ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Journal of Agronomy 6 (4): 534-540, 2007
ISSN 1812-5379

Time of Planting Mucuna and Canavalia in an Intercrop System with Maize

[1]Y.D. Innocent Lawson, [2]Israel K. Dzomeku and [2]Yahaya J. Drisah
[1]Department of Soil Science, University of Ghana, Legon, Ghana
[2]Department of Agronomy, Faculty of Agriculture,
University for Development Studies, Box TL 1882, Tamale, Ghana

Abstract: Field experiment was conducted to investigate the effects of two cover crops, *Mucuna pruriens* var. *cocchinchinensis* and *Canavalia ensiformis*, on weed interference and yield of maize (*Zea mays* var *Okomasa*) in an intercropping system at different planting dates. The cover crops were intercropped 0, 2, 4 and 6 Weeks After Planting Maize (WAPM). The intercrop components were sown at 80×40 cm and arranged in a 1:1 spatial arrangement. Non-intercropped maize plots served as sole maize or control. Results showed that Mucuna had better spreading ability than Canavalia. The highest cover spread for Mucuna and Canavalia was observed when they were intercropped at 4 and 2 WAPM, respectively. Results also showed that the two cover crops exhibited (more than 56%) weed suppression when intercropped at 4 WAPM. The highest weed suppression for Mucuna and Canavalia were recorded when they were planted at 4 and 0 WAPM, respectively. The grain yield of maize increased with delay in planting both cover crops (i.e., from 0 to 6 WAPM). The highest grain yield values of 2.95 t ha^{-1} for Mucuna and 2.56 t ha^{-1} for *Canavalia entries* were obtained when the cover crops were planted at 6 WAPM. These values however fell short of the sole maize (3.72 t ha^{-1}) but were higher than the national average yield of 1.58 t ha^{-1} for the 2004 growing season. The present study therefore recommends that *Mucuna pruriens* var. *cocchinchinensis* and *Canavalia ensiformis* could be intercropped at 4 WAPM in maize-cover crop intercrop system with one early hand weeding for good maize grain yield.

Key words: Cover crops, intercropping, maize, weed suppression

INTRODUCTION

In Ghana, maize (*Zea mays* L.) is an important cereal produced in all the five agro-ecological zones, namely the coastal savanna, forest, transitional, Guinea and Sudan Savannas (Obeng-Antwi *et al*., 2002). The crop is the most commonly cultivated cereal in the northern Guinea savanna of Ghana and according to Dowswell *et al*. (1996) it is cultivated on a million hectare. However, the soils are inherently poor and deficient in organic matter and nutrients, especially N and P. Besides, marginal lands in northern Guinea savanna agro-ecological areas are brought into cultivation and small-scale farmers are compelled to change from extensive to intensive use of land, without adopting the appropriate management practices. The intensive cultivation has led to decrease in soil fertility, build-up of weeds and other pests and fallow periods have drastically shortened. As a result, soils that were once fertile have become unproductive, severe degradation of the environment has occurred and crop yields are very low. According to Dogbe (1998), one of the consequences of these in northern Ghana in the past few decades has been the falling agricultural productivity index.

The maize crop requires substantial amounts of soil nutrients, especially N, for growth and development. It is also very sensitive to weed competition such that two hand weedings at 3 and 6 WAP were required to optimize yields (Akobundu, 1987). These characteristics constrain the growth and development of maize. One of the coping strategies adopted by farmers in the northern Guinea savanna zone of Ghana is intercropping the maize with legumes, such as groundnut and cowpea, as a means of securing food in time of crop failure and slowing down the rate of loss in soil fertility. The use of *Mucuna* sp. and *Canavalia ensiformis* for controlling weeds and improving soil fertility both in a sole-cover-crop fallow and as intercrops is a common practice adopted by modern scientists in the tropics. In Mono province of Benin for example, mucuna had been used to reduce *Imperata cylindrica* (Itchgrass) to less than 10% of its initial density (Versteeg and Koudokpon, 1990). In Central Ghana, Osei-Bonsu and Buckles (1993) estimated that mucuna as an intercrop or as a sole crop provided an equivalent of more than 100 kg N ha^{-1} to the following maize.

Even though *Mucuna* sp. and *Canavalia ensiformis* can suppress weeds and improve soil fertility, their

Corresponding Author: Y.D. Innocent Lawson, Department of Soil Science, University of Ghana, Legon, Ghana

aggressive nature could cause intra-competition between intercropping components if not controlled. For example, Osei-Bonsu and Asibuo (1997) observed that mucuna could become a weed-pest in an intercropping system by climbing and shading the component crop and thereby reducing yield. Competition between component crops could be reduced by appropriate time of planting the component crops. Osei-Bonsu and Buckles (1993) reported that sowing mucuna early could result in reduced maize yield. Kombiok and Clottey (2003) also reported that intercropping mucuna in maize at 6 weeks after planting maize (WAPM) gave higher maize grain yield than 8 and 10 WAPM. The use of *Mucuna* sp. and *Canavalia ensiformis* could however, play an important role in intercropping systems in the northern Guinea savanna of Ghana because they grow well on poor soils and are tolerant to drought. It is in light of these characteristics that the present study called for in-depth look at planting dates of *Mucuna pruriens* var. *cochinchinensis* and *Canavalia ensiformis* as component crops in a legume-maize intercrop. The study was therefore aimed at determining the optimum time for planting the component cover crops for optimum weed control to enhance maize yield.

MATERIALS AND METHODS

Experimental site description: The study was conducted at the Faculty of Agriculture, University for Development Studies, at Nyankpala in the Northern Region of Ghana during the 2004 farming seasons. The experimental site is situated on latitude 9°25'41"N and longitude 0°58'42"W at an altitude of 183 m above sea level. The vegetation of the site is grassland regrowth with shrubs. The climate is warm, semi-arid with a total annual monomial rainfall of about 1022 mm. This short rainy season is followed by a pronounced dry season between October and April. Some of climatic data the site during the experimental period is shown in Table 1. The soil is well drained, formed from Voltaian sandstone described as Nyankpala series (Plinthic Acrisol; FAO, 1988) with a sandy loam texture.

Planting materials: The test crop (*Zea mays* var *Okomasa*), is a long-duration (120 days) white grain obtained from the Seed Unit of Ministry of Food and Agriculture (MoFA) in Tamale, Ghana. The legume species used, *Mucuna pruriens* var. *cochinchinensis* and *Canavalia ensiformis* were obtained from Savanna Agricultural Research Institute (SARI), Nyankpala, Ghana.

Plant culture: The experimental field was ploughed, harrowed and 36 plots were made. Each plot was 3×3 m with 0.5 and 1 m between plots and treatment blocks, respectively. The experimental plots were laid out in a Randomized Complete Block Design (RCBD) with four replications for each treatment. The maize was sown at a spacing of 80×40 cm and intercropped with the cover crops at 0, 2, 4 and 6 Weeks after Planting Maize (WAPM) at the same planting distance. The row arrangement of the intercrop components was 1:1. Non-intercropped plots were made to serve as sole crop or control. A compound fertilizer, NPK (15-15-15) was applied 2 WAPM at 18.75 kg N ha^{-1} as a basal application to all plots. The compound fertilizer was again applied only to the sole maize 4 WAPM at 18.75 kg N ha^{-1} and top-dressed 8 WAPM with sulphate of ammonium at 30 kg N ha^{-1} Weed control was carried out by hoeing at 3 and 6 WAPM, as required, to avoid weeds build up to critical levels of infestation (Akobundu, 1987). The intercrop treatments are described below:

Table 1: Some climatic data obtained during the experimental period

Month	Temperature (°C) Min.	Temperature (°C) Max.	Relative humidity (%) Min.	Relative humidity (%) Max.	Rainfall (mm)
July	22.8	30.4	72	96	178.2
August	22.5	30.1	75	95	242.9
September	22.4	30.7	68	93	140.4
October	23.0	33.1	60	88	39.3

MT_0 = Mucuna intercropped 0 WAP maize.
MT_1 = Mucuna intercropped 2 WAPM.
MT_2 = Mucuna intercropped 4 WAPM.
MT_3 = Mucuna intercropped 6 WAPM.
CT_0 = Canavalia intercropped 0 WAPM.
CT_1 = Canavalia intercropped 2 WAPM.
CT_2 = Canavalia intercropped 4 WAPM.
CT_3 = Canavalia intercropped 6 WAPM.
SM = Sole maize.

Data collection and analysis: The data collected were weekly maize plant height (cm), legume cover spread (%), weed abundance, weed biomass (g m^{-2}), yield of maize, Mucuna and Canavalia (kg ha^{-1}). All data collected were subjected to analysis of variance (ANOVA) using the Genstat (Anonymous, 2002). Treatment means were considered significantly different at $p<0.05$.

RESULTS

Plant height of maize: The mean height of maize was not significantly ($p>0.05$) different between 1-8 WAPM (Fig. 1). However, there was significant ($p<0.05$) difference between the treatment means of legume intercrops from 9 to 12 WAPM. At the end of the experiment, the highest plant height was observed for the Sole Maize (SM). *Canavalia ensiformis* intercropped with maize at

0 WAPM (CT_0) gave the lowest plant height. The highest plant height among the intercrops was observed for *Mucuna pruriens* var. *cochinchinensis* and *Canavalia ensiformis* intercropped at 6 WAPM.

Cover spread: The mean cover spread was significantly ($p<0.05$) different throughout the experimental period (Table 2). *Canavalia ensiformis* intercropped 0 WAPM (CT_0) gave the highest cover spread between 3 and 6 weeks after intercropping (WAI). However, at 9 WAI the highest cover spread was observed for *Mucuna pruriens* var. *cochinchinensis* intercropped at 2 WAPM (MT_1). At 12 WAI the highest cover spread was observed for *Mucuna pruriens var cochinchinensis* intercropped 4 WAPM (MT_2). The *Canavalia ensiformis* intercropped 6 WAPM (CT_3) gave the lowest cover spread of 49.5% at 12 WAI, however, the *Mucuna pruriens* var *cochinchinensis* intercropped at the same time gave a higher value of 79.5%.

Weed biomass: Results obtained from the study showed that there was no significant ($p>0.05$) difference in weed biomass among the treatments at 3 WAI (Table 3). However, there was significant ($p<0.05$) difference among the treatments between 6 and 12 WAI. At 6, 9 and 12 WAI, the lowest weed biomass values were recorded for CT_1, MT_2 and CT_0, respectively. The highest weed suppression was observed for MT_2 followed by CT_0, CT_1 and MT_0 in that order. The least weed suppression was observed for the sole maize.

Weed abundance: Twenty-five dominant weed species were identified at the experimental site. The weed species were classified into four groups: grasses, sedges, broadleaves and others (Table 4). Five weed species were grasses, 19 were broadleaves and 1 sedge. The best suppression of individual weed species was observed under MT_0, MT_1, MT_2 and CT_0. The results indicated that grasses showed less dominance at maize harvest. Out of the 5 grass species only, *Paspalum scrobiculatum* persisted throughout the growth period of maize. *Cynodon dactylon* and *Brachiaria lata* were drastically reduced and eliminated by most of the intercrops whilst *Pennisetum polystachion* disappeared at harvest. The only dominant sedge in the flora, had a season-long persistence.

Among the broadleaves, *Ludwigia decurens, Ageratum conyzoides*, *Oldelandia corymbosa*, *Hyptis specigera*, *Corchorus olitorius, Comuclina benghalnsis* and *Mitracarpus villosus* were not suppressed but generally showed increased dominance at harvest. However, *Sena obtusifolia*, *Crotalaria retusa*, *Tridax rocumbens*, *Mollugo nudicaulis*, *Cleome viscosa*, *Tephrosia pedicellata* and *Trianthema portulacastrum* were suppressed below 3% by all the intercrops.

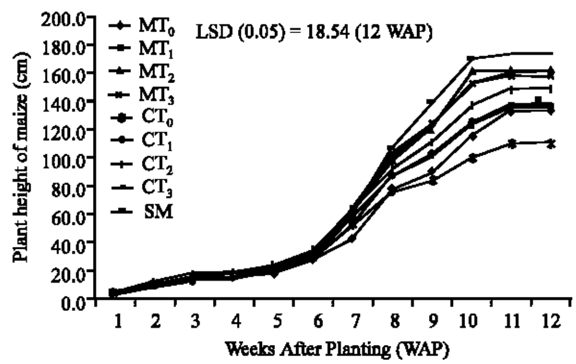

Fig. 1: Weekly response of plant height to cover crop/maize intercrop

Table 2: Cover spread (%) of legume intercrops

	Weeks after intercropping (WAI)			
Intercrops	3	6	9	12
Mucuna intercropped 0 WAPM (MT_0)	8.25	23.00	82.20	93.10
Mucuna intercropped 2 WAPM (MT_1)	17.62	60.40	85.00	99.00
Mucuna intercropped 4 WAP M (MT_2)	28.00	63.40	78.20	99.50
Mucuna intercropped 6 WAPM (MT_3)	20.25	32.40	65.80	79.50
Canavalia intercropped 0 WAPM (CT_0)	37.00	71.50	82.00	88.60
Canavalia intercropped 2 WAPM (CT_1)	19.75	61.90	67.60	89.20
Canavalia intercropped 4 WAPM (CT_2)	28.12	59.40	74.10	81.50
Canavalia intercropped 6 WAPM (CT_3)	22.25	28.20	37.00	49.50
LSD (0.05)	4.825	15.16	15.04	9.81

Table 3: Effect of legume intercrops on weed biomass (g m^{-2}) and suppression (%)

	Weeks after intercropping (WAI)				
Intercrops/Treatments	3	6	9	12	% suppression 12 WAI
Mucuna intercropped 0 WAPM (MT_0)	34.34	32.56	12.78	13.36	61.10
Mucuna intercropped 2WAPM (MT_1)	33.54	32.04	23.55	14.62	56.40
Mucuna intercropped 4WAPM (MT_2)	36.69	26.99	11.48	9.41	74.40
Mucuna intercropped 6WAPM (MT_3)	29.66	25.67	17.17	12.89	56.50
Canavalia intercropped 0 WAPM (CT_0)	34.15	30.20	15.00	9.26	72.90
Canavalia intercropped 2WAPM (CT_1)	35.61	20.65	18.20	13.14	63.10
Canavalia intercropped 4WAPM (CT_2)	38.68	34.99	19.38	16.79	56.60
Canavalia intercropped 6WAPM (CT_3)	27.93	23.70	15.11	18.68	33.10
Sole maize	39.09	30.93	33.69	30.98	20.70
LSD (0.05)	ns	7.18	6.468	5.882	

ns = No significant difference

Table 4: Weed occurrence and dominance (%) among the treatments

	3 Weeks after intercropping									At harvest								
Weed species	MT_0	MT_1	MT_2	MT_3	CT_0	CT_1	CT_2	CT_3	SM	MT_0	MT_1	MT_2	MT_3	CT_0	CT_1	CT_2	CT_3	SM
GRASSES	27.1	22.8	24.2	18.5	20.4	20.6	21.1	22.2	22.0	12.9	7.2	16.5	12.0	10.4	10.8	7.0	10.9	16.5
Brachia lata	7.2	7.1	10.5	3.3	3.8	6.1	11.0	3.0	7.8	-	1.6	-	-	-	1.2	-	-	6.0
Cynodon dactylon	2.7	1.7	1.2	1.2	1.1	2.7	2.2	3.4	0.7	5.7	-	1.8	-	-	1.2	-	-	1.3
Digitaria horizontalis	6.7	5.4	2.9	4.1	3.5	2.2	2.2	4.8	2.6	-	3.3	7.6	4.8	-	3.2	-	1.1	2.4
Paspalum scrobiculatum	8.6	8.6	7.4	7.5	9.9	8.7	4.9	10.1	8.8	7.2	2.3	7.1	7.2	10.4	5.2	7.0	9.8	6.8
Pennisetum polystachion	1.9	-	2.2	2.4	2.1	0.9	0.8	0.9	2.1	-	-	-	-	-	-	-	-	-
SEDGE	6.2	8.8	13.0	14.4	11.0	14.4	12.8	14.2	10.8	2.9	1.6	12.8	14.1	8.9	10.6	3.4	14.7	13.7
Cyperus rotundus	6.2	8.8	13.0	14.4	11.0	14.4	12.8	14.2	10.8	2.9	1.6	12.8	14.1	8.9	10.6	3.4	14.7	13.7
BROADLEAVES	62.6	61.0	62.2	64.0	68.8	65.9	66.0	61.7	64.0	81.5	91.3	61.7	90.2	79.2	79.2	89.9	74.7	66.8
Commelina benghalensis	1.4	1.9	2.6	1.5	6.1	1.3	3.1	-	1.9	2.9	-	1.7	1.5	2.4	1.2	1.3	1.1	1.1
Conyza sumatrensis	2.8	2.8	-	1.3	4.0	3.1	1.9	4.6	2.3	-	-	-	-	-	1.6	-	1.1	1.7
Corchorus olitorius	5.9	7.8	11.1	10.6	7.3	6.1	8.7	7.0	7.4	-	9.2	8.8	10.7	9.4	12.1	8.6	7.1	6.2
Crotalaria retusa	1.0	2.3	0.8	-	0.6	0.9	0.8	0.8	2.1	-	-	-	-	-	-	-	-	1.0
Euphorbia hirta	3.4	1.7	2.8	-	2.1	2.8	-	-	1.5	-	-	-	-	-	1.6	-	1.2	2.8
Hewittia sublobata	2.4	1.5	1.2	-	3.6	2.4	3.7	1.0	1.1	2.3	-	-	1.5	-	-	3.3	-	0.9
Hyptis specigera	10.6	4.7	9.9	11.2	5.3	3.8	8.8	8.7	4.8	5.2	5.6	6.5	5.6	6.4	10.9	6.0	3.4	3.3
Hyptis suaveolens	4.1	1.9	0.9	2.7	0.9	3.6	5.2	5.2	-	-	7.3	5.4	-	2.7	4.4	12.2	9.4	4.6
Mitracarpus villosus	7.8	9.9	9.2	3.6	7.9	4.5	6.3	4.4	9.3	8.4	4.4	4.6	26.1	21.0	8.3	12.8	8.6	10.0
Mollugo nudicaulis	6.5	7.2	6.3	6.9	3.6	9.6	7.9	11.0	6.6	-	-	-	-	-	-	-	-	5.4
Ageratum conyzoides	0.7	1.9	3.1	4.7	4.8	2.3	4.2	3.0	4.9	30.6	47.1	13.2	18.8	24.8	11.9	16.9	11.6	11.3
Cleome viscosa	7.0	4.9	0.9	0.9	3.6	2.5	1.0	1.1	2.3	-	-	-	-	-	-	-	-	-
Croton lobatus	2.5	-	1.7	0.8	1.8	4.2	1.8	-	2.3	-	-	-	1.8	-	1.2	2.5	1.1	1.7
Ludwigia decurens	-	2.8	3.4	7.5	4.7	5.7	3.6	6.6	4.6	24.6	7.9	7.9	10.0	3.4	11.1	10.5	11.6	4.8
Phyllanthus amarus	0.9	3.0	3.5	1.5	6.7	5.4	2.0	2.1	4.5	-	1.6	-	5.8	-	2.3	5.1	5.0	2.5
Physalis angulata	-	-	2.1	2.2	-	-	4.1	1.0	-	2.3	1.6	-	-	-	-	-	1.0	2.8
Schwenckia Americana	-	2.7	0.9	0.8	-	4.9	-	0.9	-	-	-	2.3	1.5	2.0	1.2	4.0	4.8	-
Sida cordifolia	1.0	1.1	1.8	3.7	2.1	1.9	2.9	0.9	4.6	2.3	-	-	-	2.3	1.2	-	-	1.3
Oldelandia corymbosa	4.6	2.9	-	4.1	3.7	0.9	-	3.4	3.8	2.9	6.6	11.3	6.9	4.8	10.2	6.7	7.7	5.4

MT_0 = Mucuna intercropped 0 WAPM; MT_1 = Mucuna intercropped 2 WAPM; MT_2 = Mucuna intercropped 4 WAPM; MT_3 = Mucuna intercropped 6 WAPM; CT_0 = Canavalia intercropped 0 WAPM; CT_1 = Canavalia intercropped 2 WAPM; CT_2 = Canavalia intercropped 4 WAPM; CT_3 = Canavalia intercropped 6 WAPM; SM = Sole Maize

Grain yield of mucuna and canavalia: Mucuna intercropped with maize at 0 WAPM (MT_0) gave the highest grain yield in Fig. 2. The MT_0 treatment was significantly ($p<0.05$) different from MT_1, MT_2 and MT_3. The least grain yield of mucuna was observed for the treatment MT_3, i.e., Mucuna intercropped with maize at 6 WAPM. In the case of canavalia, the highest grain yield was also observed when it was intercropped at 0 WAPM (CT_0), however, it was not significantly ($p>0.05$) different from CT_1 (Canavalia intercropped with maize at 2 WAPM). The least grain yield of Canavalia was also observed when intercropped 6 WAPM (CT_3). The least grain yield values for the two cover crops were similar.

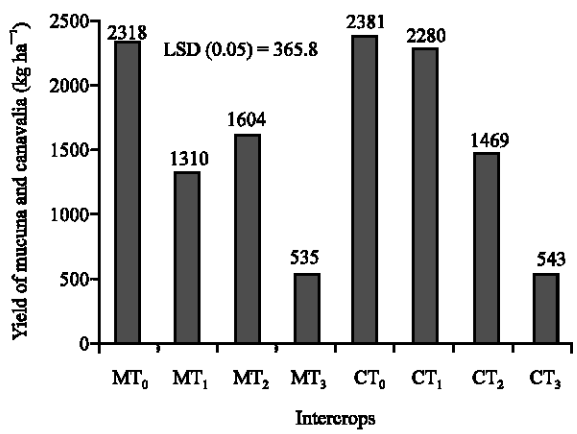

Fig. 2: Grain yield (kg ha^{-1}) of Mucuna and Canavalia intercrops

Grain yield of maize: The highest maize grain yield was observed for the sole maize (SM) followed by MT_3 and CT_3 (Fig. 3). The sole maize value was significantly ($p<0.05$) different from these two intercrops. Results have shown that the grain yield for MT_3 and CT_3 were significantly ($p<0.05$) different. Results have also shown that grain yield for the intercrops increased from 0 to 6 WAPM. The least grain yield values were observed for MT_0 and MT_1. The least grain yield for canavalia (CT_0) was not significantly different from MT_2.

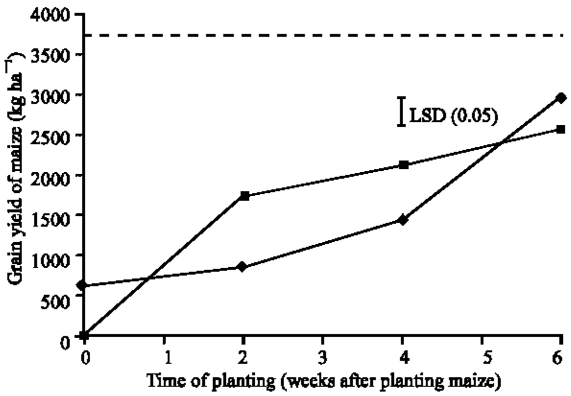

Fig. 3: Time of planting of Mucuna (♦) and Canavalia (■) on grain yield of maize and the yield of sole maize plots (– – –)

DISCUSSION

Sole maize plants grew taller than maize plants grown in intercrops. This difference in plant height could be attributed to competition for space and nutrients in the intercrops. This result is in agreement with earlier study of Wahua (1983) who observed that crops in association compete for nutrient resources, which may affect the associated crops negatively. Among the intercrops, planting mucuna and canavalia at 6 WAPM showed the highest maize height. This result suggests that planting mucuna and canavalia at 6 WAPM might have reduced competition between the legumes and maize plants. This agrees with the study of Galiba *et al.* (1998) who observed a strong competition between maize and aggressive cover crops when they were seeded the same day.

The study also revealed that there was no significant difference in cover spread for mucuna and canavalia between 3 and 6 Weeks After Intercropping (WAI), however, at 12 WAI they recorded an average cover spread of 93 and 77%, respectively. These results indicate that mucuna has a better ground cover than canavalia and it is in line with the study of Carsky and Ndikawa (1998). It was also observed in the present study that cover crops planted 6 weeks after planting maize (WAPM) gave low ground cover. This could be due to late planting because mucuna and canavalia have long maturity periods as described by Osei-Bonsu (1998). This therefore suggests early planting of these cover crops in an intercropping system to enhance adequate vegetative growth. The present study showed that the legume cover crops suppressed weeds compared to weed infestation in the sole maize. This result agrees with the study of Exner and Cruse (1993) who described that legume intercrops are included in cropping systems because they suppress weeds. One of the factors responsible for weed suppression in the present study might be the good ground cover by these cover crops because shading, entangling (especially in mucuna intercrops) and smothering of weeds was observed for these cover crops. Vissoh *et al.* (1998) also observed that *Mucuna pruriens* suppressed weeds through shading and strangling and Wilmot-Dear (1984) reported good spreading of mucuna suppressed weeds.

Results indicated that dominance of grasses decreased in the season due to suppression from the cover crops. Out of 5 species of grasses identified at 3 WAI, four grass species; *Pennisetum polystachion*, *Brachiaria lata*, *Dactylotenum aegyptium* and *Cynodon dactylon* were suppressed by the legume cover crops. The most persistent grass species was *Paspalum scrobiculatum*. The persistence of *P. scrobiculatum* might be due to fast growth rate as reported by Li (1960) who attributed the success of this weed species to its initial fast growth rate. However, the dominance of broadleaves increased during cultivation. Out of the 19 broadleaves, the legume cover crops suppressed and eliminated only 8 species. The most dominant broadleaf species not suppressed were *Ageratum conyzoides*, *Ludwigia decurens*, *Oldelandia corymbosa*, *Hyptis specigera*, *Corchorus olitorius* and *Mitracarpus villosus*. These results suggest that favourable edaphic conditions might have been created by the leaf fall and N-fixation of the legume cover for the growth and development of broadleaves. Akobundu (1987) reported that live mulch (*Centrosema pubescens*) suppressed the growth of grasses but encouraged the growth of broadleaves through such soil restoration traits. In addition, broadleaves are in the majority C3-plants having low light compensation point and as such are able to tolerate shading relative to grasses. The persistence of *C. rotundas* could be attributed to its growth characteristic because Doll (1994) reported that *C. rotundus* is well suited to compete for nutrients, water and, in the early growth stages, for light because it emerges and grows more rapidly than most crops. The small amount of sunlight, which likely penetrated the canopies of the cover crops, might also be sufficient to encourage growth of *C. rotundus*.

The study revealed that grain yields of mucuna and canavalia decreased with late planting. The low grain yield for cover crops planted late could be attributed to low soil moisture because grain formation coincided with the tail end of the rainy season. The grain yield of sole maize was higher than that of the intercrops. However, the grain yield values of the intercrops for 6 WAPM (2.95 t ha^{-1} for Mucuna and 2.56 t ha^{-1} for Canavalia) were higher than the national average yield (1.58 t ha^{-1}) for the 2004 growing season as reported by Anonymous (2005). The comparative low maize grain yield observed for the intercrops could be due to competition for growth factors such as nutrient, light and space because Wahua (1983) observed that roots of crops in association compete for nutrients and other growth resources, which could negatively affect their development. The results indicated that there was progressive increase in maize grain yield as time of intercropping increased from 0 to 6 WAPM. This implies that early intercropped maize experienced greater competition for growth factors than the late ones. The present work does not differ much from the study done by Osei-Bonsu and Buckles (1993), who observed that sowing mucuna too early (before 45 DAP maize) could result in reduced maize yields.

CONCLUSIONS

The present study showed that intercropping mucuna and canavalia very early (before 6 WAP maize) resulted in maize grain yield losses or reduction. The reduction could be due to competition for growth factors such as nutrients and space and also entangling (especially for mucuna) of the maize plants. The best weed suppressions occurred when the legume cover crops were planted between 0 to 4 WAPM. Intercropping mucuna and canavalia in maize at 6 WAPM, however, gave poor weed suppression but higher maize grain yield than earlier intercroppings (0, 2 and 4 WAP maize). The intercropping of maize with mucuna and canavalia at 4 WAP maize therefore, although was associated with some yield penalty, showed the best timing for planting the cover crops to benefit from their weed suppression and attain good maize grain yield production. Intercropping both legumes at 4 WAPM will require only one hand weeding at 3 WAP to give maize yields in the range of 1500-1600 kg ha^{-1} which was far above yields obtainable in farmers fields.

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