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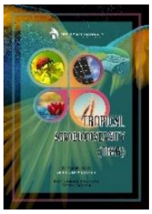

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REVIEW ARTICLE

EFFECT OF CROP SPACING, CASSAVA VARIETY, AND WEED CONTROL METHODS ON DENSITY OF *MIMOSA INVISA* MART. IN CASSAVA PRODUCTION SYSTEMS.

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ABSTRACT

Evaluation of the combined effect of crop spacing, cassava variety and different weed control methods on the density of *M. invisa* in cassava field was conducted at Umudike, Southeastern Nigeria during 2015 and 2016 cropping seasons. The study was laid out in split-split plot in randomized complete block design with three replications. The main plot treatments consisted of three crop spacing (1 m × 0.6 m, 1 m × 0.8 m, and 1 m x 1 m). The sub-plot treatments included two cassava varieties of contrasting morphology (TME 419 and NR 8082) while the sub-sub-plot treatments were four weed control methods (W1 - hoe weeding at 4, 8 and 12 weeks after planting), (W2 - S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by hoe weeding at 12 and 16 WAP), (W3 - S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP) and (W0 - Weedy checks). Data collected were subjected to analysis of variance (ANOVA). Significant means were separated using least significant difference - LSD. The results obtained showed that *M. invisa* density was significantly low in the three weed control methods used. NR 8082 cassava variety reduced the level of emergence and density of *M. invisa* whereas the TME 419 which is a non-profuse branching variety did not significantly reduce the population of the weed. Furthermore, plant spacing had no significant effect on the *M. invisa* density in both cropping seasons.

KEYWORDS

Crop spacing, Mimosa *invisa*, Cassava, Weed control.

1. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a crucial staple crop for over 800 million people in tropical and subtropical regions, particularly in sub-Saharan Africa (SSA) (Nassar and Ortiz, 2006, Adiele, 2020). It is valued not only for its role in food security but also for its industrial applications, including bioethanol production, animal feed, and starch (Rosenthal et al., 2012; Anozie, 2015; Soares et al., 2016; Pimpisaia et al., 2024). Cassava's adaptability to harsh environmental conditions; such as drought and low soil fertility, makes it very important crop for smallholder farmers (Ekeleme et al., 2016). Despite its importance, cassava production faces several limitations, including pest and disease pressures, and competition from invasive weeds like *Mimosa invisa* Mart. (Shackelford et al., 2018).

Mimosa invisa, commonly known as giant sensitive plant, is a fast-growing, invasive weed that poses a significant threat to cassava production (Ekeleme et al., 2013; Ekhator et al., 2013). Its rapid growth and ability to form dense canopies allow it to outcompete cassava, which has a relatively slow initial growth rate (Alabi et al., 2004). This competitive advantage enables *Mimosa invisa* to suppress cassava growth, leading to substantial yield losses. Effective weed management is therefore crucial to ensure sustainable cassava production.

Various weed control methods have been employed to manage *Mimosa invisa* in cassava fields. These include cultural practices such as crop spacing, mechanical methods like hoe weeding, and chemical control using herbicides. Crop spacing is a critical factor in weed management, as it influences the crop's ability to compete with weeds. Research has shown that optimal spacing can enhance cassava's competitive ability and reduce weed pressure. For instance, a study by demonstrated that appropriate spacing significantly reduced weed biomass and improved cassava yield (Soares et al., 2016). Similarly, found that optimal spacing in intercropping systems reduced weed density and enhanced cassava growth (Padmapriya et al., 2008). Another study by confirmed that different spacing treatments influenced weed regimes and cassava productivity (Moyin-Jesu, 2016). Hoe weeding, although labor-intensive, is a common practice among smallholder farmers and can be effective when performed at critical growth stages of the crop (Melifonwu et al., 2000). Chemical control, involving the use of herbicides, offers a more efficient alternative but may not be accessible or affordable for all farmers (IITA, 2023).

Given the challenges posed by Mimosa invisa, this study aims to evaluate the effectiveness of different weed management strategies, including crop spacing, early branching and non-branching cassava varieties, and a combination of chemical and manual weeding methods. By understanding how these factors interact to influence weed density, we can develop integrated weed management practices that enhance cassava productivity and sustainability.

2. MATERIALS AND METHODS

Study location: This study was done at the National Root Crops Research Institute (NRCRI), Umudike, Research Farm, located on latitude 5⁰29' N, longitude 7⁰33' E and altitude 122 meters above sea level. The location is characterized by bimodal rainfall pattern which usually occur between March and November with its peak in July and September. While a short dry period is usually observed during August.

Field preparation and treatments: The site for this research was slashed, ploughed and harrowed before ridges were made 1m apart. The cassava varieties; NR 8082 (a profuse branching variety) and TME 419 (a sparse branching variety) were sourced from NRCRI, Umudike. The stem cuttings of 23 cm long were planted at 1 m x 1 m, 1 m x 0.8 m and 1 m x 0.6 m plant

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spacing (according to treatments) at about 45^0 angles to the horizontal along the crests of the ridges. Weeding was done according to treatment. The manual (hoe) weeding was done using small locally fabricated hand hoe whereas, the herbicides were applied using a knapsack sprayer (Cooper Pegler CP-15). At 8 weeks after planting, NPK (15:15:15) fertilizer was applied to all plots by hand at the rate of 600 kg/ha as recommended by (Chude et al., 2012).

Experimental design: The study was set up in a split-split plot design within a randomized complete block design (RCBD), replicated three times. The main plot treatments consisted of three different crop spacing: 1 m × 0.6 m, 1 m × 0.8 m, and 1 m × 1 m. The sub-plot treatments included two cassava varieties with distinct morphologies (TME 419 and NR 8082). The sub-sub-plot treatments involved four weed control methods: hoe weeding at 4, 8, and 12 weeks after planting (WAP); S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by hoe weeding at 12 and 16 WAP; S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP; and a weedy check.

Data Collection: The following parameters were collected from the experiment;

Weed density: At 4, 8, 12, 14, and 16 weeks after planting (WAP), prior to hoe and chemical weeding, a $0.5\ m^2$ quadrat was diagonally placed in two areas within each plot (Zimdahl et al., 1988). The number of Mimosa invisa and other weed species within each quadrat was counted and recorded. The collected weed samples were then oven-dried to a constant weight at 80°C and weighed using a precision standard weighing balance (ATOM-120).

Weed population after harvest: The weed population was visually assessed by two independent evaluators, and the intensity of occurrence was recorded following the methods described by (Dachi et al., 2015).

Statistical Model and Analysis: All collected data were analyzed using analysis of variance (ANOVA) with GenStat Discovery Edition Version 4, GenStat Release 10.3DE. Significant differences between treatment means were determined using the least significant difference (LSD) test at a 5% probability level.

3. Results

3.1 Effect of spacing, cassava variety, and weed control methods on *Mimosa invisa* density

The effect of plant spacing, cassava variety, and weed control methods on *M. invisa* density in 2015 and 2016 cropping seasons is presented in Table 1. The result showed that plant spacing did not significantly (P≤0.05) affect *M. invisa* density in both cropping seasons. The effect of cassava variety on *M. invisa* density showed significant differences at 4 and 12 WAP in 2016, and 10 MAP in both years. The result obtained also indicated that *M. invisa* density was significantly (P≤0.05) influenced by weed control methods except at 4 and 8 WAP in 2015 cropping season alone. *Mimosa* density was lowest in plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence (W3) at 12 WAP in both cropping seasons. At 10 MAP more *Mimosa* densities were highest in plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence with two hoe weeding (W2) followed by hoe weeded plots (W1) in both cropping seasons compared to the other treatments. The weedy check and plots where S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence (W3) were used to control weeds, had significantly (P≤0.05) lower population of *M. invisa* at 10 MAP.

Table 1: Effect of plant spacing, cassava variety, and weed control methods on *Mimosa invisa* density (number /m^2) in cassava in 2015 and 2016 cropping seasons at Umudike.

	Weeks after planting, cropping season and *Mimosa* density (number/m^2)							
	4 WAP[1]		8 WAP		12 WAP		10 MAP[2]	
Treatment	2015	2016	2015	2016	2015	2016	2015	2016
Plant Spacing								
1m x 0.6m	2.04	5.04	5.46	7.54	4.46	2.79	14.71	5.71
1m x 0.8m	2.38	5.58	4.83	7.33	6.87	3.42	15.96	4.29
1m x 1m	1.58	6.33	4.29	7.12	5.92	3.67	16.79	6.04
LSD $_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS
Cassava Variety								
TME 419	1.97	4.08	5.67	6.11	5.94	3.06	18.72	4.08
NR 8082	2.03	7.22	4.06	8.56	5.56	3.53	12.92	6.61
LSD $_{(0.05)}$	NS	2.282	NS	NS	NS	0.490	3.232	2.156
Weed Control methods								
W0	2.00	7.89	5.33	11.11	5.33	9.78	4.39	1.11
W1	1.11	6.44	4.22	4.11	4.00	1.56	21.56	6.44
W2	3.11	4.50	5.61	7.44	12.44	1.17	28.50	9.72
LSD $_{(0.05)}$	NS	1.981	NS	2.617	4.655	1.246	4.699	3.213
Interaction								
PS x CV	NS	NS	NS	NS	NS	*	NS	NS
PS x WC	NS	NS	NS	NS	NS	NS	NS	NS
CV x WC	NS	NS	NS	NS	NS	NS	*	NS
PS x CV x WC	NS	NS	NS	NS	NS	NS	NS	NS

[1]WAP = Weeks after planting, [2]MAP = Months after planting, W0 = Weedy check, W1 = Hoe weeding at 4, 8 and 12 WAP (weeded control), W2 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP, W3 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP, * = Significant at 0.05% and NS = Not significant.

The interaction between plant spacing and cassava variety on *M. invisa* density at 12 WAP in 2016 is presented in Table 2. The highest *M. invisa* density was obtained in plots planted with NR 8082 at plant spacing of 1 m x 0.8 m followed TME 419 planted at 1 m x 1 m spacing in both cropping

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seasons. The lowest *M. invisa* density was recorded in plots with TME 419 with plant spacing of 1m x 0.8 m followed by TME 419 planted at 1m x 0.6 m spacing.

At 10 MAP in 2015 cropping season (Table 3) interaction of cassava variety and weed control methods showed significant (P≤0.05) influence on *M. invisa* density. S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence with two hoe weedings (W2) in TME419 plots had the highest *M. invisa* (31.78/m^2) density followed by hoe weeded plots (W1) that recorded 28.89/m^2. The *M. invisa* density was relatively lower in 2016 cropping season

Table 2: Plant spacing and cassava variety interaction effect on *Mimosa invisa* density at 12 WAP in the 2015 and 2016 cropping seasons.

		Cropping season and *Mimosa* density (no./m^2)	
Plant spacing	Cassava variety	2015	2016
1m x 0.6m	TME 419	5.25	2.67
	NR 8082	3.67	2.92
1m x 0.8m	TME 419	5.50	2.58
	NR 8082	8.25	4.25
1m x 1m	TME 419	7.08	3.92
	NR 8082	4.75	3.42
LSD $_{(0.05)}$		NS	1.72
NS = Not significant.			

Table 3: Cassava variety and weed control method interaction effect on *Mimosa* density at 10 months after planting (MAP) in the 2015 and 2016 cropping season.

		Cropping seasons and *Mimosa* density (no./m^2)	
Cassava variety	Weed control methods	2015	2016
TME 419	W0	3.78	1.00
	W1	28.89	3.89
	W2	31.78	8.56
	W3	10.44	2.89
NR 8082	W0	5.00	1.22
	W1	14.22	9.00
	W2	25.22	10.89
	W3	7.22	5.33
LSD $_{(0.05)}$		6.31	4.30

W0 = Weedy check, W1 = Hoe weeding (HW) at 4, 8 and 12 WAP (weeded control), W2 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weedings at 12 and 16 WAP, W3 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP

3.2 Effect of spacing and weed control methods on total weed dry matter

At 4, 8, and 12 WAP in both cropping seasons, total weed dry matter did not vary significantly (P≤0.05) among the different plant spacing (Table 4). On the other hand, total weed dry matter did not differ between the cassava varieties in both cropping seasons except at 4 WAP in 2016 but weed control methods significantly (P≤0.05) affected total weed dry matter. Plots hoe weeded (W1) provided excellent control of weeds at 8 (5.0 g/m^2) and 12 WAP (2.0 g/m^2) in 2015 followed by S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence with two hoe weeding (W2) at 4 WAP (2.6 g/m^2), 8 WAP (4.0 g/m^2) and 12 WAP (1.7 g/m^2) in 2016 cropping season. Plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence (W3) had the highest weed dry matter at 12 WAP in both cropping seasons.

Table 4: Effect of plant spacing, cassava variety and weed control methods on total weed dry weight in cassava field in 2015 and 2016 cropping seasons at Umudike.

Weeks after planting, cropping seasons and total weed dry weight (g/m^2)						
	4 WAP		8 WAP		12 WAP	
Treatment	2015	2016	2015	2016	2015	2016
Plant Spacing						
1m x 0.6m	6.38	13.5	158.0	51.7	108.0	50.3
1m x 0.8m	5.02	12.2	163.0	47.4	103.0	48.4
1m x 1m	5.40	11.7	170.0	51.0	100.0	47.8
LSD $_{(0.05)}$	NS	NS	NS	NS	NS	NS
Cassava Variety						

Table 4 (cont): Effect of plant spacing, cassava variety and weed control methods on total weed dry weight in cassava field in 2015 and 2016 cropping seasons at Umudike.

TME 419	4.88	9.1	177.0	48.6	112.0	46.6
NR 8082	6.32	15.8	151.0	51.5	95.0	51.0
LSD $_{(0.05)}$	NS	7.04	NS	NS	NS	NS
Weed Control methods						
W0	8.28	28.3	353.0	139.7	355.0	166.8
W1	8.87	17.2	5.0	10.5	2.0	3.0
W2	2.80	2.6	219.0	4.0	6.0	1.7
W3	2.46	1.7	79.0	45.9	53.0	23.8
LSD $_{(0.05)}$	3.412	6.87	8.2	19.36	64.2	15.13
Interaction						
PS x CV	NS	NS	NS	NS	NS	NS
PS x WC	NS	NS	NS	NS	NS	NS
CV x WC	NS	NS	NS	NS	NS	NS

WAP = Weeks after planting, **W0** = Weedy check, **W1** = Hoe weeding at 4, 8 and 12 WAP (weeded control), **W2** = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence with two hoe weedings at 12 and 16 WAP, **W3** = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP, and **NS** = Not significant.

3.3 Effect of spacing and weed control methods on weed species composition at 2 months after cassava harvest

The effects of the different weed control methods on the class of weed species at the experimental site and their level of infestation at 2 months after harvesting of cassava are shown in Table 5. The result obtained in both 2015 and 2016 cropping seasons showed that *M. invisa* was the most common weed species in plots hoe weeded (W1), and S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding (W2). The presence of *M. invisa* species was not noticeable under S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence (W3) in 2015 cropping season with low infestation in 2016 cropping season. The presence of *Mimosa* was not observed in the weedy checks in both cropping seasons. Plots that were hoe weeded (W1) and S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding (W2) recorded highest infestation of actively mature growing *Mimosa* plants in both cropping seasons. The result also showed higher infestation of grasses in plots with weedy checks and those treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence (W3) compared to other broadleaved weeds and sedges. Moderate infestations of grasses and other broadleaved weeds were observed in plots hoe (W1), and S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding (W2) in both cropping seasons.

Table 5: Class of weed species at the experimental site and their level of infestation 2 months after harvesting of cassava in 2015 and 2016 cropping seasons.

	Cropping season and level of weed infestation							
	2015 Cropping season				2016 Cropping season			
Treatment	Mimosa	Other broad-leaved weeds	Grasses	Sedges	Mimosa	Other broad-leaved weeds	Grasses	Sedges
Weed Mgt. methods								
W0	-	+	+++	-	-	++	+++	-
W1	+++	++	++	-	+++	++	++	+
W2	+++	++	++	-	+++	++	++	+
W3	-	+	+++	+	+	++	+++	+

W0 = Weedy check, W1 = Hoe weeding at 4, 8 and 12 WAP (weeded control), W2 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weedings at 12 and 16 WAP , W3 = S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP, +++ = Higher infestation (60 – 90%), ++ = Moderate infestation (40 – 59%), + = Low infestation, and - = Nil (presence not noticeable).

4. Discussion

4.1 Effect of plant spacing and weed control methods on *M. invisa* density

The *M. inivsa* density was not significantly (P≤0.05) affected by the plant spacing indicating that even at closer cassava spacing, irrespective of the cassava variety, *M. invisa* can still thrive. This may be attributed to the initial quick germination and emergence of *M. invisa* compared to the initial slow growth of cassava hence, making *M. invisa* a better competitor. This supported the findings of who reported that once the *M. invisa* had germinated and emerged, the canopy formed by cassava variety or canopy developed as a result of cassava spacing does not suppress *M. invisa* growth and development as it tends to climb and create swaths at the top to suppress the cassava and other weeds (Melifonwu, 1994).

The results obtained under the different weed control methods used, indicated that weed control methods that involve any form of soil disturbance through hoe weeding stimulated the germination and emergence of *M. invisa*. This trend supported the findings of Norgrove and who reported that tillage and any form of hoe weeding are one of the main drivers of weed community and stimulates the germination of weed seeds (Hauser, 2015; Cordeau et al., 2015). The results also indicated that application of S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied as post-emergence at 8 WAP.

At 10 MAP, the density of *M. invisa* were significantly higher in plots hoe weeded at 4, 8 and 12 WAP, and in plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP in both cropping seasons. Furthermore, plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence and the weedy check at 8 WAP, had significantly lower population of *M. invisa*. The reduction of *M. invisa* population in the weedy check could be attributed to the fact that majority of the *M. invisa* in these plots had died during the dry season after dropping its seeds into the soil seed bank. Furthermore, the significantly higher increase in the population of *M. invisa* under the plots hoe weeded at 4, 8 and 12 WAP and in plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weedings at 12 and 16 WAP could be attributed to the effect of hoe weeding which left the soil surface open during the dry season which created a favourable condition for *M. invisa* to quickly recolonize the open space at the onset of the rains before the other weeds could emerge (Derakhshan and Gherekhloo, 2013). This trend corroborates the report of Cordeau *et al.* (2015); that tillage as well as hoe weeding are among the main drivers of weed community. The field observations in this study, showed that hoe weeding stimulated *M. invisa* germination and emergence even under cassava of different morpho-types and plant spacing (Pugnaire *et al.*, 1996) confirming the invasiveness of *M. invisa* in ecological environments where they are found (Derakhshan and Gherekhloo, 2013; Mesquita et al., 2015).

4.2 Effect of plant spacing and weed control methods on *M. invisa* density

The interaction effect of plant spacing, cassava variety, and weed control methods on *M. invisa* density (Table 2 and 3) showed that lower *M. invisa* density was recorded in plots that had less soil surface disturbance caused by hoe weeding irrespective of the plant spacing and cassava variety. This could be an indication that level of soil surface disturbance through tillage practices and hoe weeding under different plant spacing and cassava variety, encouraged *M. invisa* emergence and density.

4.3 Effect of plant spacing and weed control methods on total weed dry matter

The total weed dry matter did not vary significantly (P≤0.05) among the different plant spacing and the cassava varieties but varied among the weed control methods. The significantly (P≤0.05) low total weed dry matter obtained in the plots that were hoe weeded at 4, 8 and 12 WAP and in the plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP after 3 months showed that the weeds were excellently controlled. The relatively higher total weed dry matter obtained in the plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP was due to the ineffectiveness of the herbicide in the control of grasses especially *P. maximum* which increased the weed dry matter obtained in those plots. According to Melifonwu *et al.* (2012), the efficacy of herbicide treatments can last for just 8 WAP beyond which time weed seedling emergence starts to increase and gradually re-infest cassava plot thus increasing the amount of weeds in cassava fields. Some other researchers have also reported on the poor persistence of pre-emergence herbicides in tropical soils even when applied at high rates (Akobundu, 1977; Utulu *et al.* 1986) which may have been one of the reasons why the grass population in S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP plots were more, which led to the significantly higher weed dry matter obtained under this treatment.

4.4 Effect of plant spacing and weed control methods on weed species composition after cassava harvest

The effect of the different weed control methods on class of weed species at the experimental site and their level of infestation at 2 months after harvesting of the cassava at 10 MAP (i.e., 12 MAP) in both cropping seasons (Table 5) showed that *M. invisa* was the most common weed species in plots hoe weeded at 4, 8 and 12 WAP and plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP. This condition implied that more *M. invisa* seed rains would have been added to the soil seed bank which could result in a more serious *M. invisa* problem during the following cropping season(s). The result obtained also indicated that the presence of *M. invisa* species was not very noticeable in the plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP in both cropping seasons implying that no new weed seeds were added to the seed bank in the soil in those plots. In the weedy checks, similar trend was observed, but in this case, *M. invisa* had already produced and dropped their seeds into the soil. In the other plots that were hoe weeded at 4, 8 and 12 WAP and plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP recorded actively mature growing *Mimosa* plants which recolonized those areas and would later rain/drop their seeds into the seed bank in the soil before the next cropping season. This could be the missing link resulting in why farmers continue to combat this weed every cropping season as most farmers focus on the first cycle of weeding while neglecting the second cycle of weeding which is critical for the continued survival of most persistent, invasive and obnoxious weed species. A higher infestation of grasses was observed in the weedy checks and plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by trifloxysulfuron sodium (8 g/ha) applied post-emergence at 8 WAP compared to the other broadleaved weeds and sedges. However, moderate infestations of grasses were observed in plots hoe weeded at 4, 8 and 12 WAP and plots treated with S-metolachlor (1160 g/ha) + atrazine (1480 g/ha) applied pre-emergence followed by two hoe weeding at 12 and 16 WAP in both cropping seasons which showed that weed species also respond to different weed control methods after harvest. Zimdahl (1988) reported that the unsynchronized emergence of a population of weed seeds had been described as an evolutionary survival mechanism that safeguards against death of all seedlings if unfavourable growing conditions were to occur before or before their maturity to ensure continued survival of these species. According to Forcella et al*.* (2000), the periodicity of weed emergence is basically controlled by biological attributes, features, seed dormancy, field management practices and environmental conditions. However, a high percentage of emergences early in the season confers an advantage on the affected species in terms of colonizing an area ahead of other competitors (Oliver and Bararpaur, 1996) which means that the weeds that emerged earlier have the potential to dominate the flora throughout the season and such early groups may still be emerging even when later groups begin to emerge also (Hartzler et al., 1999) as observed in this study. Also, the ability of *M. invisa* to choke out other vegetation (Alabi et al., 2004; DAF, 2016), hinder the regeneration, reproduction and growth of native species in all infested areas and consequently resulted in gradual loss of biodiversity (Waterhouse, 1994; Basu and Ghosh, 2003; Vasu, 2003; Jayasree et al., 2006; Edeoga et al., 2008).

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