© Weed Science Society of Nigeria 2013
Nigerian Journal of Weed Science Vol. 26 Nov. 2013 pp 53-63
ISSN 0794 4950

Pattern of emergence of weeds in an arable field in the Southern Guinea savanna ecology of Nigeria

F.O. Takim* and O. Fadayomi
Department of Agronomy, Faculty of Agriculture,
University of Ilorin, P.M.B. 1515, Ilorin, Nigeria

Received 23rd May, 2013 Accepted 12th August, 2013

Abstract
A field study was conducted in an arable farm in the southern Guinea savanna ecology of Nigeria to assess the pattern of weed seedling emergence under four cropping systems and three weed management practices during the 2009 to 2010 cropping seasons. The density and frequency of occurrence of individual weed species were monitored continuously in the same quadrat measuring in $0.5m^2$ at two to three weekly intervals throughout the seasons. Weed seedlings emerged throughout the periods of assessment. A total of 43 weed species of 27comprising broadleaves, 12 grasses and 4 sedges were recorded. The dominant species, on the basis of their percentage occurrence and aggregate populations were *Tridax procumbens* L., *Fimbristylis littoralis* Gaudet, *Pycereus lanceolatus* (Poir) C.B.Cl., *Brachiaria deflexa* (Schumach) C.E Hubbard, *Cynodon dactylon* (L.) Pers, *Dactyloctenum aegyptum* L., *Digitaria horizontalis* Willd, *Eleusine indica* Gaertn, *Panicum maximum* Jacq and *Rottboellia cochinchinensis* Lour. Two seedling emergence peaks were evident in all cropping systems and weed management practices. Weed seedling emergence peaks occurred at 3 & 8 weeks after planting (WAP) in 2009 and at 3 & 10 WAP in 2010. Therefore, these peak periods could be targeted by farmers in the zone for managing weeds using appropriate weed control measures to the advantage of the crop.

Keywords: Cropping system, seedling emergence, pattern, dominant species, peak periods
* Corresponding author: felixtakim@yahoo.co.uk

Introduction

Weed is an important constraint in agricultural production system, acting at the same tropic level as the crop, weed capture a part of the available resources that are essential for plant growth. Inevitably, allowing weeds uncontrolled will later lead to reduction in crop yield.

Control efforts are generally directed towards weed seedling in the period just prior to, or shortly after crop establishment (Bastiaans *et al.*, 2008). Crop emergence is generally more uniform than weed emergence because populations of weed seeds are more variable with respect to germination requirements and depth of burial in the soil. The time of emergence of a crop relative to that of associated weeds can affect both crop and weed growth. The periodicity of weed emergence is primarily controlled by biological characteristics of the weed species (for example, seed dormancy), field management practices and environmental condition (Forcella *et al.*, 2000). Zimdahl *et al.*(1988) described the unsynchronized emergence of a population of weed seeds as an evolutionary survival mechanism that safeguards against death of

all seedlings if unfavorable growing conditions were to occur before maturity.

It has been suggested that the initial time of weed emergence differs from year to year and that the relative time of weed and crop emergence can be crucial, as a few days difference in emergence can create an un-recoverable gap between plant species (Mohammed *et al.*, 1997). A high percentage of emergences early in the season confers an advantage on the affected species in terms of colonizing an area ahead of other competitors (Oliver and Bararpaur, 1996). The weeds that emerge earlier have the potential to dominate the flora throughout the season and such early emerging groups may still be emerging when later groups begin to emerge (Hartzler *et al.*, 1999).

An ability to predict the germination and emergence behaviour of weed species in relation to cultural activities presents a number of practical opportunities to meet the challenge of finding a sustainable method or strategy for weed control as a non-chemical alternative. The study was aimed at finding the pattern of weed seedling emergence in an arable field under different cropping systems and weed management practices in the southern Guinea savanna of Nigeria.

Materials and Methods

The experiment was a randomized complete block with a split-plot arrangement and three replicates. The main plots consisted of four cropping systems, made up of a maize and cowpea intercrop (MZCP), a sole crop of maize (SMZ), a sole crop of cowpea (SCP) and a no- cropping (NCRP) treatment while the sub plots consisted of three weed control methods, which included: Chemical weed control (CWC); Hoe weeding (HWC) and No weed control (NWC).

The trial occupied an area of 2250 m^2 (75 m x 30 m) which was divided into three replicates of 750 m^2 (75 m x 10 m). The site was disc ploughed, harrowed and ridged. Each replicate comprised of twelve (12) sub-plots. Each sub plots had seven (7) ridges, 5 m long and 1.0 m apart with a gross area of 35 m^2 (approximately).

The planting operations were done on 7th of July, 2009 and 23rd of July, 2010. The maize seeds (SUWAN 1) were sown at 1.0 m x 0.30 m, two plants/hill to give a density of 66,667 plants ha^{-1}. The cowpea seeds (IFE BPC) were sown at a spacing of 1.0 m x 0.25 m at two plants per hill to give an approximate density of 80,000 plants ha^{-1}. For the intercrop, maize was sown at 1.0 m x 0.3 m and cowpea at 1 m x 0.3 m within the same row using the 1:1 replacement model to give a combined plant population of 133,334 plants/ha^{-1} (66,667 plant ha^{-2} of each component plant density). Weed seedling emergence was monitored continuously in the same two fixed quadrats measuring 1.0 m by 0.5 m at 3, 6, 8, 10,12 and 15 weeks after planting (WAP) in each sub plot. On each sampling date, weed seedling was identified to species level using the weed identification manual of Akobundu and Agyakwa, (1998), counted and pulled out after enumeration.

Data collected on weed density was subjected to ANOVA using Genstat Discovery Edition 3. Mean data were used to estimate weeds emergence pattern.

Results and Discussion

A total of 43 weed species, 27 broadleaves, 12 grasses and 4 sedges consisting of 25 annuals, 15 perennials and 3 annual/perennials were identified (Table 1).

Table 1. Mean occurrence (%) of weed species encountered in the experimental fields.

Weed species	M/LC	Cropping system				Weed control		
		MZCP	SCP	SMZ	NCRP	CWC	HWC	NWC
Aspilia africana pers C.D. Adams	PB	0.51	0.93	0.51	0.78	0.67	0.76	0.72
Boerhevia coccinea Mill	PB	1.08	1.16	1.16	1.39	0.96	1.53	1.11
B. diffusa L.	PB	0.58	1.01	1.16	1.63	1.64	1.67	1.30
Brachiaria deflexa(Schumach) C.E Hubbard	AG	8.09	7.66	5.29	4.12	5.78	6.88	6.18
Cassia obtusifolia L.	AB	0.51	0.93	0.51	0.78	0.67	0.76	0.72
Cleome viscosa L.	AB	0.72	1.01	1.23	1.39	0.00	1.37	8.34
Commelina benghalensis L.	PB	0.87	0.93	0.87	0.78	0.78	0.90	1.35
Croton lobatus L.	AB	0.00	0.29	0.00	0.00	0.47	0.24	0.36
Cyperus tuberosus Rottb	PS	3.04	1.77	3.12	3.03	3.08	2.78	2.67
Cynodon dactylon (L.) Pers.	PG	7.23	5.49	4.28	3.49	5.01	5.28	4.88
Dactyloctenum aegyptum L.	APG	7.29	8.63	6.29	4.83	7.51	5.34	5.15
Digitaria horizontalis Willd	AG	7.01	5.57	4.57	4.12	5.20	5.35	5.73
Diodia scadens SW	PB	1.16	1.08	1.16	1.71	1.16	1.24	1.39
Eleusine indica Gaertn	AG	7.52	6.73	5.08	3.11	5.29	4.31	5.14
Euphorbia heterophylla L.	AB	2.09	3.87	3.48	4.74	4.24	3.41	3.06
E. hirta L.	AB	1.16	1.31	1.23	2.26	1.16	1.39	1.76
E. hyssopifolia L.	AB	0.00	1.55	1.45	1.48	1.64	1.67	1.30
Fimbristylis littoralis Gaudet	AS	6.22	6.96	8.05	5.52	3.66	7.29	7.75
Fleurya aestuans (L.) ex Miq	AB	0.87	1.39	1.16	1.63	1.25	1.25	1.24
Gomphrena celosioides C.Mart	APB	0.65	0.77	0.51	0.86	1.35	0.69	0.72
Hyptis suaveolens Poit	AB	1.37	1.01	1.02	1.94	1.06	1.53	1.11
Hypparhenia involucrata Stapf	PG	3.04	2.17	2.83	2.95	2.33	2.50	2.99
Ipomoea involucrata P. Beauv	AB	0.79	0.77	0.87	1.09	0.96	0.97	0.72
Mariscus alternifolia Vahl	PS	3.39	3.40	3.05	4.28	3.18	3.27	4.04
Melochia corchhorifolia L.	PB	0.58	0.77	0.36	0.69	0.58	0.49	0.78
Mitracapus villosus (SW) DC	AB	1.16	1.86	1.81	3.11	1.35	2.08	2.28

Table 1. continued Mean occurrence (%) of weed species encountered in the experimental fields.

Weed species	M/LC	Cropping system				Weed control		
		MZCP	SCP	SMZ	NCRP	CWC	HWC	NWC
Oldelandia corymbosa L.	AB	0.79	1.01	1.02	1.39	1.83	1.18	1.04
Panicum maximum Jacq	APG	5.06	3.79	4.13	3.34	4.53	3.96	3.97
Paspalum conjugatum Berg	PG	3.83	2.94	3.48	2.64	3.56	3.41	2.93
P. orbicolare Forst	PG	3.47	2.86	6.02	3.03	3.66	3.19	3.19
P. vaginatum SW	PG	2.39	1.55	2.47	2.64	2.12	2.22	2.41
Phyllantus amarus Schum. & Thonn	AB	1.37	2.09	1.23	1.87	1.83	1.59	1.63
Physalis angulata L.	AB	0.87	1.16	1.02	1.63	1.16	1.11	1.24
Portulaca oleracea L.	AB	1.30	0.93	0.58	1.39	0.77	1.25	0.00
Pycereus lanceolatus (poir) C.B.Cl	PS	12.24	12.79	9.71	12.18	9.39	11.01	13.59
Richardia brasilliensis Gomez	AB	0.65	0.69	0.73	1.17	0.96	0.90	0.78
Rottboellia cochinchinensis Lour	AG	6.22	6.96	5.58	3.65	5.39	5.21	5.99
Seteria barbata (Lam) Kunth	AG	3.11	2.71	3.26	4.74	3.18	4.17	2.79
Sida rhombofolia L	PB	0.65	0.69	0.51	0.00	0.58	0.63	0.72
Spigellia anthelmia L	AB	0.94	0.59	0.26	1.15	0.00	0.49	1.69
Tephrosia bracteolata Guill. & Perr.	AB	0.00	0.00	0.00	0.92	0.47	0.49	1.42
Tridax procumbens L.	AB	6.36	9.28	9.21	8.79	10.50	7.99	7.09
Vernonia galamensis (Cass.) Less.	AB	0.65	0.69	0.65	0.86	0.00	0.76	0.78

M/LC= morphology/life cycle, MZCP= intercrop of maize/cowpea, SCP= sole cowpea, SMZ=sole maize, NCRP= no cropping, CWC= chemical weed control, HWC = hoe weeding, NWC= no weed control, A= Annual, P= Perennial, AP = Annual/ Perennial, B = Broadleaf, G = Grass, S = Sedge.

The dominant species, on the basis of percentage occurrence and aggregate populations were *Tridax procumbens, Fimbristylis littoralis, Pycereus lanceolatus, Brachiaria deflexa, Cynodon dactylon,, Dactyloctenum aegyptum, Digitaria horizontalis, Eleusine indica, Panicum maximum* and *Rottboellia cochinchinensis*. In general majority of weed species were not encountered frequently in the uncropped (NCRP) and unweeded (NWC) plots as in other treatments. This observation may be attributed to absence of soil disturbance that might encourage weeds emergence and the inability of weeds to emerge early in these treatments. Weeds have the potential to become dominant when they emerged earlier Hartzler *et al.* (1999). The average density of weed species in the NCRP and NWC plots were higher than the average densities of weed species in the cropped and weed controlled plots. Conversely, densities of weeds in the cropped and weed controlled plots were relatively lower but the number

of individual weed species that emerged in these plots were higher than what was obtained from NCRP and NWC plots. This agreed with the report of Fadayomi *et al.* (1992) in Sudan Savanna ecology of Nigeria who reported that the mean frequency of occurrence of the different species in the undisturbed quadrats were generally higher than in the disturbed quadrats. Conversely, the average densities of individual species in undisturbed quadrats were lower than aggregate densities of same species in the continuously assessed quadrats.

The pattern of emergence of individual weed species show two peaks of emergence but at different periods of assessment. *Tridax procumbens* had the highest emergence at 3 WAP in both years while the second peak of weed emergence was at 8 WAP and 12 WAP during the 2009 and 2010 growing season, respectively (Fig.1) except the intercrop plot that had single peak (8WAP) of weed emergence in 2009.

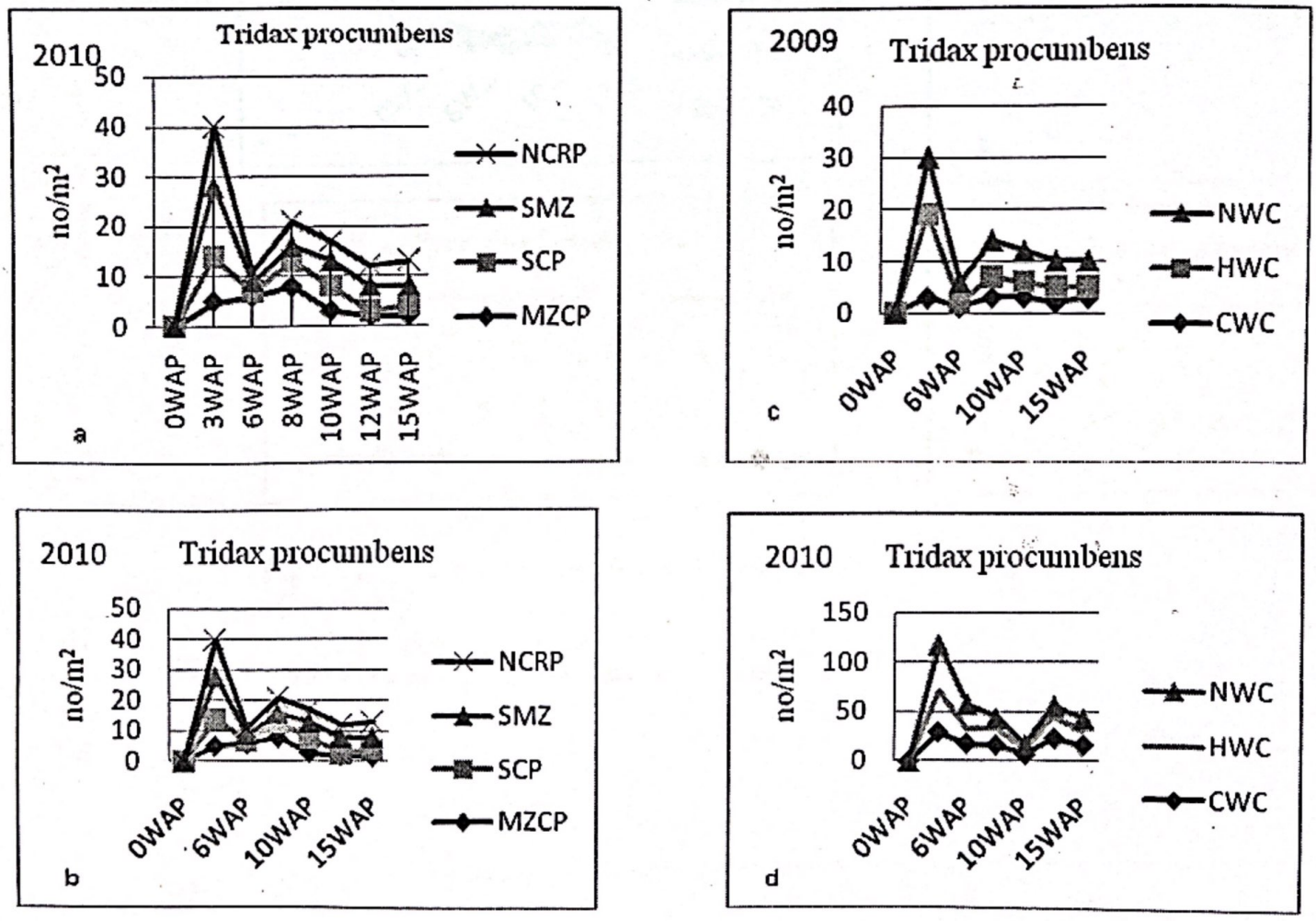


Figure 1. Pattern of emergence of *Tridax procumbens* seedlings

a, b = cropping pattern,

c, d = weed control method

Fimbristylis littoralis and *Pycereus lanceolatus* had similar pattern of emergence as *T. procumbens* (Fig.2).

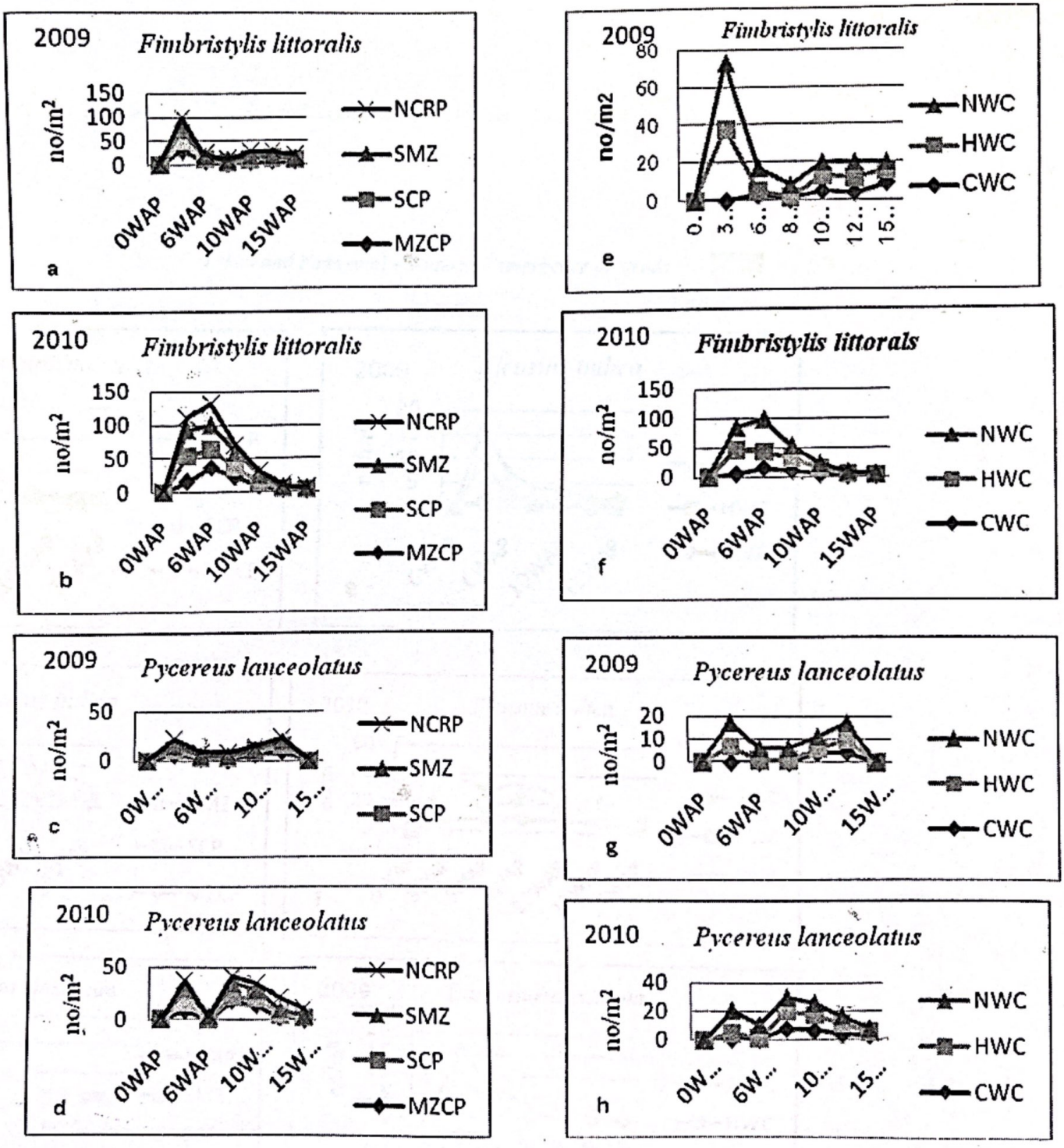


Figure 2 pattern of emergence of dominant sedge seedlings
a,b,c,d = cropping pattern
e,f,g,h = weed control method

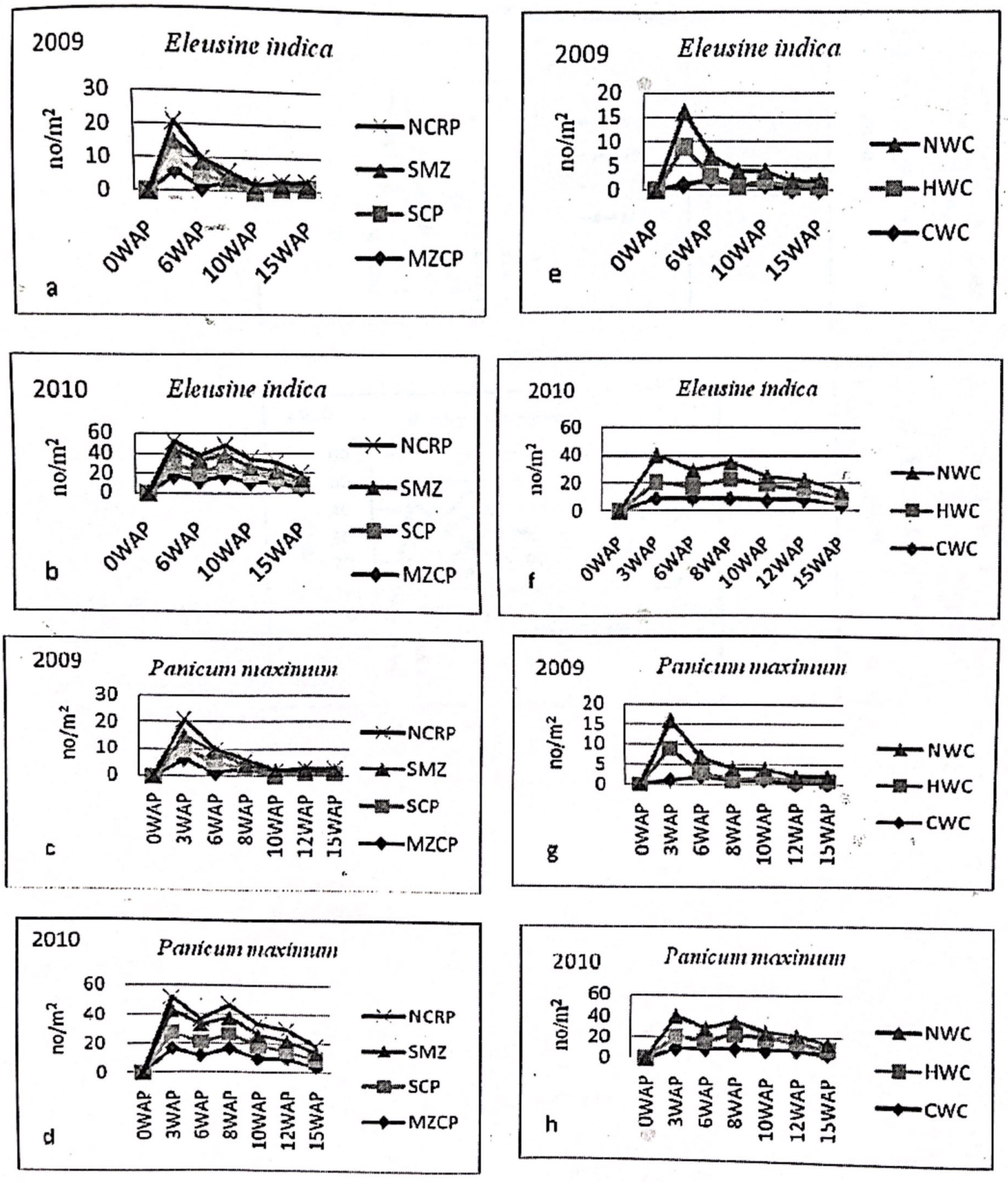


Figure 3a pattern of emergence of the dominant grass species
a,b,c,d = cropping pattern
e,f,g,h = weed control method

The first peak was obtained at 3 WAP which was common to both sedges except in 2010 *when emergence in all the plots except those* that received hoe weeding peaked at 6 WAP. The second peak of emergence was at 12 WAP in 2009 and either at 8 or 10 WAP in 2010. The grasses emerged very early in the season with a peak at 3 WAP but emergence sharply declined at 8 or 10 WAP and then peaked again at 10 or 12 WAP. In 2009, *Eleusine indica, Panicum maximum and Rottboellia cochinchinensis* encountered in the herbicide treated plots had different emergence pattern. These grasses had emergence peaks at 6 and 10 WAP. In 2010 *C. dactylon* had similar pattern as the grasses in the herbicide treated plots above (Fig.3).

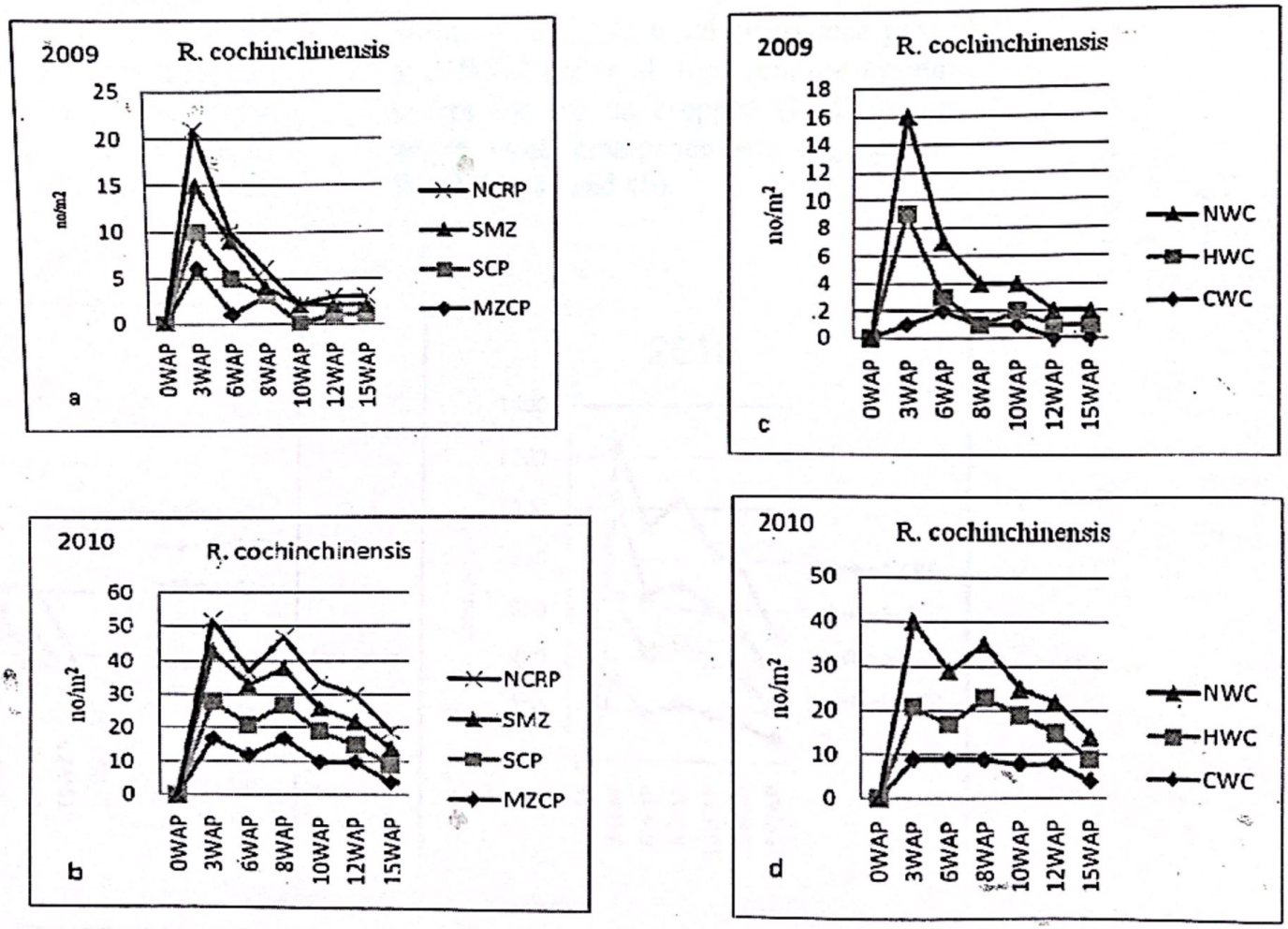


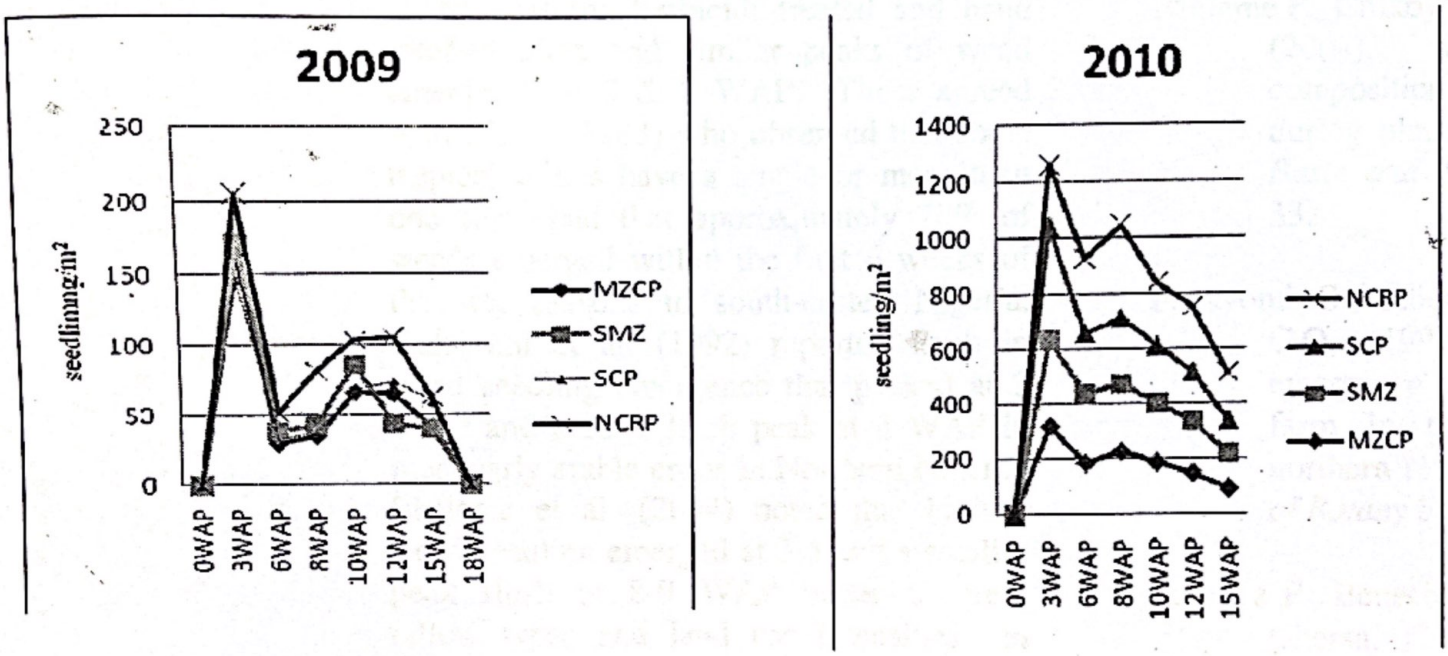
Figure 3b. Pattern of emergence of dominant grass seedlings (R. cochinchinensis)

a,b = cropping pattern

c,d = weed control method

The overall pattern of weed seedling emergence under the different cropping system showed that in 2009, weed emergence was highest (peaked) at 3 WAP irrespective of the cropping system. Similarly, in 2010, weed emergence peaked at 3 WAP under all the cropping systems, except for the un cropped (NCRP) plots, where weed emergence was highest at 8 WAP (Fig.4a and 4b).

a.



b.

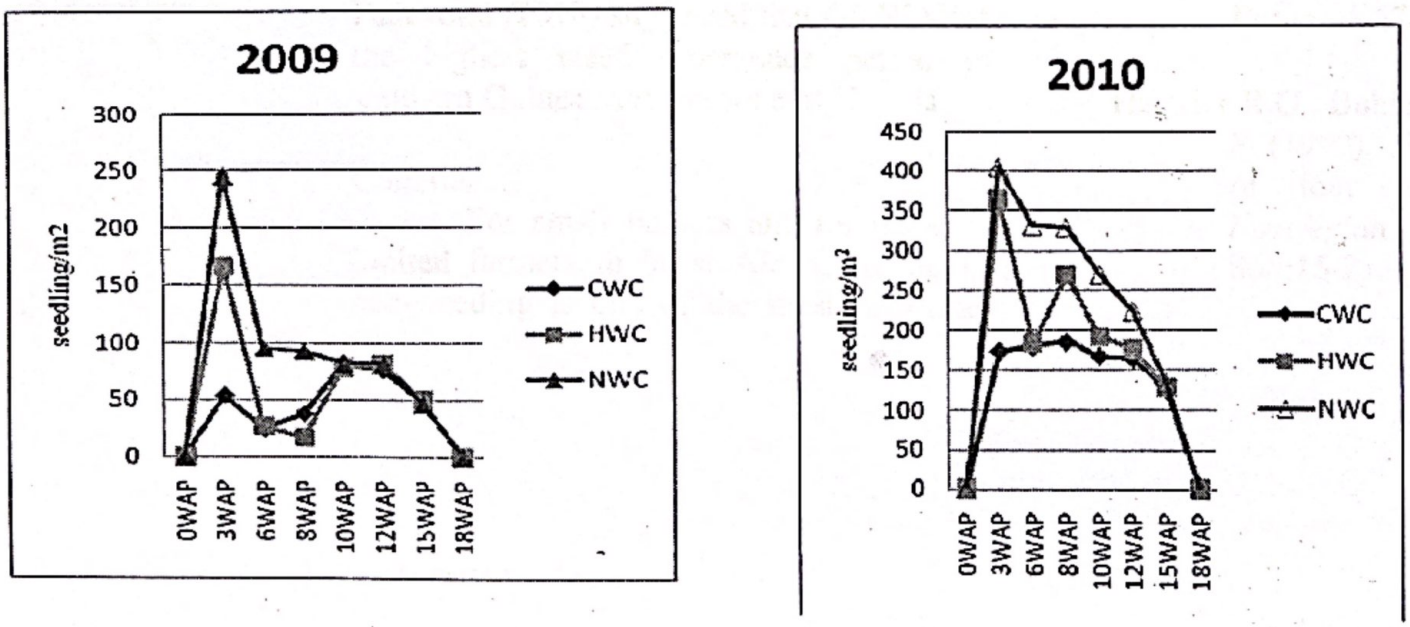


Figure 4. Pattern of weed seedling emergence as influenced by cropping systems (a) and weed management practices (b)

In both years, there was a sharp decrease in seedling emergence at 6 WAP, followed by a gradual decline thereafter. The only exception to the above observation was in the NCRP plots in 2010, where total seedling emergences increased from 219 seedling/m^2 at 3 WAP to 268 seedling/m^2 at WAP. A fairly similar pattern of weed emergence, as influenced by cropping system, was observed under the different weed management practices. In 2009, all the plots had peaks of weed seedling emergence at 3 WAP. However, while the herbicide-treated and hand weeded plots had secondary weed emergence peaks at 10 and 12 WAP, respectively, the plots with no weed control practice had a single peak of weed emergence at 3 WAP. The same general pattern was observed in 2010, except that the herbicide-treated and hand weeded plots had similar peaks of weed emergence at 3 & 8 WAP. These agreed with Marks (1983) who observed that some tropical weeds have a single or more than one flush had that approximately 70% of weeds emerged within the first 6 weeks of the wet seasons in south-easten Nigeria, Fadayomi et al. (1992) reported flush in weed seedling emergence that peaked at 3 WAP and second flush peak at 8 WAP in most early arable crops in Northern Nigeria, Ekeleme et al. (2004) noted that highest weed seedling emerged at 3-5 and a smaller peak flush at 8-9 WAP under different fallow types and land use intensities in south-western Nigeria while Takim & Fadayomi (2010) suggested that 4-8 WAP is the highest weed emergence period in southern Guinea savanna zone of Nigeria.

Conclusion

For small holders and /or resource limited farmers in West Africa, timing of hoe-weeding is one of the most important factors influencing the effectiveness of manual weed control activities. Therefore, these peak periods could be targeted for managing weeds using appropriate targeted for managing weeds using appropriate weed control measures to the advantage of the crop.

References

Akobundu I.O. and Agyakwa C.W. (1998). *A Handbook of West Africa Weeds.* IITA. Ibadan Nigeria. 564p.

Bastiaans L. Paolini R. and Baumann D.T. (2008). Focus on ecological weed management: what is hindering adoption? *Weed Research* **48:**481-491.

Ekeleme F., Chikoye D., and Akobundu I.O. (2004). Changes in size and composition of weed communities during planted and natural fallows. *Basic and Applied Ecology* **5:** 25-33.

Fadayomi O., Aliero B.L. and Muoneke, C.O. (1992). Pattern of field emergence of weeds in an upland farm in the Sudan savanna of northern Nigeria. *Nigerian Journal of Botany* **5:**193-202.

Forcella F., Benech A.R.L., Sanchez R and Ghersa, C.M. (2000). Modeling seedling emergence. *Field Crops Research* **67(2):** 123-139.

Hartzler R.G., Buhler, D.D. and Stoltenberg S. (1999). Emergence characteristic of four annual weed species. *Norwegian extension publication* **868:**15-21.

Marks M.K. (1983). Timing of seedling emergence and reproduction in some tropical weeds. *Weeds Research* **23:**325-332.

Mohammed E.S., Nourai A.A., Mohammed G.C., Mohammed M.I. and Sexena M.C. (1997). Weeds and weed management in irrigated lentil in Northern Sudan. *Weed Research* **37:**211-218.

Oliver L.R. and Bararpour M.T. (1996). Effect of tillage on Senna obtusofolia and Xanthum strumanium population, interference and seed bank in: proceeding of 2nd *International Weed Control Congress.* 1:241-246.

Takim F.O. and Fadayomi O. (2010). Influence of tillage and cropping systems on field emergence and growth of weeds and yield of maize (*Zea mays* L.) and Cowpea (*Vigna unguiculata* L.). *Australian Journal of Agricultural Engineering* **1(4):** 141-148.

Zimdahl R.L., Moody K, Lubigan R.T. and Castin E.M. (1988). Pattern of weed emergence in tropical soils. *Weed Science* **36:** 603.