekuba Agbor															3
Delta Aburo															3
Delta Obetom-uro															3
Delta Fila															2
Delta Osovo															4
Delta Upperkoko															2
Edo Lifinngbe															2
Lilo Eha-ndhia															2
Edo Alize															1
Edo Ayasa															1
Edo Ughoba															2
Rivers Abuada (Ula Etudai)															3
Rivers Ewuric Rumuokpe															2
Rivers Umuagha															2
Rivers Nigbe															1
Rivers Dagana															2
Rivers Umuchoku Chikochu															1
Rivers Rantwala Ojokoku															3
	7	2	10	3	16	4	1	6	1	7	6	2	3	4	72

#### A4. Accredited distributors.

Zone	State	Company	Address	Contact
<b>West</b>				
Lagos		Koenez Chemical & Technical Company	54, Irekari Road, Isolo	01-4523261, 01-4525140.
		Oro-Ale Trading Stores	27, Idun-uagbo Avenue, Lagos.	01-2602498, 01-2640657.
		Lagos ADP	Oko-Oba Road, Agege-Lagos.	
		Lagos MANR	Secretariat Alausa	
Oyo		Collins Groupe Ltd.	N6/621B, Oyo Road, Beside Fototek, Mokola, Ibadan	02-2413167, 02-2411771
		Moafak Nigeria Ltd.	96, Iwo Road, Ibadan	02-2411805
		S.A. Adekola & Sons	Balloon Building, Iwo Road, Ibadan.	02-710367
		Farmers Support Shop	Ogunpa, Ibadan	
		Vincekol Enterprises	Ogunpa, Ibadan	
		Farmers Shopping Plaza	Ogunpa, Ibadan	
		Fitsco Nigeria Ltd.	Iwo Road, Ibadan	
		Bukedor Farm Enterprises	Iwo Road, Ibadan	
		Mama Adura Stores	Amunigun/Ogunpa Junction, Ibadan	
		Iya Dare Shop	Idikan-Ogunpa Junction, Ibadan	
		Ife Oluwa Stores	Amunigun/Ogunpa Junction, Ibadan	
		Solokad Enterprises	Amunigun Street, Ogunpa, Ibadan	
		Oyo ADP (OSADEP)	Ibadan	
		MANR	Ibadan	
		Osun		Anifowoshe Junior Ent.
Ogo-Oluwa Stores	Idasa Street, Ilesa			
Jehovah Shammah				
Osun ADP	Osogbo			
MANR	Osogbo			

**A4. Accredited distributors cont'd.**

Zone	State	Company	Address	Contact
Ogun		El-Shaddai Vet. Services	67, Totoro Road, Abeokuta 039-242462	
		Ogun State Agric. Credit Agency (OSACA)	Ogun State Radio Office, GRA, Abeokuta	Dr (Mrs) Afolami
		Ogun State Agro-Services Corporation	Asero - Abeokuta	Mr Soyole
		Ogun ADP (OGADEP)	Olabisi Onabanjo Road, Idi-Aba, Abeokuta	Mr A. Fasasi
		MANR	Abeokuta	
Ondo		JOF Ideal Farms	Oke-Ogun Street, Owo (051-41360)	
		Mikky Farm Enterprises	Arokale Street, Akure	
		Bonvik Comm. Ent.	Ondo Road, Akure	
		Ondo MANR	Akure	
		Okitipupa Oil Palm	Akure	
		AISC	Akure	
		Stamark Nigeria Ltd.	Akure	
Ekiti		Ekiti State Agric. Input Supply Co.	Ado-Ekiti	
		Ekiti MANR	Ado-Ekiti	
<b>East</b>				
Enugu		Molons/Oner. Associates Ltd.	1, Bank Road, Enugu 042-258559	Bro. Moses Onuoha
		Karylyn. Agrochemical Ltd.	80, Zak Ave, Enugu (042-251483)	Mr I.O.J. Agwatu
		Animal Health Business Concept Ltd.	195, Agbani Road, Enugu 042-258887	
Anambra		All Ventures Nig. Ltd.	5, Sokoto Rd, Onitsha (046-410598)	Chief A.V. Nzewi
		Okwutex Nig. Ltd.	6, Sokoto Rd, Onitsha (046-216872)	Mr Okwudili P. Okwonkwo
		Dumbeck Ventures	6, Sokoto Rd, Onitsha (046-888958)	Mr Chinedu Izuchakwu
		Bon-Gyke Agro Centre	24, Sokoto Rd, Onitsha (046-480663)	Mr Boniface Ejike
		IK Chemicals	2C, Sokoto Rd, Onitsha (08033186735)	Mr I.K. Anudu
Imo		Krisbon Agro Centre	2B, Sokoto Rd, Onitsha (046-480579)	Mr Christopher Egu
		Gofons Vet. Services	117, Wethrel Rd, Owerri (083-233378)	
		Tonab Agrochem Ltd.	46, Wethrel Rd, Owerri (083-233375)	

## A4. Accredited distributors cont'd.

Zone/ State	Company	Address	Contact
<b>East</b>			
Abia	Clem Agro	25, Market Rd, Umuabia (088-221311)	
	Demco Best Chemicals	EWLS No. 18, Ariaria Market, Aba (082-222675)	Mr Damian Gusiona
	Emma Odo & Bros Ent.	V Line, No. 1, Ariaria Market, Aba (082-226240)	Mr. Emma Odo
	Seaside Chemicals	Block F, No. 9, Ariaria Market Aba (082-225488)	Mr. Ninabike Nwokwu
Edo	Jappor Nigeria Ltd	177, Murtala Mohammed Way, Benin City (052-252545)	
	Farmers' Shopping Centre	83, Sakpoba Rd, Benin City (052-254812)	Mr Wilson Eselebor
	Progress Agric. Agen- cies Ltd.	122, Murtala Mohammed Way, Benin City (052-257071)	
Benue	Mathias Ameh	A2, No. 640, Nsukka Lane, Otukpo	044-660791
	Franken Technologies Ltd.	34, Onitsha Street, Wurukum, Makurdi	044-531831
	Rodesu Nig Ltd.	76, Ankpa Road, Makurdi	044-531704
<b>North</b>			
Kaduna	JOCHFEM Tech. Serv. Ltd.	12, Daura Road, Kaduna	062-233583
	Joad (Nig.) Ent. Ltd.	1-4, Ahmadu Bello Way, Kaduna	062-240563
	Al-Salam Agro Co. Ltd. Services	6, Walf Road, P.Z. Zaria	069-334623
Katsina	Aih. Bello Bindawa Agrochemical	Kofar Marusa Layout, Katsina	065-434582
Plateau	Jochem Tech. Services Ltd.	27, Joseph Gowwalk Road, Jos	073-457884
Kano	Ashura Ali	A140, M/M Market, Sabongari, Kano	064-637669
	Os. Agro Ind. Ltd.	A215, Sabongari Market, Kano	064-637982
	Obi Agro Ltd.	A14, Sabongari Market, Kano	064-639441
	Bala Hausawa	B11, Sabongari Market, Kano	064-633948
	Akan Nigeria Ltd	3, Beirut Road, Kano	064-634052
	Danlami Ali & Sons Ltd.	57, Bello Dandalio Road, Kano	064-645999
	Alahrahma & Sons Ltd.	A142, Sabongari Market, Kano	064-635299, 643082
Sokoto	DD Baƙarawa Ent.	Baƙarawa Petrol Filling Station, Gusau Road, P.O. Box 880, Sokoto	060-231860
Zamfara	Mal. Sani Mohammed & Sons	2, Abdulsalam Estate, Gusau	063-200914
Niger	Aceka Nig. Ltd.	c/o NACB, Bidia	066-462277
	Sani Maungwa Ent.	16, SS Quarters, PMB 74, Bossom Minna	066-221184
Borno	Yilbar Agric. Ltd.	S38/39, Ramat Shopping Complex, Maiduguri	076-236036

**A5. Offices of CANDEL Company Limited**

Zone	State	Address	Contact
Lagos	Head Office	The CANDEL Company Limited 8B, Close, Off Ligali Ayorinde Ave Victoria Island, Lagos	01-4619170-2
Central	Suleja	Opp Berger Paint Suleja-Abuja Road Suleja	Mr Uzo Nwagbaraocha (Manager) 09-8502363  08033174250
Southeast	Onitsha	2, Ridge Road GRA, Onitsha	Bona Egbo (Manager)
Northwest	Kano	Plot F, Kawaji Quarters (Behind Kapital Insurance) Off Hadejia Road Kano	Collins Nwoke
Northeast	Gombe	C/o Alhaji Minangi Stores Gombe New Market Gombe	Tunde Ojo (Manager)  0/2-223791
Southwest	Ibadan	2 Fadayini Avenue New Bodija, Ibadan	Yinka Yusuf (Manager) 02-8108757 08023277756

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