Survey of Weed Management in Peanut (*Arachis hypogaea* L.) Fields in Southern Ghana, West Africa

G. Bolfrey-Arku[1], M. Owusu-Akyaw[1], J.V.K. Afun[2], J. Adu-Mensah[1], F.O. Anno-Nyako[1], E. Moses[1], K. Osei[1], S. Osei-Yeboah[1], M.B. Mochiah[1], I. Adama[1], A.A. Dankyi[1], R.L. Brandenburg[3], J.E. Bailey[3], and D.L. Jordan[3]*

ABSTRACT

A survey to document peanut farmers' weed management practices was conducted in the Ashanti, Brong Ahafo, Eastern, and Volta regions of Ghana, West Africa during 2001. Peanut was planted as the only crop in 64% of fields surveyed. Land preparation method was related to land tenure system. The slash and burn system constituted 72% of farmers surveyed. In Brong Ahafo region, 80% of the farmers planted on ridges while peanut was planted flat primarily in the Volta region. Planting flat or on ridges was variable in Ashanti and Eastern regions. Cogongrass [*Imperata cylindrical* (L.) Beauv.] was ranked as the worst weed by 41% of farmers. Wild poinsettia (*Euphorbia heterophylla* L.) was ranked second by 38% of farmers. Difficulty in weeding, interference with peanut, rapid growth, and profuse seeding were reasons given by farmers for ranking these weeds as the two most pernicious in Ghana. Weed control was perceived as poor by 65% of farmers, fair by 24% of farmers, and good by 12% of farmers. Sixty-nine percent of farmers hired labor for weed control. Weeding was done manually by 96% of growers with only 4% of weed control being achieved by herbicides. Farmers perceived that peanut yield loss, due to untimely or inappropriate weed control, could range from 21 to 80%.

Key Words: Cogongrass, groundnut, land tenure system, wild poinsettia, yield loss estimate.

Peanut is grown successfully in many tropical and subtropical countries worldwide because of its adaptability to a wide range of climatic and soil conditions and its nutritional value. Debrah and Waliyar (1996) reported that about 60% of Africa's peanut production comes from West Africa. In Ghana, peanut is grown in all the agroecological zones, and it is the most consumed legume after cowpea [*Vigna unguiculata* (L.) Walpers]. Recent increases in peanut yield have been attributed to the use of improved cultivars (PPMED, 1998). However, according to Akobundu (1987) weed infestation is one of the major causes of lower peanut yield in Africa compared with the United States.

Management of weeds in sub-Saharan Africa constitutes an estimated 40% of the total available farm labor (Akobundu, 1987). Weeds not only affect yield through direct interference but also serve as alternate hosts for insects, nematodes, and diseases. Consequently, determining the relationships among weed management practices and prevalence of other pests is essential. Chikoye et al. (1999) reported that cogongrass threatens the livelihood of at least 200 million people in West Africa because of its impact on crop yield.

Inconsistent weed management practices for peanut production necessitated the need for a survey to determine farmers' practices influencing weed management in southern Ghana in order to develop a comprehensive strategy that improves weed control in the region. The objective of this article is to summarize results of the survey of weed management practices in southern Ghana.

Materials and Methods

A survey was conducted in the Ashanti, Brong Ahafo, Eastern, and Volta regions of Ghana during 2001. These regions included Forest, Forest-Savanna transition, and Coastal Savanna ecological zones with bimodal rainfall that allows for two cropping seasons within a year. The forest zone that comprises the Eastern and part of the Ashanti regions has annual rainfall of 1400 to 1750 mm while the transition covers the entire of Brong Ahafo and a portion of the Ashanti region with a rainfall of 1200 to 1400 mm. Both zones have similar temperatures ranging from 28 to 31 C. The Volta region, which is part of the Coastal Savanna zone, has annual rainfall of 600 to 900 mm with temperatures of 22 to 31 C. The study involved surveying farmers from nine villages in the Volta region, four from the Ashanti region, seven in the Brong Ahafo region, and four villages from the Eastern region.

[1]Crops Research Institute, P. O. Box 3785, Kumasi, Ghana.
[2]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
[3]Departments of Entomology, Plant Pathology, and Crop Science, North Carolina State University, Box 7620, Raleigh, NC 27695.
*Corresponding author: david_jordan@ncsu.edu

Table 1. Common name, Latin binomial, and authority for weeds documented in southern Ghana.

Common name	Latin binomial and authority
Acalphya	*Acalphya citiata* Forsk
Annual morningglory	*Ipomoea* spp.
Bristly starbur	*Acanthospernum hispidum* DC
Butterfly pea	*Centrosema pubescens*
Calopo	*Calopogonium mucunoides* Desu.
Cogongrass	*Imperata cylindrica* (L.) Beauv.
Common dandelion	*Taraxacum officinale* G.H. Weber ex Wiggins
East Indian bristlegrass	*Setaria barbara* (Lam.) Kunth
Flor de conchitas	*Centrosema pubescens* Benth.
Guineagrass	*Panicum maximum* Jacq.
Itchgrass	*Rottboellia conchinchinensis* (Lour.) W. Clayton
Jamaican crabgrass	*Digitaria horizontalis* Willd.
Natal redtop	*Rhynchelytrum repens* (Wild.) C.E. Hubbard
Purple nutsedge	*Cyperus rotundus* L.
Red spiderling	*Boerhavia diffusa* L.
Siam weed	*Chromolaena odorata*
Signalgrass	*Brachiaria* sp.
Spinyhead sida	*Sida acuta* Burm. F.
Synedrella	*Synedrella nodiflora (L.)* Gaertn.
Tropic ageratum	*Ageratum conyzoides L.*
Tropical spiderwort	*Commelina benghalensis* L.
Wild poinsettia	*Euphorbia heterophylla* L.
Wild spikenard	*Hyptis suaveolens* (L.) Poit.
Wingleaf primrose	*Ludwiga decurrens* Walt.

Data were collected randomly through individually or groups of 2 to 3 interviews conducted in the field. Percentages of farmers employing land preparation in the categories of tillage by tractor, slash and burn; slash, burning, and manual ridging; slash, burn, and mounding, and tillage with hand implements and mounding were determined in relation to land tenure system. Land preparation systems were also compared among production regions. Farmers were also asked to list the most troublesome weeds in their peanut production system. The farmer also provided the perception of the ability to control weeds. The effectiveness of weed control pooled over land preparation system was listed qualitatively in the categories of poor, fair, or good. Farmers were also asked to list estimates of peanut yield loss under the different production systems.

While surveying farmers, five quadrants of 1.0 m^2 were randomly placed in surveyed fields during mid season and number of weeds by species recorded. Common name, Latin binomial, and authority of weeds reported in this article are presented in Table 1. Weed assessment based on percentage of ground cover was estimated visually using a scale of 0 to 100 where 0 = no cover by a specific weed and 100 = complete quadrant coverage by a specific weed. Discrete classes where established where 0 to 25% was considered as low, 26 to 50% as moderate, 51 to 75% as heavy, and greater than 75% as very heavy. Data were analyzed with SPSS 8.0 for Windows, and the most important crop and weeds were ranked by frequency of occurrence. Cropping intensity factor for each district was computed as:

$$\text{Cropping Intensity Factor (CIF)} = \frac{C}{C + F} \times 100$$

Where C = length of cropping; F = fallow period

Table 2. Characteristics of farming systems in southern Ghana.

Characteristic	Description	Percentage of farmers[a]
Farm size (ha)		
	Less than 1	56
	1 to 2	44
Land tenure system		
	Personally owned	18
	Owned by family	40
	Rented	33
	Sharecropped	4
	Other	5
Cropping system		
	Monocropped	62
	Mixed croppping	38

[a]Data are pooled over four production regions.

Table 3. Cropping system distribution within a growing season in selected production regions of southern Ghana.

Cropping system	Percentage of farmers[a]
Peanut only	64
Peanut/Corn	14
Peanut/Cassava	10
Peanut/Cassava/Cocoyam	3
Peanut/Yam/Cassava	3
Peanut/Corn/Cassava	3
Peanut/Cassava/Yam	3

[a]Data are pooled over four production regions.

Results and Discussion

Fifty-six percent of fields were less than 0.4 ha with 44% between 0.4 and 0.8 ha (Table 2). Five land tenure systems were in place with the two most prevalent systems being family or rent systems constituting 40 and 33%, respectively. Farmers owning land constituted 18% of farmers surveyed, while 5% or less were sharecropped or were engaged in some other land tenure system. Peanut was planted as a monocrop in 62% of fields (Table 2).

When peanut was not grown in a monoculture system, peanut was almost always grown in association with corn (*Zea mays* L.) or cassava (*Manihot esculenta* Crantz) compared with three-way multi-crop systems including cocoyam (*Xanthosoma* spp.) and yam (*Dioscorea rotundus* or *alata*) (Table 3). Across regions, 38% of fields had been fallowed for at least five years, while 36% had been continuously cropped for more than three years (Table 4). Mean fallow years and cropping length is 5.8 and 4.6%, respectively, with cropping intensity of less than 50% (Table 4).

The three land preparation systems included slash and burn, tillage with a tractor, and tillage using hand implements. Peanut was planted flat, in mounds, or on ridges. The slash-burn method of land preparation with any of the planting methods constituted 72% while tillage with a tractor or using hand implements were listed by 25% and 4% of respective respondents. Land preparation method was often associated with land tenure system (Table 5). Those farming on their own land or family lands employed the slash-burn-ridge combination while those on renting property used a tractor for tillage or employed the slash-burn-flat method. The latter were more inclined to these methods apparently because it was faster, and the initial cost comparatively less expensive. Planting on ridges was more prevalent in Brong Ahafo region (80%) while farmers in the Volta region planted on the flat on fields that were either tilled using a tractor or slash and burned. Seeding peanut in mounds following tillage with hand implements was used in the Ashanti region (Table 6).

Cogongrass was ranked as the most abundant weed across all regions by 41% of farmers (Table 7).

Table 4. Duration of fallow cropping and cropping intensity in southern Ghana.

Region	System		Cropping intensity[a]
	Fallow	Cropped	
	No. of years		%
Brong Ahafo	5.9	3.7	38.5
Ashanti	5.3	4.9	47.8
Eastern	5.0	6.0	54.5
Volta	6.7	4.2	38.3
Average across region	5.8	4.6	44.2

[a]Cropping intensity defines as $\frac{C}{C+F} \times 100$, where C = length of cropping system and F = fallow period.

Table 5. Relationship between land preparation method and land tenure system in southern Ghana.

Land tenure system	Land preparation system				
	Tractor tilled flat	Slash and burn flat	Slash, burn, and manual ridge	Slash, burn, and mound	Hoe, till, and mound
	% of farmers				
Personally own	14	0	50	25	0
Family owned	29	50	50	37	100
Rented	43	50	0	25	0
Sharecropped	0	0	0	13	0
Other	14	0	0	0	0

Table 6. Interaction of land preparation system and production region in southern Ghana.

Production region	Land preparation system				
	Tractor tilled flat	Slash and burn flat	Slash, burn, and manual ridge	Slash, burn, and mound	Hoe, till, and mound
	%				
Brong Ahafo	14	14	80	25	0
Eastern	14	29	0	25	0
Ashanti	29	14	20	50	100
Volta	43	43	0	0	0

Cogongrass is ranked the world's 7th most troublesome weed (Holm et al., 1977), and in West Africa it was reported in Senegal, Benin, Ghana, Nigeria, and Cameroon (Chikoye et al., 1999; Ivens, 1980) with coverage ranging from 9 to 97% of farmer's fields. In Nigeria, cogongrass has been reported to infest 260 million hectares of land and negatively affect nearly 80 million people residing in intensively cultivated areas of the moist savanna and humid forest zones (Chikoye et al., 1999; Anoka, 1995; Jagtap, 1995). Cogongrass with its high nutrient uptake offers serious competition to cereals, grain legumes, vegetables, and root and tuber crops (Saxena and Ramakrishnan, 1983), and apart from direct yield losses, rhizomes cause physical injury to tuber crops, predisposing them to attack by insect pests and disease pathogens. Cogongrass was reported as a noxious weed in about 60% of the African country reports (EPHTA, 1997).

Wild poinsettia was mentioned by 33% of farmers as the most deleterious weed (Table 6). Itchgrass has been reported as very competitive in yam, corn, cowpea, and soybean [*Glycine max* (L.) Merr.] (Akobundu et. al., 1987; Anchirinah et al., 1996). Purple nutsedge was also listed as negatively affecting peanut yield, and this weed is ranked as the world's most troublesome weed (Holms et al., 1977). Weed densities of cogongrass, wild poinsettia, and purple nutsedge ranged from 26 to 42 plants/m^2, 25 to 110 plants/m^2, and 5 to 20 plants/m^2, respectively (Table 8).

Sixty-five percent of farmers reported fair weed control while 12% and 23% of farmers perceived weed control to be poor and good, respectively (Table 9). Labor for follow-up weed control was not gender specific, and family labor was defined as the farmer alone or with his dependants by 21% and hired labor by 68% of the farmers. Eleven percent of farmers used a combination of family and hired labor to control weeds (Table 9). Hoeing was used by 91% of the farmers, the cutlass by 4%, and 4% applied herbicides (Table 9). Farmers generally weeded two to three times per season and approximately 10 to 30 workdays are needed to weed one ha depending on type of weeds and level of infestation (Table 9). In Senegal, weeding takes 63 man days/ha consisting of approximately 50% of total labor in peanut production (Chickoye et al., 1999).

Ninety-one percent of those who reported poor weed control methods did not know how long their lands had been fallowed before farming (data not

Table 7. Farmer's perception of difficulty in controlling weeds. Data are pooled over production regions in southern Ghana.

Common name	Ranking weeds as troublesome in peanut[a]		
	First	Second	Third
	% of farmers		
Annual morningglory	0	0	7
Calopo	0	0	7
Cogongrass	41	6	36
Flor de conchitas	7	6	0
Guineagrass	7	6	0
Itchgrass	0	19	7
Jamaican crabgrass	4	6	14
Purple nutsedge	4	13	0
Siam weed	4	6	7
Synedrella	0	6	0
Wild poinsettia	33	38	21

[a]Farmers were asked to list the three most troublesome weeds in their farming operation.

Table 8. Weed density and level of infestation in Brong Ahafo, Ashanti, Eastern, and Volta regions of southern Ghana.[a]

Weed	Region	Weed density	Weed infestation
		plants/m^2	%
Cogongrass	Ashanti	26	Moderate
Cogongrass	Brong Ahafo	49	Heavy
Cogongrass	Eastern	19	Low
Cogongrass	Volta	37	Moderate
Itchgrass	Ashanti	10	Low
Itchgrass	Brong Ahafo	22	Moderate
Itchgrass	Eastern	22	Moderate
Itchgrass	Volta	35	Heavy
Jamaican crabgrass	Ashanti	10	Heavy
Jamaican crabgrass	Brong Ahafo	1	Low
Signalgrass	Ashanti	26	Moderate
Signalgrass	Brong Ahafo	15	Moderate
Signalgrass	Volta	18	Moderate
Siam weed	Volta	15	Low
Tropic ageratum	Brong Ahafo	8	Low
Tropic ageratum	Volta	15	Moderate
Tropical spiderwort	Brong Ahafo	18	Moderate
Tropical spiderwort	Volta	12	Moderate
Wild poinsettia	Ashanti	60	Heavy
Wild poinsettia	Brong Ahafo	25	Low
Wild poinsettia	Eastern	110	Very heavy
Wild poinsettia	Volta	35	Moderate

[a]Weed assessment based on percentage of ground cover was estimated visually using a scale of 0 to 100 where 0 = no cover by a specific weed and 100 = complete quadrant coverage by a specific weed. Discrete classes where established where 0 to 25% was considered as low, 26 to 50% as moderate, 51 to 75% as heavy, and greater than 75% as very heavy.

Table 9. Weed control characteristics in southern Ghana. Data were poooled over production regions in southern Ghana.

Characteristic	Description	Percentage of farmers
Perception of weed control		
	Poor	12
	Fair	65
	Good	23
Type of labor by gender		
Family	Male	5
Family	Female	16
Hired	Male	47
Hired	Female	21
Family plus hired	Male	3
Family plus hired	Female	8
Weed Control		
	Hoe	91
	Cutlass	4
	Herbicide	4
Number of weeding times per crop		
	Once	33
	Two to three	59
	Unsure	4
	When necessary	4
Number of weeds per ha		
	10–20	60
	25–30	40

presented). Control of butterfly pea, cogongrass, Jamaican crabgrass, and wild poinsettia was considered poor by 50, 74, 100, and 67% of farmers, respectively (Table 10). While all farmers listed purple nutsedge and Siam weed control as poor, good control was perceived only for cogongrass. Farmers perceived weed control as good only when fields were tractor tilled or when fields were slashed, burned, and mounded (Table 11). Slashing and burning, either alone or when ridges were mounded manually, was perceived to be the fields with the poorest level of weed control. Eighty percent of farmers indicating that weed control was poor practiced slash and burn approach while 20% of those who reported of adequate weed control tilled fields (Table 11).

The combination of land preparation method and planting seemed to influence peanut yield loss ($r = 0.45$, $p = 0.05$). Farmers perceived that peanut yield loss could be in the range of 21 to 80% if weeds are not controlled timely or appropriately (Table 12). Seventy-five and 100% of farmers, who either tractor tilled and planted flat or employed the slash, burn, and ridge method, respectively, reported yield loss of 60% or less. Twenty–five percent of farmers and 60% farmers who tilled or slashed, burned and planted flat reported of yield loss of 61 to 80%. Also, farmers who employed the slash-burn-ridge method minimized yield losses to 60% relative to the other combinations. Most of the respondents, however, had observed that very good crop yields were realized on relatively fertile cogongrass infested fields if there was good and timely control.

Weed sampling revealed three major genera of nematodes were found associated with weed roots and included Meloidogyne, Pratilenchus, and Paratrichodorus (Table 13). Meloidogyne and Pratilenchus were found more often than Paratrichodoras. However, none of the these nematode groups were found associated with roots of wild spikenard, cogongrass, broomweed (*Sida acuta* Brum. F.), and only nematodes of the genera Pratilenchus were found associated with itchgrass in one region. All three general of nematodes were found associated with bristly starbur (Volta region), tropic ageratum, and wild poinsettia (Eastern and Volta regions) (Table 13).

Since agricultural practices can result in changes in occurrence of individual weed species, it is important to have information on the most

Table 10. Perception of weed control effectiveness by peanut farmers in southern Ghana.

Common name	Weed control		
	Good	Fair	Poor
	% of farmers		
Butterfly pea	0	50	50
Cogongrass	13	13	74
Jamaican crabgrass	0	0	100
Purple nutsedge	0	100	0
Siam weed	0	100	0
Wild poinsettia	0	33	67

Table 11. Influence of land preparation on farmer's perception of weed control in southern Ghana.

Weed control effectiveness	Land preparation system			
	Tractor tilled flat	Slash and burn flat	Slash, burn, and manual ridge	Slash, burn, and mound
	% of farmers			
Poor	40	80	100	50
Fair	40	20	0	25
Good	20	0	0	25

Table 12. Influence of land preparation method on estimated yield loss due to weed control success in southern Ghana.

Estimated yield loss	Land preparation system				
	Tractor tilled flat	Slash and burn	Slash, burn, and manual ridge	Slash, burn, and mound	Average
%	% of farmers				
21 to 40	25	0	25	0	10
41 to 60	50	40	75	13	38
61 to 80	25	60	0	75	48
Unsure	0	0	0	13	5

Table 13. Plant nematode population associated with weed roots in Brong Ahafo, Ashanti, Eastern, and Volta regions of southern Ghana.

Common name or Latin binomial	Region	Nematode		
		Meloidogyne	Pratilenchus	Paratrichodurus
		No./5 g root		
Acalphya	Brong Ahafo	11	3	0
Acalypha	Eastern	55	75	0
Bristly starbur	Volta	20	70	40
Cogongrass	Volta	0	0	0
Common dandelion	Volta	0	0	0
Itchgrass	Volta	0	0	0
Natal redtop	Volta	70	15	60
Red spiderling	Volta	65	35	0
Spinyhead sida	Volta	0	0	0
Spinyhead sida	Eastern	0	0	0
Tropic ageratum	Eastern	25	50	15
Tropical spiderwort	Brong Ahafo	29	11	-
Wild poinsettia	Brong Ahafo	20	17	16
Wild poinsettia	Eastern	75	30	50
Wild poinsettia	Volta	45	75	15
Wild spikenard	Volta	0	0	0
Wingleaf primrose.	Eastern	25	50	0

frequent species in particular cropping systems and how their control affects costs and crop yields. Knowledge of the weed management practices employed by farmers is also vital in developing control measures for a country where most of the fields belong to small-scale farmers who rely mostly on manual weed control, a time consuming and labor intensive practice.

Acknowledgements

The authors are grateful to the staff of Plant Health Division of the CSIR-Crops Research Institute and USAID for the financial support through Peanut CRSP, USAID (Grant No. LAG-G-00-96-90013-00).

Literature Cited

Akobundu, I.O. 1987. Weed control in other food crops. 522 pp. *In* Weed Science in the Tropics. Principles and practices. A Wiley-Interscience publication.

Anchirinah, V., D. Ojha, R. Owusu-Sekyere, N. Ramnanan, and S. Zhou. 1996. Production and marketing of yams in the forest/savanna transition zone of Ghana. International Centre for Development Oriented Research in Agriculture (ICRA). Working Document Series. 53:38-39, 67-68.

Anoka, A. 1995. Phenology of speargrass [*Imperata cylindrica* (L.) Räeuschel variety *Africana* (Andeass) C.E Hubbard], and the contributions of bush-fire, cultivation and nitrogen fertilizer to its persistence in arable lands. PhD. thesis, University of Reading, UK. 187 pp.

Chikoye, D., F. Ekeleme, and J.T. Ambe. 1999. Survey of distribution and farmers' perceptions of speargrass [*Imperata cylindrica* (L.) Raeuschel] in cassava-based systems in West Africa. Int. J. of Pest Management. 45(4):305-311.

Debrah, S.K., and F. Waliyar. 1996. Peanut production and utilzation in Western Africa: past trends, projections and opportunities for increased production. Paper delivered at the fifth Regional Peanut Workshop for West and Central Africa, 18–21 Nov., 1996. Accra, Ghana.

Holm, L.R., D.L. Plucknett, J.V. Pancho, and J.P. Herberger. 1977. *Imperata cylindrica* (L.) Beauv. pp. 62-71. *In* The world's worst weeds: Distribution and Biology. Honolulu, USA: University Press of Hawaii.

Ivens, G.L. 1980. *Imperata cylindrica* (L.) Beauv. in West Africa agriculture. BIOTROP Special Publication 5:149-156.

Jagtap, S.S. 1995. Environmental characterization of the moist lowland savanna of Africa. Proc. of the International Workshop. Cotonou, Benin: Produced by IITA, 382 pp.

PPMED, J. 1970–1998. Ministry of Food andAgriculture. Annual sample survey of Agriculture in Ghana.

Saxena, K.G., and P.S. Ramakrishnan. 1983. Growth and allocation strategies of some perennial weeds of slash and burn agriculture (Jhum) in northeastern India. Can. J. of Bot. 61:1300-1306.