International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 11 (2014) pp. 173-180**
http://www.ijcmas.com

Original Research Article

Weed diversity in maize (*Zea mays* L.) fields in South Western Cameroon

L.M.Ndam*, J.E.Enang, A.M.Mih and A.E.Egbe

Department of Botany and Plant Physiology, University of Buea, PO BOX 63, Fako, South West Region, Cameroon
**Corresponding author*

Keywords

Weed diversity, South West Region, Maize, Specific weeds, Checklist

A B S T R A C T

Understanding the weed flora of a particular crop helps decide an effective weed management strategy. Maize, though a good competitor cannot cope with a number of competitive weeds at a time. Hence, the present study was aimed at documenting the weeds in maize crop in the South West Region of Cameroon in the growing seasons of 2010–2013. A total of 53 weed species were recorded as problematic and inflicting yield losses to maize crop. The weeds belong to 53 different families with *Asteraceae* as the most dominant (15%) of the weed flora of the crop and was followed by *Poaceae* (8%), *Fabaceae* (6%), *Euphorbiaceae* (6%) and *Amaranthaceae* (6%). These five families contributed 41% of the weed flora of maize crop. As far as the distribution pattern of the weeds was concerned, there were five dominant weeds, viz., *Amaranthus spinosus, Bidens pilosa, Commelina benghalensis, Mariscus alternafolius* and *Cynodon dactylon.* The rest of the weeds were however occasional and did not have consistent and dominant distribution. The distribution of weed species was diverse and important for the botanists and weed scientists to formulate a long term weed management strategy in the locality in light of the weed flora recorded in maize crop.

Introduction

Maize (*Zea mays* L.) is an important cereal crop that ranks third in the world after wheat and rice (Mahmoodi and Rahimi 2009), with an annual cultivation area of more than 150 million hectares and harvest of almost 800 million tons/year of grain (FAOSTAT, 2007). The major producers are the United States, Brazil, France, India and Italy (James *et al.,* 2000). Maize tops the list of close to 150 species of crops grown in Sub Saharan Africa each year and its contribution to Africa`s food basket is estimated at more than 43% of all cereals (Pingali, 2001; Menkir *et al.,* 2009; DT Maize, 2012). Maize production in Africa increased from 2.7 million tons/year in the 1980s to 105.5 million tons/year in the year 2000. This increase in production occurred as a result of an expansion of the cultivated area from 3 million ha in the 1990 to 8 million ha in 2001 (Fakorede *et al.,* 2003). In Cameroon, maize production contributes enormously to food security and employment and is the first most widely produced and consumed cereal with over 700.000 farm families involved in its cultivation (MINEPAT,

2008). The South West region has the highest yield potential for maize production in Cameroon. However, in the Region, actual average yields of maize are still low (1.67 tons/ha) as compared to the potential yields of 6 tons/ha (MINEPAT, 2008). Driven by a rapid rise in petroleum prices and a rapid global expansion of biofuel production from maize (Cassman, 2007), the price of maize rose by over 50% from 2001–2007 (FAO, 2008), and the demand for maize is estimated to double in the next half century (Gowing and Palmer, 2008). Maize production suffers from a number of constraints which include diseases, insect pests, decline in soil fertility, environmental degradation and weeds in infestation (DT Maize, 2012).

Worldwide production of maize is reduced to about 40% due to competition from weeds, which are the most important pest groups (Oerke and Dehn, 2004). African soils contain 100 to 300 million buried weed seeds per hectare of which a fraction germinate and emerge each year. Yield losses in maize due to weeds range from 50–90% in Central and West Africa (Chikoye *et al.*, 2002). Weeds are unfriendly as a consequence of their allelopathic, competitive, persistent and pernicious attributes (Zamam *et al.*, 2011).

Weeds reduce crop yields and increase production cost by competing for space, water, light, nutrients and intrinsically acting as alternative hosts of other pests and pathogens (Oerke, 2005; Ademiluyi and Abegunde, 2007). The competitiveness of weeds is often measured in terms of crop yield reduction per unit of weed population or biomass, and the yield reduction can vary greatly as a result of the weed species (Kumar and Sundari, 2002; Teasdale and Mohler, 2000; Hassan *et al.*, 2010). Yield losses due to the parasitic weed, *Striga hermonthica* can reach 100 % in susceptible maize cultivars under severe field infestation in marginal production areas (Haussman *et al.*, 2000). Some weeds prevail in particular crop fields uniquely. Before embarking to proffer any remedy to a problem, there is need to survey, identify and catalogue weed diversity and also to make an observational confirmation of the weeds situation in maize fields.

Little information is available in literature on the distribution of weeds in maize farms in the South West Region of Cameroon. The present comprehensive study on weedy species of maize crop in this area is the first and highly desirable and crucial in order to understand their identity and persistence as baseline information for future extensive work on biology, ecology, ethnobotany and allelopathy. It was therefore imperative to carry out the present investigation.

Materials and Methods

The study area

The study area is the South West Region of Cameroon, with an estimated population of 1.3 million inhabitants, covering a surface area of 24,923 km² and a population density of about 75 inhabitants/km² (Fig. 1). The area lies within the tropical rainforest belt, latitude 4.09-5º N of the equator and longitude 8 and 10ºE of the Greenwich meridian (MINEPAT, 2008). The mean annual temperature is 28^0C while the annual rainfall stands at about 2.000 mm, most of which is received between June and September (Ndam *et al.*, 1998). The relative humidity averages 70–80% while the annual sunshine lies between 900–1200 hours. The soil type is basically volcanic (Cable and Cheek, 1998) making it suitable for agriculture.

Weed survey procedure

Before starting the research work, general information about the area was collected from the Regional Delegation of Agriculture and Rural Development for South West. Afterwards, personal reconnaissance visits were conducted in different localities of the region.

The weed diversity of maize crop fields in the area was studied as per the methods described by Rahman *et al.* (2007). Accordingly, the weed survey was done from 2010 to 2013 during the maize crop growing season. The South West region was divided into 61 agricultural extension zones in all 35 sub-divisions within the six divisions of the region under the National Support Programme for Maize Production and National Agricultural Extension research Programme. The Survey was done in two stages. During the first stage in 2010, a total of 300 questionnaires were administered to 300 agricultural staff among which were sixty-one Frontline/Zonal Extension Workers of the South West Regional Delegation of Agriculture and Rural Development, who were in charge of the daily follow-up and backstopping of the farmers involved in maize production in their respective zones. They were required to indicate the different weeds observed in maize farms in their respective zones and work environment.

The second stage was done from March to December 2011 and replicated in 2012 and 2013. This stage of survey was considered necessary to verify information from the first stage. During this period, the authors went to maize crop fields at least twice in a month and later once in a month in 2011 and 2012–2013, respectively. For the selection of farmers whose fields were sampled, stratified random sampling was used. Each agricultural extension officer was asked to divide his zone of operation into 8 equal parts. Each area was further subdivided into 16 smaller areas. Of the 16 small portions, each was sub divided into 32 units. From the 32 units, the names of 100 above -average and 100 below- average maize farmers were submitted. The 8 and 16 smaller areas were numbered. By use of random number tables, the first number to appear was chosen. The same process was repeated for the 32 units. Then 10 farmers were chosen from the 100 above- average and another 10 chosen from the 100 below- average farmers. Their fields were sampled for the present of weeds. For the actual sampling spots of the field, systematic sampling was used. The land was divided diagonally and sampling was done every 5m following the diagonal line. A total of six quadrates were taken in each field and quadrates were 1mx1m. Representative weeds in each quadrate were collected. Personal interviews were also conducted with some of the farmers whose fields were visited.

Species collection, preservation and identification

Plant specimens were collected during the entire period of studies. The collected weeds were preserved in news papers, placed in proper positions and left to completely dry. After drying, all the plants were mounted on standard herbarium sheets with proper identification and taxonomy. Weeds were identified on the spot and at the herbarium of the Limbe botanic garden on the basis of their natural characters with the help of identification keys, flora of South West region and other relevant literature.

Species categorization

The documented specimens were calculated by using the Oosting scale (Oosting, 1956).

Under this scale, the distribution pattern of the weed flora was made into five varying categories those are 1. Very rare, 2. Rare, 3. Infrequent, 4. Abundant and 5. Very abundant.

Herbarium

Prepared specimens were deposited in the herbarium section of the Department of Botany, University of Buea, Cameroon.

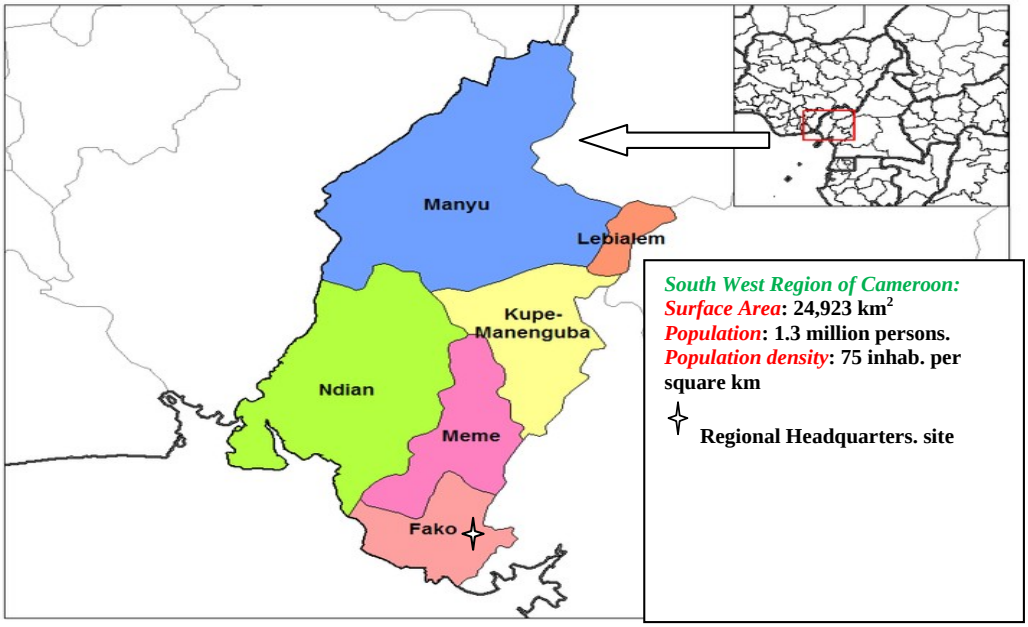
Results and Discussion

A total of 53 weed species belonging to 28 angiosperm families were recorded from the study area (Table 1). *Asteraceae* was found to be the most dominant family in the weed flora of the studied crop with a percentage of (15%) followed by *Poaceae (8%), Amaranthaceae, Euphorbiaceae* and *Fabaceae* (6%), respectively. The rest of the families with their respective percentages are showed in Figure 2. The documented weed flora along with their botanical names, families and their individual rating on Oosting scales are given in Table 1. The five most dominant and widespread weed species within the weed communities of maize crop in the study area were *Amaranthus spinosus, Bidens pilosa, Commelina benghalensis, Mariscus alternafolius* and *Cynodon dactylon.* Fongod (2004) recorded similar results on a checklist of noxious weeds in banana plantations in south western Cameroon.

Amarantus spinosus species have an extended period of germination, rapid growth and high rates of seed production. The species of *Amaranthus* are considered invasive and noxious weeds. *Bidens pilosa* is an aggressive weed in the study area. This weed was found growing where there was heavy infestation. Well fertilized field seems to encourage the weed to grow well, even under heavy shading from the maize crop. *Commelina benghalensis* was found growing in all soil types and altitudes and seems to tolerate shading. *C. benghalensis* produces both aerial and subterranean seeds and also reproduces vegetatively. Control of this weed is difficult since it employs several regeneration strategies such as growth from nodes to producing new plants. Chivinge (1983) reported *C. benghanlensis* to be among the most aggressive weeds in farming sectors of Africa. *Mariscus alternifolius* is one of the most invasive weeds known, having spread out to a worldwide distribution in tropical and temperate regions. It has been called one of "the world's worst weed" as it is known as a weed in over 90 countries and infesting over 50 crops worldwide. Its existence in a field significantly reduces crop yield, both because it is a tough competitor for ground resources and because it is allelopathic, the roots releasing substances harmful to the crop plants. *Cynodon dactylon* is a fast growing and tough weed, making it popular and useful for lawn and turf, as when damaged it will recover quickly. It is a highly desirable turf grass in warm temperate climates, particularly for those regions where its heat and drought tolerance enables it to survive where few other grasses do. It is also highly aggressive, crowding out most other grasses and invading other habitats.

Having recorded the existing weed flora of maize crop in the locality, it became quite easier to formulate a long term weed management program. The dominant weed species, their families and percent contribution to the weed flora were also recognized. In addition, the year to year introduction of new species can easily be spotted because of having the record of the weed flora in the previous year.

Fig.1 Study site: South West region of Cameroon



Source: MINEPAT, 2008.

Fig.2 Percentage contribution of plant families in the formation of weed flora in maize field in South West region of Cameroon

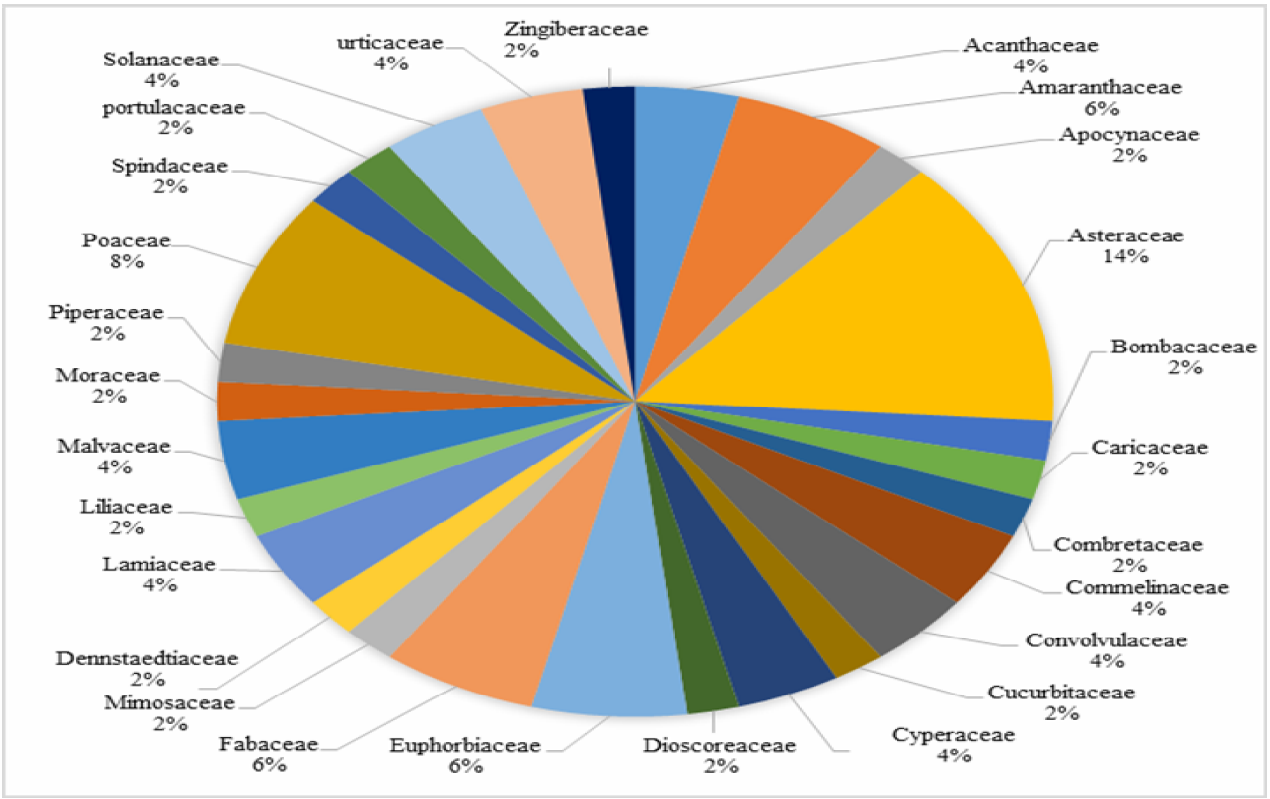


Table.1 Diversity of weed species associated with maize production in South West region of Cameroon

Weed family/Species	Life Cycle	Morphotype	Mode of reproduction	Abundance (Oosting Scale)
Acanthaceae				
- *Acanthus montanus* (Nees) T.Aders	P	D	S, Sc	1
- *Lindernia crustaceae* L	A	D	S	2
Amaranthaceae				
- *Cyathula prostrate* (L) Blume	A	D	S	2
- *Amaranthus spinosus* L.	A	D	S	5
- *Amaranthus hybridus* L.	A	D	S	1
Apocynaceae				
- *Voacanga Africana* (Benth)	P	D	S	1
Araceae				
- *Colocasia esculenta* (L) Scoth	A	M	S	2
- *Asystasia gangetica* (L) Blume	A	D	S	1
Asteraceae				
- *Ageratum conyzoides* L	A	D	S	3
- *Synedrella nodiflora* (Gaertn)	A	D	S	2
- *Triplotaxis stellulifera* (Benth)	A	D	S	1
- *Vernonia amydalina Del.*	A	D	S	1
- *Emilia coccinea(Sims)G. Don*	A	D	S	3
- *Chromolaena ordorata (L)R. King and H. Robinson*	P	D	S, Sc	3
- *Erigeron floribundus* (Kunth)	A	D	S	2
- *Bidens Pilosa Linn.*	A	D	S	5
Bombacaceae				
- *Ceiba Pentandra* (L) Gaernt	P	D	S	1
Caricaceae				
- *Carica papaya* L	P	M	S	1
Combretaceae				
- *Combretum hispidum* L	P	D	S, Sc	3
Commelinaceae				
- *Commelina diffusa Bum F.*	P	M	S, Sc	3
- *Commelina benghalensis L.*	A/P	M	S, Sc	4
Convolvulaceae				
- *Ipomoea batata* (L) Lam	A/P	D	S, Tu	2
- *Ipomoea involucrate P.Beauv*	A/P	D	S, Sc	3
Cucurbitaceae				
- *Momordica charantia* L	P	D	S	1
Cyperaceae				
- *Mariscus alternifolius* Vahl	P	M	S	4
- *Cyperus rotundus* L	P	M	S	
Dioscoreaceae				
- *Dioscorea alata* L	A	D	S, Tu	1
Euphorbiaceae				
- *Phyllanthus amaurus* Shumach	A	D	S	1
- *Acalypha ciliate* Forsk	A	D	S	2
- *Manihot esculentus* Crantz	P	M	S	1
Fabaceae				
- *Desmodium abdescendens(Sw.)DC var. Abdescendens*	A/P	D	S	3
- *Centrosema pubescens* Benth	P	D	S	3
- *Phaseolus vulgaris* L	A	D	S	2
Mimosaceae				
- *Albizia zygia(DC) J.F. Macbr.*	P	D	S	3

Dennstaedtiaceae - *Pteridium aquilinum (L.)Kuhn subsp. Aquilinum*	P	M	R, Sc	1
Lamiaceae - *Ocimum graticcimum* L	P	D	S	3
- *Plectranthus aromaticus* Roxb	P	M	Sc	2
Liliaceae - *Gloriosa superb* L	P	M	Sc	1
Malvaceae - *Sida acuta* (L) Burm	P	D	S	1
- *Glyphaea brevis L.*	P	M	S	2
Moraceae - *Ficus exasperate* Vahl	A	D	S, Sc	1
Piperaceae - *Peperomia pellucid* (L) Kunth	A	M	S	1
Poaceae - *Eleusine indica* (L) Gaertn	A	M	S	3
- *Oplismenus cf bumannii* Retz	P	M	S, Sc	2
- *Andropogon tectorum* Schum - *Cynodon dactylon L.*	P p	M M	S, Sc S	3
Sapindaceae - *Paullinia pinnata* L	P	M	S	3
Portulacaceae - *Talinum triangulare* Jacq	A/P	M	S, Sc	1
Solanaceae - *Solanium nigrum L*	P	D	S	2
- *Solanium torvum* Swartz	A	D	S	1
Urticaceae - *Fleurga aestuans Linn*	A	D	S	1
- *Laportea alatipes Hook F.*	A	D	S	2
Zingiberaceae - *Zingeber officinalis* Schum	P	D	S, R	2

Life cycle: A=annual; P=perennial; A/P=annual and perennial

The results highlighted five dominant and major weeds in maize crop that is a big menace to the plant. The five dominant weeds were *Amaranthus spinosus,Bidens pilosa, Commelina bengha lensis,Mariscus alternafolius and Cynodon dactylon*. Further studies are required on alllelopathy, ethnobotany and distribution and quantification of weeds for ecological management.

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