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Full Length Research Paper

Competitive capacity of cassava with weeds: Implications on accumulation of dry matter

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This work aimed to determine the competitive ability of two varieties of cassava against six weed species at initial growth stages, in relation to the allocation of dry mass in plants. The trial was conducted as a factorial experiment, with two cassava genotypes (IAC - 12 and Periquita) under competition with six weed species (*Euphorbia heterophylla*, *Bidens pilosa*, *Cenchrus echinatus*, *Amaranthus spinosus*, *Commelina benghalensis* and *Brachiaria plantaginea*), plus eight treatments corresponding to cassava varieties and weed species free from competition. The period of competition between cassava varieties and weeds was 75 days after crop emergence, when shoot and root mass were collected for evaluation of leaf area as well as, dry mass accumulation and distribution along plant organs (roots, leaves and stem). Cassava varieties presented smaller dry mass accumulation when under competition with weed species. Roots were the most affected organ by the competition. On the other hand, partition of dry mass in weeds was barely affected. In general terms, cassava variety Periquita was the most tolerant genotype to the competition and *B. plantaginea* was the weed species with higher competitive ability.

Key words: Weed species, cassava genotypes, competition, dry matter accumulation.

INTRODUCTION

Brazil currently ranks second as the world largest producer of cassava (*Manihot esculenta* Crantz) after Nigeria (FAO, 2010). However, current national average yields are relatively low (around 14 t ha^{-1}) if considering the fact that yield potential can be as high as 150 t ha^{-1} of tuberous roots (IITA, 2005). Cassava is a crop adapted to adverse environmental conditions, reaching satisfactory yields even in poor soils and without use of improved practices or technology. However, according to Alburquerque et al. (2008), this crop is highly susceptible to competition with weeds, and yield losses may be as high as to 90%, depending on the duration of competition and weed management practices adopted.

Cassava growers usually do not pay attention to weed control especially, at the early stage of crop and weed growth, as they were supposed to (Albuquerque et al., 2008). However, weed competition at initial stages of cassava development are among major factors contributing to the low income usually obtained with this crop (Pacheco et al., 1974).

In order to plan an appropriate and economical weed management program for cassava, the knowledge of the critical period of weed competition as well as, intensity of competition must be established (Carvalho et al., 2004). However, most of the studies about weed-crop competition are focused mainly in their occurrence and impact on yields without examining characteristics of both crop and weed species, and the mechanisms of their

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competition (Radosevich et al., 1996).

Many authors relate that morpho-physiological characteristics can be directly related to higher competitive ability of crops, as germination and emergence (Carvalho and Christoffoleti, 2008), height (Mcdonald, 2003), leaf area index (Haefele et al., 2004), solar radiation interception (Carvalho and Christoffoleti, 2008) and leaf density of top of plant (Caton et al., 2001). However, the accumulation and allocation capacity of dry matter depends on each species, and not always do the researchers pay attention on the necessary relevance of this.

Researches of plant competition can be used to predict losses of crop production due to co-existence with weeds and to determine optical levels or control periods of weed community. The context of the present work is to determine biological characteristics associated with the competitive ability of cassava varieties against weeds in terms of growth effect and dry mass partitioning within the plant.

MATERIALS AND METHODS

The trial was conducted under greenhouse environment. The soil used for this study was typical Red-Yellow Dystrophic Latosoil with medium texture. The soil after air drying was passed through a 5 mm mesh sieve before use. Soil chemical analysis showed the following results: pH (water) 5.4; organic matter 1mg kg^{-1}; P, K and Ca of 1.4; 10 and 0.5 mg dm^{-3}, respectively; Mg, Al, H + Al and CTC effective 0.2; 0.4; 4.4 and 1.7 cmolc dm^{-3}, respectively. In order to make the soil suitable as substract, 3.0 g dm^{-3} of dolomitic limestone, 2.2 g dm^{-3} of super simple phosphate or single super phosphate (P_2O_5) and 0.4 g dm^{-3} of potassium chloride or potassium oxide (K_2O) were applied. Nitrogen was applied 30 days after crop emergence, at dose of 0.4 g dm^{-3} of urea (45% N), previously dissolved in water. Irrigations were done by an automatic sprayer system. A factorial scheme 2 × 6 + 8 was adopted, constituted by combination of two cassava genotypes [IAC - 12 and Periquita] under competition with six weed species: *Euphorbia heterophylla* (EPHHL), *Bidens pilosa* (BIDPI), *Cenchrus echinatus* (CCHEC), *Amaranthus spinosus* (AMASP), *Commelina benghalensis* (COMBE) and *Brachiaria plantaginea* (BRAPL), plus eight additional treatments corresponding to the cassava varieties and weed species planted without other plant in competition. Treatments were arranged as a completely randomized design with four replications, and each bucket with capacity of 5 L (25 × 21 cm of diameter and height, respectively), represented one experimental plot.

Seedlings of *C. benghalensis* were transplanted while the other weed species were planted directly in the experimental plots at the same time cassava was planted, allowing weed and crop emergence to occur at the same time. For planted species, desired densities were established through thinning. The trial consisted of the same density of weed and cassava plants (one plant of each species per vase) except for *E. heterophylla*, which were two plants per vase after thinning. Weed and crop densities were predetermined by phytosociological studies in areas where cassava is cultivated on the same soil type (data not presented).

The period of coexistence between cassava varieties and weed species was 75 days after crop emergence. This intermission was established with the intention of quantifying damages by coexistence during the critical period of interference (CPIC) of weed species, which can be extended up to 100 days after crop emergence (Carvalho et al., 2004).

At the end of this period, cassava plants and weeds were sampled and dry mass was determined individually for roots, stems and leaves. For the weed species *C. echinatus* and *B. plantaginea*, leaf sheats were added to leaves and culms were considered as stems. For determination of leaf area, all leaves of each cassava plant were scanned and analyzed by the software Digital Areas Determiner (DAA) (Ferreira et al., 2008). Later, plant material was washed in distilled water and dried in oven under forced air circulation, at 70°C, until constant weight. Dry mass was determined in electronic balance with precision of 0.0001 g. Based on those data, leaf area ratio [LAR = (leaf area/total dry mass)], specific leaf area [SLA = (leaf area/dry mass of leaves)] and crop growth rate [GRC = (final dry mass/number of days between planting and harvest)] were determined. Also, partitioning of dry mass between plant parts (roots, stems, leaves) was determined for both crop and weed species.

As it was a greenhouse trial, all treatments were repeated twice in order to increase precision and accuracy of the results. All data was subjected to analysis of variance and treatment means and when significant, were compared by Scheffé test at 10% probability. In addition, contrasts estimates were used for comparison between plants of the same species under different situations; free from interference or under competition. Means comparison by Scheffé test was established due to the loss of some plots and to the determination of contrasts *a posteriori*. The significance level of 10% was used as recommended by Carraher and Rego (1981), due to Scheffé's high rigor in indicating differences between treatments. Pearson correlation between variables was also established for cassava plants.

RESULTS

Cassava varieties showed smaller overall dry mass accumulation as a function of weed interference (Table 1). Averages over genotype, dry mass of leaves, stems and roots were 30, 35 and 22%, respectively, when compared with the control affecting directly the accumulation of total crop dry mass (reduction of around 72%). The level of interference changed as a function of weed species and cassava variety. In general terms, it was observed that variety Periquita was the most tolerant to competition imposed by weeds. Under interference of *B. pilosa*, this variety had a superior dry mass accumulation in leaves and roots than IAC - 12 (Table 1). Under competition with *B. pilosa* and *C. benghalensis*, the average dry mass accumulation by crop plants as a whole and in roots was around 31 and 60%, respectively, when compared to the control without weed competition (Table 1). On the average, total dry mass and roots dry mass accumulation of the cassava varieties was reduced by 21 and 11% respectively, due to competition from *A. spinosus* and *E. heterophylla* when compared to the check (Table 1). When cassava was under competition with *C. echinatus*, total and root dry mass accumulation was reduced by 27 and 17%, respectively, compared to the control treatment without weed competition. *B. plantaginea had* a higher competitive ability against cassava causing reduction in dry mass accumulation for all parts of the crop plants, which translates into a loss of about 10, 13 and 18%, respectively in roots, leaves and and stems, when compared to the check free of interference (Table 1).

Table 1. Effect of weed species interference on cassava cultivar dry mass accumulation at 75 days after emergency.

Treatment	TDM			RDM			LDM			SDM		
	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$
Control[1/]	29.97^{Aa}	27.45^{Aa}	28.71^{a}	11.28^{Aa}	11.58^{Aa}	11.43^{a}	13.99^{Aa}	11.50^{Aa}	12.74^{a}	4.71^{Aa}	4.37^{Aa}	4.54^{a}
EPHHL	6.13^{Ac}	6.57 ^{Acd}	6.31^{cd}	2.16^{Ac}	0.36^{Bd}	1.44^{de}	3.04^{Ab}	5.16^{Aab}	3.89^{bc}	0.94^{Ac}	1.05^{Ab}	0.98^{c}
BIDPI	5.09^{Bc}	13.01^{Abc}	9.05^{c}	1.41^{Bc}	5.54^{Ac}	3.48^{c}	2.63^{Bb}	5.44^{Aab}	4.04^{bc}	1.05^{Abc}	2.03^{Aab}	1.54^{bc}
CCHEC	6.17^{Bc}	9.16^{Abcd}	7.67^{cd}	1.65^{Ac}	2.14^{Ad}	1.89^{cd}	2.92^{Ab}	4.49^{Ab}	3.70^{bc}	1.61^{Abc}	2.54^{Aab}	2.07^{bc}
AMASP	4.05^{Bc}	7.88^{Abcd}	5.32^{cd}	1.09^{Ac}	1.37^{Ad}	1.18^{de}	2.16^{Ab}	4.71^{Ab}	3.01^{c}	0.80^{Ac}	1.81^{Aab}	1.13^{c}
COMBE	17.76^{Ab}	15.90^{Ab}	16.83^{b}	5.20^{Bb}	8.69^{Ab}	6.95^{b}	9.32^{Aa}	4.54^{Bb}	6.93^{b}	3.24^{Aab}	2.67^{Aab}	2.95^{ab}
BRAPL	2.47^{Ac}	3.10^{Ad}	2.83^{d}	0.25^{Ac}	0.34^{Ad}	0.30^{e}	1.52^{Ab}	1.85^{Ab}	1.71^{c}	0.70^{Ac}	0.91^{Ab}	0.8^{2c}
CV (%)[2/]		29.26			24.5			41.89			43.90	

[1]TDM, Total dry matter; RDM, root dry matter; LDM, leaves dry matter; SDM, stem dry matter. Means followed by the same letter in line (capital letter) and in column (lower case) for each variable (plant organ) did not differ by Scheffé test at 10% error probability; [1/], control absentee of weed interference; [2/], variation coefficient; $\bar{x}$, average of cassava cultivars; EPHHL, *Euphorbia heterophylla;* BIDPI, *Bidens pilosa*; CCHEC, *Cenchrus echinatus;* AMASP, *Amaranthus spinosus;* COMBE, *Commelina benghalensis;* BRAPL, *Brachiaria plantaginea*.

Dry mass partitioning between plant parts of cassava varieties as a function of the weed species caused the interference (Figure 1). Under interference of *C*. *echinatus*, *A*. *spinosus* and *B. plantaginea* a larger relative allocation of dry mass in stems of the crop was noticed, however, with a consequent reduction of dry mass accumulation in roots (dry mass was 12, 5 and 15% higher in stems and about 14, 17 and 29% lower in roots, respectively to the weed species (Figure 1).

Under interference of *C. benghalensis*, a smaller relative dry mass allocation was observed in cassava leaves (39%) when compared to the check (44%) (Figure 1). On the other hand, under competition with *E*. *heterophylla*, a smaller relative dry mass allocation in crop roots (22%) was observed in relation to the check (40%).

Changes in pattern of dry mass allocation by cassava plants also influenced dry mass distribution in weed species (Figure 2). A relatively higher dry mass accumulation was observed in leaves of *B. pilosa* and *C. echinatus* (34 and 43% respectively), when compared to the check (30 and 40%, respectively) (Figure 2).

Unlike *C. benghalensis*, the weed species *B. plantaginea* in co-existence with cassava accumulated larger amounts of dry mass in roots, in detriment of leaves (dry mass 4% superior in roots and 3% inferior in leaves, in relation to the respective check competition (Table 2).

The leaf area index (LAI) and crop growth rate (CGT), were the only growth analysis parameters for cassava that were significant (Table 3).

Competition with weeds caused reductions in leaf area of cassava (Table 3). Under interference of *E. heterophylla, B. pilosa, C. echinatus, A. spinosus* and *C. benghalensis*, cassava leaf area was 31, 36, 22, 24 and 66%, respectively, of the value observed at checks free from these species. *B. plantaginea* presented again a superior competitive ability than the other weeds, because it caused crop leaf area reduction of around 89% (only 11% of the observed at the respective check) (Table 3).

In general terms, the average growth rate of cassava shifted according to the weed species present, but was significant only when varieties were under competition with *A. spinosus, C. benghalensis* and *B. plantaginea* (Table 3).

At the correlation analysis between variables, it is possible to observe that a given variable does not influence all the others at the same degree, once significant interaction was not observed between all pairs of variables analyzed (Table 4).

Crop leaf area and growth rate are related in a negative and positive way to the total dry mass of leaves, stems and roots of cassava.

In this case, plants with larger leaf area are usually more capable of capturing sun radiation; however, it does not mean a linear relation between amounts of light intercepted and amount of dry mass accumulated by these species. Specific leaf area and leaf area ratio were not significantly

Table 2. Effect of cassava cultivar competition on weed dry matter at 75 days after emergency.

Species	TDM				RDM				LDM				SDM			
	IAC – 12	Periquita	$\bar{x}$	Test$^{1/}$	IAC – 12	Periquita	$\bar{x}$	Test$^{1/}$	IAC – 12	Periquita	$\bar{x}$	Test$^{1/}$	IAC – 12	Periquita	$\bar{x}$	Test$^{1/}$
EPHHL	18.97^{b}	16.35^{b}	15.43^{Ad}	12.31^{Ac}	3.67^{b}	4.64^{b}	3.97^{Ad}	3.87^{Ac}	7.13^{c}	5.62^{c}	6.70^{Ad}	6.91^{Ac}	8.17^{b}	6.62^{b}	6.70^{Ab}	5.64^{Ab}
BIDPI	35.82^{b}	29.80^{b}	33.72^{Acd}	35.09^{Abc}	7.92^{b}	5.02^{b}	7.02^{Acd}	7.85^{Abc}	12.10^{b}	9.95^{bc}	10.77^{Ad}	10.38^{Ac}	15.80^{b}	14.82^{b}	15.93^{Ab}	16.86^{Ab}
CCHEC	67.60^{b}	58.35^{b}	59.92^{Abc}	55.33^{Abc}	21.10^{b}	21.47^{b}	23.42^{Ab}	26.62^{Abc}	30.02^{a}	24.09^{ab}	28.64^{Aab}	31.01^{Aa}	16.49^{b}	12.79^{b}	16.40^{Ab}	19.04^{Ab}
AMASP	72.18^{b}	64.07^{ab}	69.76^{Ab}	70.19^{Ab}	24.77^{b}	30.51^{ab}	28.56^{Ab}	31.37^{Aab}	26.06^{a}	21.82^{ab}	25.60^{Ab}	27.05^{Aa}	16.17^{b}	11.74^{b}	15.34^{Ab}	16.32^{Ab}
COMBE	23.26^{b}	32.12^{b}	33.88^{Acd}	43.15^{Abc}	5.19^{b}	3.05^{b}	6.36^{Ad}	9.72^{Abc}	10.69^{c}	14.13^{bc}	14.24^{Acd}	16.98^{Ab}	8.97^{b}	11.90^{b}	12.85^{Ab}	16.46^{Ab}
BRAPL	149.23^{a}	130.80^{a}	134.16^{Aa}	126.21^{Aa}	66.95^{a}	55.85^{a}	57.78^{Aa}	52.85^{Aa}	36.34^{a}	34.29^{a}	34.87^{Aa}	34.34^{Aa}	45.95^{a}	40.66^{a}	41.51^{Aa}	39.02^{Aa}
CV (%)$^{2/}$	42.13				52.24				30.03				37.33			

TDM, Total dry matter; RDM, root dry matter; LDM, leaves dry matter; SDM, stem dry matter. Means followed by the same letter in line (capital letter) and in column (lower case) for each variable (plant organ) did not differ by Scheffé test at 10% error probability; $^{1/}$, control absentee of weed interference; $^{2/}$, variation coefficient; $\bar{x}$, average of cassava cultivars; EPHHL, *Euphorbia heterophylla;* BIDPI, *Bidens pilosa*; CCHEC, *Cenchrus echinatus;* AMASP, *Amaranthus spinosus;* COMBE, *Commelina benghalensis;* BRAPL, *Brachiaria plantaginea*.

Table 3. Growth parameter estimates of cassava cultivars under interference of different weed species, at 75 days after emergency.

Treatment	LA (cm^2 pl^{-1})			GRC (g pl^{-1})			SLA (cm^2 g^{-1})			LAR (cm^2 g^{-1})		
	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$	IAC – 12	Periquita	$\bar{x}$
Control$^{1/}$	20.77^{Aa}	19.89^{Aa}	20.42^{a}	0.33^{Aa}	0.31^{Aa}	0.32^{a}	0.67^{ns}	0.73^{ns}	0.70^{ns}	1.45^{ns}	1.69^{ns}	1.55^{ns}
EPHHL	5.32^{Ac}	7.28^{Abc}	6.30^{cd}	0.07^{Ac}	0.07^{Acd}	0.07^{cd}	0.94	1.12	1.03	2.22	1.31	1.77
BIDPI	5.57^{Bbc}	9.26^{Abc}	7.42^{c}	0.06^{Ac}	0.14^{Abc}	0.10^{c}	1.11	0.71	0.91	2.26	1.71	1.99
CCHEC	4.19^{Ac}	4.80^{Ac}	4.40^{cd}	0.07^{Ac}	0.10^{Abcd}	0.09^{cd}	0.76	0.65	0.72	1.87	1.34	1.69
AMASP	3.39^{Bc}	6.55^{Abc}	4.97^{cd}	0.04^{Ac}	0.09^{Abcd}	0.06^{cd}	1.06	0.89	0.97	2.34	1.41	1.88
COMBE	15.47^{Aa}	12.07^{Bb}	13.52^{b}	0.20^{Ab}	0.18^{Ab}	0.19^{b}	0.80	0.75	0.77	1.44	3.11	2.40
BRAPL	1.30^{Ac}	3.37^{Ac}	2.34^{d}	0.03^{Ac}	0.03^{Ad}	0.03^{d}	0.61	1.30	0.95	0.96	3.08	2.02
CV (%)$^{2/}$	25.61			29.26			31.13			56.62		

LA, Leaf area; GRC, crop growth rate; SLA, specific leaf area; LAR, leaf area ratio. Means followed by the same letter in line (capital letter) and in column (lower case) for each variable (plant organ) did not differ by Scheffé test at 10% error probability; ^{ns} no significant; $^{1/}$Control absent of weed interference; $^{2/}$Variation coefficient; $\bar{x}$ - Average of cassava cultivars; EPHHL, *Euphorbia heterophylla;* BIDPI, *Bidens pilosa*; CCHEC, *Cenchrus echinatus;* AMASP, *Amaranthus spinosus;* COMBE, *Commelina benghalensis;* BRAPL, *Brachiaria plantaginea*.

correlated with any other variable, except for the interaction between them (Table 4).

DISCUSSION

Both architecture and growth characteristics of the crop can be directly related to its ability to compete favorably with weed species at the initial stages of their growth and development. Periquita's ability to form more uniform and dense canopy earlier, due its branching habit, gave it advantage over the weed species. These characteristics reduce weeds access to sunlight as well as, its photosynthesis rate. However, according to Moura (2000), branching of cassava plants does not confer advantages to the crop in relation to roots yield. *Bidens pilosa* and *Commelina benghalensis* are among the major weeds in areas where cassava is grown, pre-senting potential infestation problem than many

Table 4. Pearson lineal correlation matrix between the analyzed variables of cassava cultivars (IAC - 12 and Periquita) after 75 days of emergency.

Variable	Interaction	Variable	Interaction
TDM × LDM	+ 0.94**	SDM × LA	- 0.49**
TDM × SDM	+ 0.92**	SDM × SLA	- 0.03^{ns}
TDM × RDM	+ 0.93**	SDM × LAR	+ 0.21^{ns}
TDM × LA	- 0.49**	SDM × GTC	+ 0.92**
TDM × SLA	- 0.05^{ns}	RDM × LA	- 0.47**
TDM × LAR	+ 0.19^{ns}	RDM × SLA	- 0.07^{ns}
TDM × GTC	+ 1.00**	RDM × LAR	+ 0.24^{ns}
LDM × SDM	+ 0.88**	RDM × GTC	+ 0.93**
LDM × RDM	+ 0.76**	LA × SLA	+ 0.01^{ns}
LDM × LA	- 0.43**	LA × LAR	- 0.18^{ns}
LDM × SLA	- 0.07^{ns}	LA × GTC	- 0.49**
LDM × LAR	+ 0.10^{ns}	AFE × LAR	+ 0.67**
LDM × GTC	+ 0.94**	AFE × GTC	- 0.05^{ns}
SDM × RDM	+ 0.79**	RAF × GTC	+ 0.19^{ns}

Ns, Non-significant interaction, **, significant interaction at 1% probability by Pearson matrix; TDM, total dry matter; LDM, leaf dry matter; RDM, roots dry matter; SDM, stem dry matter; LA, leaf area; SLA, specific leaf area; LAR, leaf area ratio; GTC, growth tax of culture.

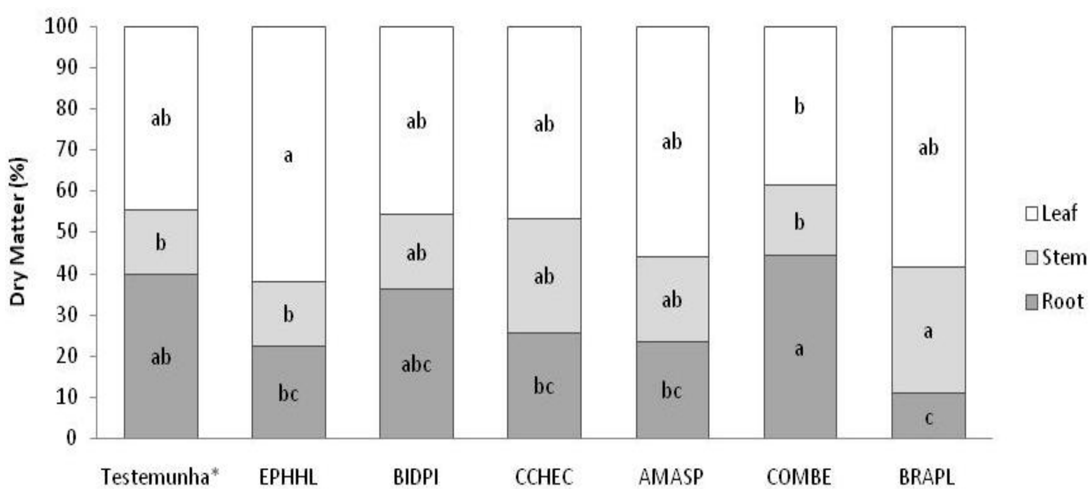

Figure 1. Average percentage distribution of dry matter between vegetative components of cassava cultivars (IAC - 12 and Periquita) under interference of different weeds. Means followed by same letter in each variable (plant organ) did not differ by Scheffé test at 10% error probability *Cassava cultivars absent of interference from weed; EPHHL, *Euphorbia heterophylla;* BIDPI, *Bidens pilosa*; CCHEC, *Cenchrus echinatus;* AMASP, *Amaranthus spinosus;* COMBE, *Commelina benghalensis;* BRAPL, *Brachiaria plantaginea*.

other weed species (Albuquerque et al., 2008). They are also predominant in potato (Ossom and Rhykerd, 2007), bean (Cury et al., 2011) and maize (Carvalho et al., 2011) fields. At varietal level, cassava under interference from different weed species showed some levels of competitive ability and tolerance to competition, with the consequences of lower dry mass accumulation mainly in roots in relation to more competitive weed species. However, it was observed that in relation to the weed community, weed species behaved from a neutral way in relation to the effects of competition imposed by cassava plants.

According to Carvalho et al. (2011), not only biomass accumulation but also biomass allocation is a fundamental aspect in the competition between plant species. The pattern of dry mass allocation between plant organs denotes it to be a variable more important than the total amount of biomass accumulated as regarding

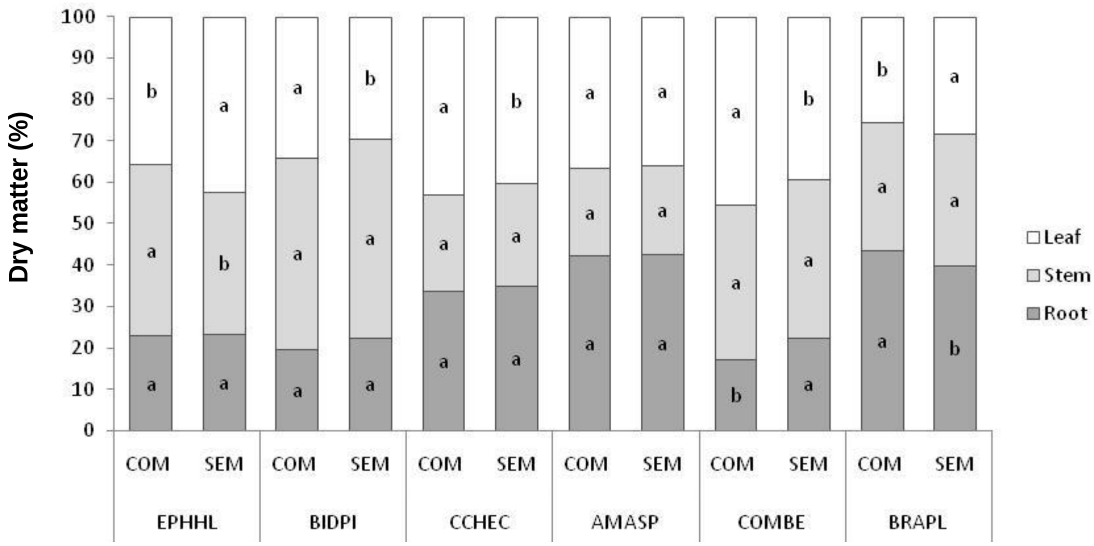

Figure 2. Average percentage distribution of dry matter between vegetative components of different weeds in competition with cassava cultivars (IAC - 12 and Periquita). Means followed by same letter for each variable (plant organ) did not differ by Scheffé test at 10% error probability; COM/Average of weeds in competition with cassava cultivars; SEM/Weeds absent of competition with cassava cultivars.

the tolerance mechanisms of crops to the competition with weed species (Ngouajio et al., 2001).

Dry mass allocation in *C. benghalensis* also followed the same tendency; however, that species shifted its ability in forming roots. It is possible that those weeds, when subjected to the co-existence with cassava, induced the allocation of dry mass in shoots to the detriment of roots, in order to attempt to close its canopy faster and allow maximum light interception.

Specific leaf area is related to thickness and density of a leaf, and leaf area ratio is considered as a measure of plant's capacity in intercepting solar radiation (Ferreira et al., 2008). Probably certain morpho-physiological indexes are not associated with the competitive ability of the crop against weeds once cassava varieties presented similar leaf area and leaf area ratio under competition with all weed species (Table 3).

In general terms, results showed that the leaf area of variety Periquita was superior to IAC - 12, when subjected to interference by *B. pilosa* and *A. spinosus*. However, under competition with *C. benghalensis*, IAC - 12 presented larger leaf area. This characteristic, associated to superior shoot dry mass accumulation (leaf and stem) (Table 1), would provide to that variety faster formation of a dense canopy which would reduce the effect of initial interference imposed by weed species under field conditions. In cassava, positive correlation between leaf area or leaf area duration and increase of root yields was observed, indicating that leaf area is crucial to determining both crop growth rate and roots development rate (Cock et al., 1979).

All weed species under competition with cassava, had similar dry mass to the respective check. On the other hand, the crop was practically suppressed by those species. In general terms, variety Periquita was the one with most tolerated weed competition. *B. plantaginea* demonstrated to be the weed species with higher competitive ability, because it affected both leaf area and dry mass partitioning by the crop. Both specific leaf area and leaf area ratio were not morpho-physiological indices associated with the competitive ability of cassava plants.

The wide set of competitive relationships to what cassava was submitted was due to the presence of distinct competitors and this showed that there is always a variation in the flux of photosynthates between different parts of the plant. In general terms, crop roots were the most affected part when under competition with weeds. On the other hand, weeds were affected at a smaller extent under competition with the crop with almost no hazard to the dry mass accumulation in these species.

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