Survey of Weeds and Management Practices in Peanut (*Arachis hypogaea* L.) in the Savanna Ecology of Ghana[1]

I.K. Dzomeku[1], M. Abudulai[2], R.L. Brandenburg[3], and D.L. Jordan[4]*

ABSTRACT

Peanut (*Arachis hypogaea* L.) is the most popular legume cultivated for food and cash in the Guinea and Sudan savannah ecologies of northern Ghana. A three-year survey was conducted between 2003 and 2005 to: (1) document the prevalence of weed species, (2) determine current cropping systems and weed management practices, and (3) assess the response of peanut to weed management practices. Flora with more than 5% dominance included: (1) the dicotyledonous weeds, *Corchorus olitorius* L. *Commelina benghalensis* L., *Commelina diffusa* Burm., f, *Desmodium scorpluras* (Sw.) Desv., *Hyptis suoveolens* Poit., *Mimosa invisa* Mart., *Mimosa pigra* L., *Mitracarpus villosus* (Sw.) DC., *Oldenlandia corymbosa* L., *Phyllanthus amarus* Schum. & Thonn., *Scoparia dulcis* L., *Tridax procumbens* L., *Triumfeta cordiflora* A. Rich., and *Vernonia galamensis* (Cass.) Less.; (2) the monocotyledonous weeds *Axonopus compresus* (Sw.) P. Beauv., *Cyperus esculentus* L., *Cyperus rotundus* L., *Digitaria horizontalis*Willd., *Eragrostis tremula* Hochst. Ex Steud., *Hackelochloa granularis* (L.) O. Ktze., *Kyllinga erecta* Schumach. Var., *Kyllinga squamulata* Thonn. Ex Vahl., *Paspalum scrobiculatum* L., *Rottboellia cochinchinensis* (Lour.) Clayton, and *Setaria pallide-fusca* (Schum.) Stapf. & C.E. Hubbard; and (3) the parasitic weed *Striga hermonthica* (Del.) Benth. Land preparation practices included the use of tractors, followed by use of livestock, and lastly hand preparation. Cropping systems consisted of cereals preceding peanut, peanut preceding peanut, and intercropping peanut with sorghum (*Sorghum bicolor* L. *Moench.*), millet (*Pennisetum Americanum* L.), or corn (*Zea mays* L.). Genetically-improved peanut cultivars expressing bunch or erect growth habits were the most common cultivars although some farmers planted local cultivars expressing a distinct runner growth habit. The majority of farmers planted peanut from early June to early July based on rainfall pattern. Eighty-eight percent of peanut fields were hand weeded once, 3 to 5 weeks after planting (WAP) or twice, 2 to 3 and 5 to 6 WAP. Weed management was generally poorly timed and insufficient to prevent significant weed interference resulting in total oven-dried weed biomass ranging from 600 to 2400 kg/ha at harvest. Peanut haulm production ranged from 500 to 5500 kg/ha with improved cultivars. Pod yield production ranged from 200 to 1680 kg/ha. Results from this survey revealed the need for accelerated research and capacity building of farmers and agricultural extension agents for improved technology transfer to the peanut industry in the region.

Key Words: Groundnut, weed management, West Africa.

Peanut (*Arachis hypogaea* L.) is the most widely cultivated legume crop in northern Ghana because of its adaptation to the climatic conditions and its ability to grow relatively well on poor soils (Gascho and Davis, 1995; Kaleem, 1990). Peanut is a major source of protein in human diets and haulms are important components of livestock feed in Ghana (Marfo, 1997). Edible oil is also extracted from peanut seed and is used for local consumption. Peanut is effective in rotation with corn and other cereals due to biological nitrogen fixation by peanut (Gascho and Davis, 1995; Kaleem, 1990).

Peanut production in the savanna ecology is of great potential in the West African region (Schilling and Misari, 1992). However, weed interference is a major constraint to optimum production requiring considerable investment of human labor to minimize negative impact on pod yield (Akobundu, 1987; FAO, 1994; Frimprong, 2002). Yield loss due to weed interference in West Africa is estimated to be 50 to 80% (Akobundu, 1987; Carson, 1979). The relatively slow initial growth of peanut and morphological characteristics that do not allow it to grow above weeds influences susceptibility of peanut to early season weed interference (Akobundu, 1987; Subrahmaniyan *et al.*, 2002). Although peanut is susceptible to weed interference, cultivars with running growth habit can suppress weeds by providing ground cover more quickly than cultivars with a more upright growth habit (Akobundu, 1980). Three timings of weed removal

[1]Department of Agronomy, University for Development Studies, P. O. Box TL 1882, Tamale, Ghana.
[2]CSIR-Savanna Agricultural Research Institute, P. O. Box 52, Tamale, Ghana.
[3]Department of Entomology, North Carolina State University, Box 7613, Raleigh, NC 27695-7613.
[4]Department of Crop Science, North Carolina State University, Box 7620, Raleigh, NC 27695-7620.
*Corresponding author: david_jordan@ncsu.edu

Table 1. Questions posed to farmers in northern Ghana at the time of weed surveys.

What method of land preparation did you perform?
What peanut cultivars do you plant?
What is the average planting date of peanut?
What is the frequency and timing of weeding peanut?
What is the cropping system associated with peanut?

during the first 6 weeks after plant (WAP) are recommended to substantially reduce weed interference in peanut (Akobundu, 1987).

Despite importance of peanut to the economy of Ghana, current information on weeds and other management constraints is limited. In order to formulate and transfer effective and sustainable weed management strategies in peanut, documentation of distribution of weeds and characterization of agronomic and weed management practices are needed. The objectives of this study were to (1) document the distribution and density of weeds in peanut cropping systems, (2) document current weed management practices of farmers, and (3) assess yield response of peanut to current farmer weed management strategies.

Materials and Methods

Prior to sampling each field, a short survey (Table 1) was administered to farmers to document information on method of land preparation; peanut cultivar; date of planting; and method, timing, and frequency of weed control practices. Cropping systems implemented also were documented. The survey was conducted in 48 farmer fields during 2003, 2004, and 2005 between August and October by randomly evaluating four 1-m^2 quadrants per field in the Northern, Upper East, and Upper West savannah regions of Ghana. Weed species, density of each species, weed biomass at harvest, peanut haulm production, and pod yield were recorded based on the 1-m^2 quadrants. Latin binomial and authority for each weed over the duration of the survey are presented in Table 2. Weed and peanut haulm biomass were individually oven dried at 80 C for 48 h. Average weed occurrence in farms was calculated using the Summed Dominance Ratio (SDR) approach (Dangol, 1991).

$$SDR\% = \frac{1}{2}\frac{\sum F}{\sum\sum F + \sum\sum D} \times 100 \quad (1)$$

where F = frequency of occurrence of a weed species within a field, D = density of occurrence within a field

Table 2. Latin binomials and authorities of weeds found in peanut fields in northern Ghana from 2003–2005.

Genus and species	Authority
Acalypha fimbriata	Schum.& Thnn.
Acanthospermum hispidium	DC.
Ageratum conyzoides	L.
Albizia zygia	(DC.) J. F. Machr.
Amaranthus spinosus	L.
Andropogon gayanus	Kunth var. Gayanus
Aspilia Africana	(Pers.) C.D Adams
Aspilia busei	O. Hoffm. & Muschl.
Axonopus compressus	(Sw.) P. Beauv.
Boerhavia diffusa	L.
Brachiaria deflexa	(Schumach.) C.E Hubbard ex Robyns
Brachiaria lata	(Schumach.) C.E Hubbard
Celosia laxa	Schum. & Thonn.
Cenchrus biflorus	Roxb.
Centrosema pubescence	Benth.
Chaemaecrista mimosoides	(L.) Greene
Chloris pilosa	Schumach.
Chrysanthellum indicum	(L.) Vatke var. *afroamecanum* Turner
Cleome viscosa	L.
Commelina benghalensis	L.
Commelina Africana	L.
Commelina diffusa	Burm, f.
Corchorus olittorius	L.
Croton lobatus	L.
Crotalaria retusa	L.
Cyperus esculentus	L.
Cyperus rotundus	L.
Dactyloctenium aegyptium	(L.) P. Beauv.
Desmodium scorpiurus	(Sw.) Desv.
Digitaria horizontalis	Willd.
Diodia sarmentosa	Sw.
Diodia scandens	Sw
Senna obtusifolia	(L.) Irwin & Barneby
Eleusine indica	L. Gaertn.
Eragrostis tremula	Hochst. ex Steud.
Euphorbia hirta	L.
Hackelochloa granularis	(L.) O. Ktze.
Hibiscus asper	Hook. F.
Hyparrhenia involucrata.	Stapf.
Hyptis lanceolata	Poir.
Hyptis spicigera	L.
Hyptis suaveolens	Poit.
Imperata cylindrica	(L.) Raeuschel var.
Ipomoea eriocarpa	R. Br.
Ipomoea vagans	Bak.
Kyllinga erecta	Schumach. Var.
Kyllinga squamulata	Thonn. ex Vahl
Lactuca spp.	_
Lactuca taraxacifolia	(Willd.) Schum. ex horsemann.
Leucas martinicensis	(Jacq.) Ait. f.
Ludwigia decurrens	Walt. Syn.
Mariscus alternifolius	Vahl.
Mimosa invisa	Mart.
Mimosa pigra	L.
Mitracarpus villosus	(Sw.) DC.

Table 2. Continued.

Genus and species	Authority
Mollugo nudicaulis	Lam.
Oldenlandia corymbosa	L.
Panicum pilosa	-
Panicum repens	L.
Panicum scrobium	-
Paspalum conjugatum	Berg.
Paspalum orbiculare	Forst.
Paspalum scrobiculatum	L.
Pennisetum pedicellatum	Trin.
Pennisetum polystachyion	(L.) Schult.
Phyllanthus amarus	Schum. & Thonn.
Physalis angulata	L.
Physalis insertii	-
Physalis micrantha	L.
Rhynchelytrum repens	(Wild.) C.E. Hubbard.
Rottboellia cochinchinensis	(Lour.) Clayton
Schizachyrium exile	Pilger
Schwenckia americana	L.
Scoparia dulcis	L.
Sesamum indicum	L.
Setaria pallide-fusca	(Schum.) Stapf. & C.E. Hubbard
Setaria pumila	(Poir.) Roem & Schult.
Spermacoce verticillata	L.
Stachytarpheta cayennensis	(L. C. Rich) Schau.
Striga hermonthica	(Del.) Benth
Zornia latifolia	Sm.
Tephrosia pedicellata	Bak.
Tridax procumbens	L.
Triumfetta cordifolia	A. Rich.
Vernonia galamensis	(Cass.) Less.

on the scale of 0 to 4, where 0 = no occurrence of a weed species (1 m^2) and 4 = 20 or more plants of the weed species. Coefficient correlations were determined for weed biomass and haulm production versus pod yield at $p < 0.01$.

Results and Discussion

Characteristics of peanut cropping systems. The surface soil texture of the survey area generally consisted of silt loam (48%), sandy loam (48%) and silty clay loam (2%) (data not presented). Forty-four percent of farmers prepared land with a tractor while 37% used livestock to plow fields and 20% used traditional hoeing to prepare land for planting (data not presented). Nine and 18% of farmers planted peanut in April and May, respectively, while 41% planted in June and 32% planted in early July (data not presented). Planting coincided with the stability of rainfall and temperatures suitable for optimum for germination and seedling establishment (Abudulai *et al.*, 2007).

Similar to a survey by Bolfrey-Arku *et al.* (2006) in southern Ghana, hoeing was the dominant weed control method practiced by 91% of farmers (data not presented). Fifty-two percent of farmers weeded only once, which is less than recommended to optimize peanut yield (Akobundu, 1987). Thirty-six percent of the farmers weeded their fields twice at 3 and 6 WAP while only 2% weeded three times. Bolfrey-Arku *et al.* (2006), in southern Ghana, reported that 33 and 59% of farmers weeded peanut fields once or twice, respectively. Herbicides were applied by 9% of farmers in northern Ghana (data not presented) compared with only 4% of farmers in southern Ghana (Bolfrey-Arku *et al.*, 2006).

Generally, cereals such as corn preceded peanut, but peanut following peanut was also practiced. Farmers planted improved peanut cultivars with bunch or erect morphological characteristics, primarily the cultivar China, although some farmers planted locally-derived cultivars such as Bugla. Intercropping peanut with cereals was common but monocropping of peanut for several years prior to rotation with cereals was also practiced (data not presented). Although pod yield was the primary criteria for cultivar selection, cultivars were also selected by farmers based on their suppressive ability against weeds; the runner morphology of the improved cultivar Manipintar was preferred on these farms (Abudulai *et al.*, 2007).

Prevalent weed species and their level of dominance. Weed species associated with peanut fields were highly diversified in species composition and density in the three regions (Tables 3–5). Generally, dicotyledonous weeds dominated the flora followed by monocotyledonous weeds (grasses and sedges) and the parasitic weed *Striga hermonthica*. Average weed occurrence (at least 5% SDR) for the three years included the dicotyledonous weeds: *Corchorus olitorius*, *Commelina benghalensis*, *Commelina diffusa*, *Desmodium* spp., *Hyptis suoveolens*, *Mimosa invisa*, *Mimosa pigra*, *Mitracarpus villosus*, *Oldenlandia corymbosa*, *Phyllanthus amarus*, *Scoparia dulcis*, *Tridax procumbens*, *Triumfeta cordiflora*, and *Vernonia galamensis*; and the monocotyledonous weeds *Axonopus compresus*, *Cyperus* spp., *Digitaria horizontalis*, *Eragrostis tremula*, *Hackelochloa granularis*, *Kyllinga* spp., *Paspalum scrobiculatum*, *Rottboellia cochinchinensis*, and *Setaria pallide-fusca*.

During 2003, a total of 38 weed species were observed in the Northern Region, of which 23 were dicotyledonous, 14 were monocotyledonous (11 grasses and 3 sedges), and 1 parasitic weed (Table 3). In the Upper East Region, 29 species were observed with 17 being dicotyledonous, 11 monocotyledonous (7 grasses and 4 sedges), and 1 parasitic weed

Table 3. Mean occurrence of weed species (%) at crop maturity in the three northern regions of Ghana, 2003.

Northern Region		Upper East Region		Upper West Region	
Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]
	%		%		%
Dicotyledonous		**Dicotyledonous**		**Dicotyledonous**	
Ageratum conyzoides	0.92	*Acalypha frimbriata*	0.33	*Aspilia bussei*	0.35
Albizia zygia	0.70	*Acanthospermum hispidium*	0.38	*Commenlina benghalensis*	0.95
Aspilia busei	0.32	*Aspilia bussei*	2.25	*Corchorus olitorius*	2.08
Commenlina benghalensis	1.54	*Commenlina benghalensis*	2.45	*Desmodium scrorpuirus*	1.55
Commenlina Africana	1.26	*Commenlina Africana*	4.6	*Diodia sarmentosa*	3.40
Croton lobatus	0.64	*Diodia sarmentosa*	4.49	*Hyptis lanceolata*	0.58
Diodia sarmentosa	2.68	*Hyptis suaveolens*	1.30	*Hyptis suaveolens*	3.35
Hibiscus asper	1.18	*Ipomea vegans*	3.75	*Lactuca teraxacifolia*	0.45
Hyptis spicigera	0.66	*Leucas martinicensis*	2.23	*Mimosa* spp.	1.30
Hyptis suaveolens	6.70	*Mitracarpus villosus*	5.15	*Mitracarpus villosus*	4.80
Ipomoea vegans	0.32	*Mollugo nudicanlis*	1.15	*Oldenladia corymbosa*	1.50
Lactuca spp.	0.22	*Oldenladia corymbosa*	1.75	*Phyllanthus amarus*	6.60
Corchorus olitorius	3.42	*Corchorus olitorius*	5.90	*Senna obtusifolia*	0.40
Lactuca teraxacifolia	0.40	*Phyllanthus amarus*	0.40	*Spermacoce verticillata*	0.85
Leucas martinicensis	0.48	*Physalis micrantha*	1.15	*Vernonia galamensis*	38.55
Ludwigia decurrens	1.26	*Tephrosia pedicellata*	1.60	**Monocotyledonous**	
Mimosa spp.	0.32	*Triumfetta cordifolia*	27.05	*Axonopus compressus*	0.93
Mitracarpus villosus	5.72	**Monocotyledonous**		*Bracharia lata*	0.70
Oldenladia corymbosa	0.56	*Bracharia lata*	0.63	*Digitaria horitzontalis*	2.95
Phyllanthus amarus	1.80	*Digitaria horizontalis*	3.60	*Hackelochloa granularis*	1.10
Schwenkia Americana	0.76	*Eragrotis tremula*	0.65	*Hyparrheania* spp.	0.70
Tridax procumbens	3.08	*Hackelochloa granularis*	3.88	*Panicum ripens*	0.58
Vernonia galamensis	22.02	*Paspalum scrobiculatum*	1.80	*Pennisetum pedicellata*	1.78
Monocotyledonous		*Pennisetum polystachion*	0.60	*Rottboellia cochinchinensis*	2.33
Axonopus compressus	2.74	*Rottboellia cochinchinensis*	1.85	*Setaria pallide-fusca*	19.28
Bracharia lata	1.30	*Cyperus esculentus*	2.50	*Mariscus alternifolius*	4.65
Digitaria horizontalis	6.00	*Cyperus rotundus*	0.95	*Kyllinga erecta*	13.38
Hackelochloa granularis	1.68	*Kyllinga erecta*	7.43		
Paspalum conjugatum	0.64	**Parasitic weed**			
Paspalum obiculare	2.24	*Striga hermonthica*	1.60		
Paspalum scrobiculatum	1.68				
Pennisetum polystachion	0.24				
Rottboellia cochinchinensis	1.68				
Setaria pallide-fusca	16.14				
Cyperus esculentus	1.64				
Kyllinga erecta	2.54				
Parasitic weed	-				
Striga hermonthica	1.08				

[a]Weed species with less than 0.1% mean occurrence in a region were excluded from data.
[b]SDR = Summed dominance ratio of weed species.

(Table 3). In the Upper West Region, the weed flora composed of 15 dicotyledonous and 11 monocotyledonous species (9 grasses and 2 sedges). Weed flora distribution in 2004 in the Northern Region consisted of 38 species (26 dicotyledonous, 11 monocotyledonous, and 1 parasitic weed) (Table 4). In the Upper East Region 24 dicotyledonous and 13 monocotyledonous were observed. In the Upper West Region a total of 33 species were distributed as 16 dicotyledonous and 17 monocotyledonous species (Table 4). In 2005, weeds in peanut cropping system in the surveyed area revealed 37 species (23 dicotyledonous and 14 monocotyledonous), 33 species (23 dicotyledonous and 10 monocotyledonous), and 32 species (17 dicotyledonous, 14 monocotyledonous, and 1 parasitic species) in the Northern, Upper East, and Upper West Regions, respectively (Table 5).

There were differences between levels of dominance of the various weed types at the different locations (data not shown). Locations with less weed dominance had a relatively more effective

Table 4. Mean occurrence of weed species (%) at crop maturity in the three northern regions of Ghana, 2004.

Northern Region		Upper East Region		Upper West Region	
Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]
	%		%		%
Dicotyledonous		**Dicotyledonous**		**Dicotyledonous**	
Ageratum conyzoides	2.78	*Acanthospermum hispidium*	0.32	*Acanthospermum hispidium*	1.98
Amaranthus spinosus	1.50	*Amaranthus spinosus*	0.43	*Ageratum conyzoides*	1.60
Boerhavia diffusa	0.36	*Aspilia africana*	2.92	*Aspilia Africana*	0.34
Celosia laxa	0.50	*Boerhavia diffusa*	1.08	*Celosia laxa*	0.38
Commelina Africana	1.72	*Celosia laxa*	1.08	*Commenlina africana*	0.72
Commelina benghalensis	2.58	*Centrocema* spp.	1.08	*Commenlina benghalensis*	3.82
Corchorus olitorius	2.26	*Cleome viscose*	0.32	*Corchorus olitorius*	4.68
Corchorus spp	2.28	*Commelina benghanlensis*	7.35	*Desmodium* spp.	1.14
Crotolaria retusa	1.58	*Corchorus olitorius*	3.03	*Diodia sarmentosa*	3.70
Croton lobatus	1.12	*Croton lobatus*	0.47	*Euphorbia hirta*	1.98
Diodia sarmentosa	1.18	*Croton* spp.	0.72	*Hyptis suaveolens*	8.92
Hyptis lanceolata	4.66	*Desmodium* spp.	5.60	*Ipomoea vegans*	2.24
Hyptis suaveolens	3.37	*Diodia sarmentosa*	3.18	*Leucas martinicensis*	4.04
Ipomoea galamensis	0.62	*Euphorbia hirta*	0.73	*Mitracarpus villosus*	9.96
Ipomoea vegans	0.94	*Hyptis suaveolens*	3.45	*Tridax procumbens*	1.78
Lactuca taraxacifolia	2.82	*Ipomoea vagans*	2.82	*Vernonia galamensis*	2.56
Leucas martinicensis	2.38	*Leucas martinicensis*	3.97	*Oldenlandia corymbosa*	4.25
Ludwigia decurrens	0.60	*Ludwigia decurrens*	1.25	**Monocotyledonous**	
Mimosa pigra	0.46	*Mitracarpus villosus*	5.70	*Bracharia lata*	3.66
Mitracarpus villosus	6.64	*Oldenlandia conymbosa*	2.73	*Chloris pilosa*	1.18
Oldenlandia corymbosa	1.64	*Physalis insertii*	0.68	*Dactyloctenium aegyptium*	3.42
Phyllanthus amarus	1.74	*Stylosanthes* spp.	0.57	*Digitaria horizontalis*	7.78
Schwenckia americana	1.36	*Tephrosia pedcellata*	1.73	*Schizachyrium exile*	1.14
Stachytaphyta cayenensis	0.66	*Triumfetta cordifolia*	0.50	*Eragrostis tremula*	6.80
Tridax procumbens	4.06	**Monocotyledonous**		*Hackelochloa granularis*	8.76
Vernonia galamensis	3.5	*Cenchrus biflorus*	2.53	*Imperata cylindrica*	0.40
Monocotyledonous		*Dactyloctenium aegyptium*	1.45	*Paspalum scrobiculatum*	4.52
Axonopus compressus	1.22	*Digitaria horizontalis*	9.12	*Pennisetum polystachion*	1.42
Brachiaria brassica	1.10	*Eleucine indica*	0.57	*Rhynchelytrum repens*	0.32
Brachiaria lata	3.24	*Eragrostis tremula*	2.12	*Rottboellia conchinchinensis*	4.70
Digitaria horizontalis	1.62	*Hackelochloa granularis*	2.40	*Setaria pallisade-fusca*	1.54
Hackelochloa granularis	3.80	*Panicum scrobiculatum*	0.75	*Mariscus alternifolius*	0.56
Paspalum obiculare	2.82	*Paspalum scrobiculatum*	0.72	*Cyperus esculentus*	0.82
Pennisetum spp.	2.28	*Pennisetum* spp.	0.62		
Rottboellia cochinchinensis	4.76	*Rottboellia cochinchinensis*	0.62		
Setaria palisade-fusca	3.94	*Mariscus alternifolius*	3.70		
Mariscus alternifolius	4.88	*Cyperus esculentus*	3.00		
Kyllinga spp.	1.33	*Kyllinga* spp.	4.23		
Parasitic weed					
Striga hermonthica	1.52				

[a]Weed species with less than 0.1% mean occurrence in a region were excluded from data.
[b]SDR = Summed dominance ratio of weed species.

weed management with associated higher peanut haulm and pod yield than those with higher weed infestations. Due to their rapid proliferation and regeneration ability through stem cuttings , dicotyledonous weeds such as *Commelina benghalensis* and *Commelina africana* L. have been identified by the farmers as difficult to manage, as hoeing leads to breakage and multiplication of their vegetative propagules (Akobundu, 1987). Nitrogen fixation by the previous peanut crop could also stimulate growth of weeds (Kaleem, 1990). Despite the higher abundance of dicotyledonous weeds relative to monocotyledonous weeds, the latter poses a more serious threat to both peanut and farmer management efforts. Monocotyledonous weeds such as *Digitaria horizontalis*, *Cynodon dactylon* (L.) Pers., and *Paspalum scrobiculatum* L. regenerate quickly while *Rottboellia cochinchinensis* and

Table 5. Mean occurrence of weed species (%) at crop maturity in the three northern regions of Ghana, 2005.

Northern Region		Upper East Region		Upper West Region	
Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]	Latin binomial[a]	SDR[b]
	%		%		%
Dicotyledonous		**Dicotyledonous**		**Dicotyledonous**	
Acalypha fimbriata	2.12	*Acanthospermum hispidum*	0.62	*Centrosema pubescence*	1.74
Ageratum conyzoides	3.03	*Chrysanthemum indicum*	0.42	*Cleome viscosa*	0.44
Aspilia busei	0.75	*Cochorus olitorius*	4.28	*Cochorus olitorius*	1.64
Chaemaecrista mimosoides	1.18	*Commelina benghalensis*	4.24	*Commelina diffusa*	6.08
Cochorus olitorius	2.70	*Commelina diffusa*	3.71	*Hyptis lanceolata*	0.94
Commelina benghalensis	5.50	*Dodia sarmentosa*	1.54	*Hyptis suaveolens*	1.16
Commelina diffusa	3.22	*Euphorbia hirta*	1.50	*Leucas martinicensis*	4.32
Crotalaria spp.	1.08	*Hyptis lanceolata*	0.88	*Ludwigia decurrens*	4.80
Croton lobatus	1.25	*Hyptis suaveolens*	2.70	*Mimosa invisa*	5.98
Diodia scandense	4.47	*Ipomoea vegans*	3.22	*Mimosa pigra*	5.70
Hyptis lanceolata	3.07	*Leucas martinicensis*	2.70	*Mitracarpus villosus*	1.20
Hyptis suaveolens	3.68	*Ludwigia decurrens*	3.22	*Mollugo nudicaulis*	4.18
Ipomoea vegans	2.83	*Mimosa pigra*	2.28	*Oldenlandia corymbosa.*	2.00
Leucas martinicensis	4.98	*Mitrocarpus villosus*	1.50	*Phyllanthus amarus*	6.38
Mimosa invisa	0.93	*Mollugo nudicaulis*	1.02	*Spermacoce verticillata*	1.72
Mimosa pigra	0.77	*Oldelandia corymbosa*	6.90	*Tridax procumbens*	1.34
Mitracarpus villosus	6.20	*Phyllanthus amarus*	4.18	*Vernonia galamensis*	1.34
Oldelandia corymbosa	1.13	*Scoparia dulcis*	6.66	**Monocotyledonous**	
Phyllanthus amarus	2.68	*Sesamum* indicum	1.06	*Andropogon gayanus*	2.46
Physalis angulata	2.27	*Spermacoce verticillata*	1.30	*Axonopus compressus*	8.22
Schwenckia americana	1.33	*Tridax procumbens*	0.62	*Brachiaria lata*	2.86
Tridax procumbens	7.45	*Triumfetta cordifolia*	1.66	*Dactyloctenum aegyptium*	0.84
Vernonia galamensis	4.45	*Vernonia galamensis*	0.42	*Digitaria horizontalis*	8.34
Monocotyledonous		**Monocotyledonous**		*Eragrostis tremula*	0.90
Andropogon gayanus	0.90	*Axonopus compressus*	7.18	*Hackelochloa granularis*	1.34
Kyllinga squamulata	2.58	*Rottboellia cochinchinensis*	1.76	*Kyllinga squamulata*	7.00
Imperata cylindrica	1.60	*Pennisetum pedicellatum*	0.80	*Mariscus alternifolius*	3.86
Axonopus compressus	1.27	*Brachiaria lata*	1.96	*Paspalum scrobiculatum*	6.94
Brachiaria lata	2.83	*Dactyloctenium aegyptium*	1.68	*Paspalum* spp.	0.90
Chloris pilosa	1.68	*Digitaria horizontalis*	6.32	*Pennisetum pedicellata*	0.76
Digitaria horizontalis	0.55	*Mariscus alternifolius*	9.04	*Rottboellia cochinchinensis*	1.46
Hackelochloa granularis	5.73	*Paspalum scrobiculatum*	4.92	*Setaria pumila*	1.20
Mariscus alternifolius	2.87	*Setaria pallide-fusca*	1.54	**Parasitic weed**	
Panicum pilosa	1.45	*Kyllinga squamulata*	5.58	*Striga hermonthica*	0.62
Paspalum scrobiculatum	6.13				
Pennisetum pedicellatum	0.98				
Rottboellia cochinchinensis	3.68				
Setaria pallide-fusca	1.70				

[a]Weed species with less than 0.1% mean occurrence in a region were excluded from data.
[b]SDR = Summed dominance ratio of weed species.

Ishaemunm rogosum Salisb. are highly competitive (Akobundu, 1987). Most of the grasses are anatomically C-4 plants and express higher photosynthetic rates than peanut, especially under conditions of elevated temperatures and limited soil moisture (Akobundu, 1987). Although parasitic weeds, especially *Striga hermonthica*, form a small proportion of weeds in the peanut cropping system, they constitute the most important biotic weed pest in cereal-peanut intercropping systems (Parker and Riches, 1993).

Weed dry matter production in farmer fields at crop maturity. Despite weed management interventions using hoeing, weed dry matter production at crop harvest in farmers fields during the three years and ranged from 650 to 2350 kg/ha, 650 to 2400 kg/ha, 600 to 2100 kg/ha during 2003, 2004 and 2005, respectively (Table 6). In 2003, the

Table 6. Mean weed biomass, vine biomass and pod production of peanuts from at eighteen locations in the Northern, Upper East and Upper West Regions of Ghana during 2003, 2004 and 2005.[a]

Region and location	Weed biomass			Haulm			Pod production		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
	kg/ha								
Northern									
Bagurugu	1450	1000	1200	850	1000	5000	920	1200	1680
Gushegu	1250	800	1250	610	700	3600	940	950	680
Karaga	-	700	2100	-	950	3200	-	900	800
Nyong	1400	650	1800	850	1800	4500	1480	810	950
Pishigu	1350	-	900	1010	-	7500	1180	-	1150
Tingoli	1500	-	1200	480	-	-	820	-	960
Upper East									
Bawku	1850	-	750	830	-	3800	440	-	660
Nangode	650	-	-	1000	-	-	580	-	-
Navrongo	-	2400	2000	-	820	3000	-	210	500
Sumburugu	1250	1250	-	570	1620	-	600	610	-
Winkogo	900	900	800	510	1120	2000	520	400	420
Zebila	-	750	1050	-	860	3300	-	900	450
Zuarungu	-	1100	1350	-	1530	5000	-	680	800
Upper West									
Jirapa	2050	650	750	980	820	4000	540	580	1050
Lawra	1250	700	950	1230	590	2700	460	540	680
Nandom	1100	1350	1200	1490	850	5500	500	790	770
Tumu	-	2350	600	-	1110	5200	-	880	660
Wa	2350	1250	1550	1460	680	2200	800	500	470

[a]Data are from four fields per location and four replications per field in each sampling year.

highest weed biomass was produced at Wa in the Upper West Region but this was similar to results at all the locations in Northern Region and two other locations each in the Upper West and Upper East Regions. In 2004, weed biomass production was highest at Navrongo in the Upper East Region but this value was not different from weed production at three locations in the Upper West and two locations each in the Upper East and Northern Regions. In 2005, Karaga, in the Northern Region, recorded the highest weed biomass production but this was similar to most locations in the three regions.

Generally, the dominantly one hoe-weeding regime practiced by farmers in the survey region does not reduce weed interference sufficiently to optimize peanut yield (Akobundu, 1987). Akobundu (1987) observed that the growth of peanut is slow and therefore could require more than two hand weeding regimes to offer adequate protection of the crop against weed interference.

Peanut haulm production in farmer fields at crop maturity. Peanut haulm production in farmer fields in each year of the survey was low (Table 6). In 2003, haulm production was lowest and in the range of 510 to 1490 kg/ha (Table 6). Haulm production was higher and ranged from 590 to 1800 kg/ha during 2004 (Table 6). Production increased considerably and was high at all locations during 2005, ranging from 860 to 5500 kg/ha (Table 6). Higher rainfall during 2005 compared with 2003 or 2004 most likely contributed to higher yields (data not presented). The wide variation in peanut haulm in farmer fields in the three years is

Table 7. Correlation coefficients of peanut parameters of weed biomass with haulm and pod yield in the Northern, Upper East and Upper West Regions of Ghana during 2003–2005 cropping seasons.

Parameter	2003		2004		2005	
	Weed biomass	Haulm	Weed biomass	Haulm	Weed biomass	Haulm
Haulm	−0.30	1.00	0.25	1.00	0.40	1.00
Pod yield	−0.59*	−0.55*	−0.87*	−0.65*	−0.84*	−0.80*

*Denotes significance at $p \leq 0.01$.

indicative of non-attainment of the potential haulm production for the zone. This shortfall in haulm production has the implication of limited appropriate agronomic crop management practices by farmers and could potentially reduce haulm used as feed for livestock production.

Peanut pod production in farmer fields. Peanut pod production in farmer fields exhibited significant variation among locations in each of the three years (Table 6). Pod production was low ranging from 520 to 1480 kg/ha during 2003, 210 to 1200 kg/ha during 2004, and 420 to 1680 kg/ha during 2005 (Table 6). Generally, pod production was highest in the Northern Region and Bagurugu gave the highest yield in 2005 due likely to a better production environment of rainfall (Kasei, 1988), soil fertility, and cropping history.

Relationship between weed biomass, peanut haulm, and pod production. Weed biomass and peanut haulm were negatively correlated with pod production in each year of the survey (Table 7). The correlation coefficients were moderate in 2003 for both weed biomass and haulm production and above average for haulm production in 2004. However, weed biomass gave consistently high correlation coefficients with pod yield in 2004 and 2005, while the coefficient of haulm with pod yield was high only in 2005.

The potential haulm yield of some peanut cultivars including a local cultivar at Nyankpala in the Northern Region ranged from 2180 to 3000 kg/ha (Marfo, 1997). The prospective kernel yield of peanut cultivars including some local entries in the zone could be high, in the range of 760 to 6200 kg/ha (Marfo, 1997). It is apparent that effective weed management regimes which remove weed interference increase peanut haulm and pod yield. FAO (1994) reported that in-row weed density of approximately 1 plant/m resulted in a yield loss of 32 to 45%. The dominance of annual weeds in the cropping system could confer additional interference due to similarity in root habit of the crop and the associated weeds of annual growth cycle (Akobundu, 1987). Consequently, weed biomass at crop harvest was high enough to indicate likely high degree of weed interference during crop development with subsequent reduction in peanut yield. Prolonged weed-peanut interference most likely was responsible for the low haulm and pod yield in these fields.

Peanut cultivars with high haulm production could offer some measure of weed suppression to reduce weed-peanut interference and promote higher haulm and pod yield (Akobundu, 1987). Reducing peanut haulm and pod yield due to weeds will require combination of management practices including improved seedbed preparation, timely planting, appropriate fertilizer application, timely weeding at the appropriate frequency, crop rotation, and fallow management. Furthermore, additional research should include greater capacity building of farmers and Agricultural Extension agents in integration of proven and alternative weed management tactics including selective herbicides to increase peanut production in northern Ghana (Akobundu, 1990; Labrada, 2002).

Acknowledgements

We are grateful to the United States Agency for International Development (USAID) Peanut CRSP (LAG-G-00-96-90013-00) for financial support. Appreciation is expressed to Fred Anaman, D. Opare-Atakora, Issifu Ramat, and Osman Iddrisu for technical assistance.

Literature Cited

Abudulai, M., I.K. Dzomeku, A.B. Salifu, S.K. Nutsugah, R.L. Brandenburg, and D.L. Jordan. 2007. Influence of cultural practices on soil arthropods, leaf spot, pod damage, and yield of peanut in Northern Ghana. Peanut Sci. 34:72-78.

Akobundu, I.O. 1980. Weed science research at the International Institute of Tropical Agriculture and research needs in Africa. Weed Sci. 28:439-445.

Akobundu, I.O. 1987. Weed control in other food crops. *In* Weed Science in the Tropics: Principles and Practices. A John Wiley and Sons publication, Chichester. 522 p.

Akobundu, I.O. 1990. The role of weed control in integrated pest management for tropical root and tuber crops, pp. 23-29. *In* S.K. Hahn and F.E. Cravenness (eds.). Integrated Pest Management for the Tropical Root and Tuber Crops. IITA. Ibadan, Nigeria.

Bolfrey-Arku, G., M. Owusu-Akyaw, J.V.K. Afu, J. Adu-Mensah, F.O. Anno-Nyako, E. Moses, K. Osei, S. Osei-Yeboah, M.B. Mochiah, I. Adama, A.A. Dankyi, R.L. Brandenburg, J.E. Bailey, and D.L. Jordan. 2006. Survey of weed management in peanut (*Arachis hypogaea* L.) fields in southern Ghana, West Africa. Peanut Sci. 33:90-96.

Carson, A.G. 1979. Weed competition and control in peanut (*Arachis hypogaea* L). Ghana J. Agric. Sci. 9:169-173.

Dangol, D.R. 1991. Rice field weeds in Chitwan Valley, Nepal, pp. 1627-1628. *In* J. Maclean (ed.). Rice Science for a Better World – International Rice Research Institute Newsletter. Los Baños, Philippines.

FAO. 1994. Weed Management for Developing Countries, pp. 30-34, 335-339. *In* R. Labrada, J.C. Casely, and C. Parker (eds.). FAO Plant Production and Protection Paper 120. Food and Agriculture Organization of the United Nations. Rome.

Frimpong, A. 2002. Production guide on peanut and bambara peanut, pp. 1-11. *In* V.A. Clottey, A.Y. Alhassan, S.K. Asante, and R.K. Owusu (eds.). Savanna Agricultural Research Institute. Tamale, Ghana.

Gascho, G.J. and J.G. Davis. 1995. Soil fertility and plant nutrition, pp. 383-418. *In* H.E. Pattee and H.T. Stalker (eds.). Advances in Peanut Science. Am. Peanut Research and Education Society, Stillwater, OK.

Labrada, R. 2002. The need for improved weed management in rice, 306 pp. *In* Dat Van and R. Duffy (eds.). Proc. 20th Session of the International Rice Commission. July 23–26, 2002. Bangkok, Thailand.

Kaleem, F. 1990. Assessment of nitrogen fixation by legumes and their relative contribution to a succeeding maize crop in the savannah zone of Ghana, pp. 123-127. *In* H. Rudat, H. Mercer-Quarshie, J.

von Bargen, K.O. Marfo, A.B. Salifu, A.L. Nyamekye, J.J. Afuakwa, R.C. Dekuku, and P.Y.K. Sallah (eds.). Proc. of the Second Workshop on Improving Farming Systems in the Interior Savanna Zone of Ghana. 24–26th April, 1990. Nyankpala Agricultural Experiment Station, Nyankpala. Ghana.

Kasei, C.N. 1988. The physical environment of Semi-arid Ghana, pp. 350-354. *In* Challenges in Dryland Agriculture. A Global Perspective. Proceeding of the International Conference on Dry land Farming, August 1988, Amarillo/Bushland, Texas. Texas A and M University Press. College Station, Texas.

Marfo, K.O. 1997. The performance and association among some important peanut yield traits in northern Ghana, pp. 133-140. *In* H. Mercer-Quarshie, K.O. Marfo, A.S. Langyintuo, and R.K. Owusu (eds.). Proc. of the 3rd Workshop on Improving Farming Systems in the Interior Savanna Zzone of Ghana. 27–29th April, 1993. Nyankpala Agricultural Experiment Station, Tamale, Ghana.

Parker, C. and C.R. Riches. 1993. Parasitic weeds of the world: Biology and control. CAB International Wallingford, UK. 332 pp.

Schilling, R. and S.M. Misari. 1992. Assessment of research achievements in the savannah region in West Africa, pp. 97-112. *In* S.N. Nigam (ed.). Groundnut – a global perspective: Proceedings of International Workshop, 25–29 Nov. 1991. ICRISAT Centre, Patancheru, A.P. 502 324, India.

Subrahmaniyan, K., P. Kalaiselvan, and N. Arulmozih. 2002. Weed control in groundnut (*Arachis hypogaea* L.) with polyethylene film mulching. Int. J. Pest Manage. 48:261-264.