EFFECT OF TILLAGE PRACTICES AND OVER-SOWING METHODS ON GROWTH AND POPULATION DYNAMICS OF TWO STYLOSANTHES SPECIES IN NATURAL PASTURE

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Abstract

This study was conducted to evaluate the growth and population dynamics of two legume species oversown into natural pasture. Two legumes (Stylosanthes guianensis cv. Cook and Stylosanthes hamata cv. Verano), two tillage methods (zero-tillage and minimal tillage) and two planting methods (broadcasting and drilling) were combined into eight (8) treatments and replicated 4 times as a 2 × 2 × 2 factorial arrangements in a randomized complete block design. Planting was carried out in late rainy season (September, 2013) and the components of the oversown natural pasture were evaluated for height and soil cover between 2-8 months after planting (MAP) which covered the dry and rainy seasons. There were no marked differences ($p>0.05$) in the heights of the sown legumes, other herbaceous species, sown legume cover and existing dominant grass (P. maximum) cover in the dry season. There were significant differences ($p<0.05$) in the height of existing dominant grass, soil covered by sown legumes and other herbaceous species in the dry season. There were no significant differences ($p>0.05$) in the heights and soil cover of the legumes, other herbaceous species, and existing dominant grass (P. maximum). The two Stylosanthes species tolerated the drought of dry season. Irrespective of the tillage or sowing methods employed, the two oversown legumes survived competition from companion or existing species over the growing seasons, perhaps through the initial clearing of the field prior to over-sowing activities.

Key words: Tillage, Over-Sowing, Stylosanthes, Natural Pasture

Introduction

Insufficiency of quality fodder has been a perennial problem facing ruminant production, especially in the dry season in Nigeria. The natural pasture which is the cheapest source of forage does not supply adequate year-round quality and quantity forage and needs to be improved. Oversowing of natural pasture with improved and proven forage legumes has been proven as a feasible and productive option to increase the dry matter yield of natural pasture and improve the sustainability of livestock production in the region (Tarawali *et al.*, 1999). However, investigation of the population dynamics of *Stylosanthes* species or other legumes oversown in the natural pasture or in a grass-legume pasture is crucial for designation of effective and economical methods of establishment and biologically sound management practices that target long-term adequate yields with high legume content (de Leeuw *et al.*, 1992). Therefore, this study seeks better ways of enhancing the productivity of natural pasture through over-sowing by evaluating the plant height and soil cover of *Stylosanthes guianensis* and *S. hamata* amidst the existing plant species.

Materials and Methods

Experimental site

The experiment was carried out at Oja-Odan, Yewa North Local Government Area of Ogun state, Nigeria. The site lies in the Derived Savanna agro-ecological zone of Southwest, Nigeria. Oja-Odan is about 20.18km and 78.82km from Ilaro and Abeokuta, the Ogun State capital, respectively and lies on latitude 7° 1' 2.6" N and longitude 2° 50' 41" E, at altitude 35m (Google Earth, 2013). Abeokuta lies on latitude 7° 9' 39" N, longitude 3.5° 20' 54" E, at altitude 67m. Abeokuta records a mean annual rainfall of 1230mm in bimodal pattern with peaks in July and September and experiences high (83-100%) and low (55-84%) relative humidity during the rainy and dry seasons, respectively. Mean monthly temperature ranges between 23.25 °C in April and 31.00 °C in December (OORBDA, 2014). The soil at the experimental site was similar to the pre-classified Iwo series of alfisols (Nwachokor and Uzu, 2008); it was a slightly acidic (pH 6.52) and sandy loam soil (Nwachokor *et al.*, 2009).

Pre-planting activities and experimental design

An experimental land measuring 31m × 15m was mapped out in area with moderate concentration of naturally existing grasses. The land was minimally cleared to 20 cm average stubble height for easy access. Thereafter, the plots for minimal tillage were further cut to 5cm stubble height, such that

the top soil was minimally agitated (between 0-5 cm soil depth) with no serious overturning, while there was no soil agitation on the zero-tilled plots. The treatments were arranged as 2 × 2 × 2 factorial in a randomized complete block design with 4 replicates and 8 plots per replicate. Each plot measured 3m², with 1m inter-plots spaces and 1m between the replicates. Two legumes (*Stylosanthes guianensis* cv. Cook and *Stylosanthes hamata* cv. Verano), two tillage methods (Zero-tillage and minimal tillage) and two planting methods (broadcasting and drilling) constituted eight (8) treatment combinations. The treatments were randomly allotted to the plots per replicate. Prominent plant species other than the sown legumes and existing dominant grass on each plot were identified within the quadrats (Appendix 1).

Planting materials, oversowing and post-sowing activities

The legume seeds were procured from National Animal Production Research Institute (NAPRI) Shika, Ahmadu Bello University, Zaria. A day prior to planting, the legume seeds were scarified, using water at boiling point. The seeds were placed in a cloth bag, immersed in boiling water for 3 minutes, and thereafter dried under a shade (Olanite, 1997). In late rainy season (September, 2013), planting was carried out according to the treatments of each plot by broadcast or drill at 7 kg/ha seeding rate. Drilling was achieved with seeds been placed along each row, at 50 cm inter-row spacing. Seeds were evenly spread on each plot for the broadcast method. Single superphosphate (SSP) fertilizer was broadcast on the plots at the rate of 60 kg/ha at the onset of rains (in April 2014).

Estimation of drought tolerance and plant growth

The drought tolerance and survival of the legumes amidst the existing dominant grass and other herbaceous species were visually estimated during dry (November 2013 - January, 2014) and rainy (May and July 2014) seasons, as percentage of green plant stands of the sown legumes, existing dominant grass and other herbaceous species covering each plot using two 0.5 m² quadrats. All plant materials within the quadrats were visually rated in percentage (Olanite, 1997). Height of the existing dominant grass, sown legumes and other herbaceous species were measured during the dry (November 2013 - January, 2014) and rainy (May and July 2014) seasons, within 0.5 m² quadrat using meter rule.

Statistical Analysis

All field data were subjected to analysis of variance and the treatment means were separated using Duncan's Multiple Range Test (SAS, 1999).

Results and Discussion

Table 1 presents the effects of tillage practices and sowing methods on growth and population dynamics of two oversown *Stylosanthes* species, *Panicum* and other plant species in a natural pasture during dry season. There were no marked differences ($p>0.05$) in the heights of the sown legumes, other herbaceous species, sown legume cover and existing dominant grass (*P. maximum*) cover in the dry season. There were significant differences ($p<0.05$) in the height of existing dominant grass, soil covered by sown legume and other herbaceous species in the dry season. Table 2 presents the effects of tillage practices and sowing methods on growth and population dynamics of the two oversown *Stylosanthes* species, *Panicum* and other plant species in a natural pasture during rainy season. There were no significant differences ($p>0.05$) in the heights of the legumes, other herbaceous species, and existing dominant grass (*P. maximum*). Similarly, the soil cover was similar for existing dominant grass, sown legume and other herbaceous species in the rainy season. Higher dry season soil cover of *S. guianensis* (65.00%) when it was broadcast on zero tillage plots was lesser than 70% reported for sole Verano stylo within the first 30-40 days of establishment in early-rainy season (de Leeuw *et al.*, 1992). The difference can be attributed to serious competition for water between the existing species on the natural pasture and the sown legumes in the dry season. Dry season higher weed cover (other herbaceous species cover) recorded (62.50%) when *S. guianensis* was drilled without soil agitation did not limit the growth and dominance of the legumes later on in the rainy season. The major information usually used in the selection of forage accessions for evaluation in different agro-climatic zones is rainfall, temperature (altitude) and soil pH (Hanson and Heering, 1992). The soil pH (6.52) of this experimental field which is close to the acidity range (*S. guianensis*-4.5-5.8; *S. hamata*-5.4-8.5) for the two *Stylosanthes spp* (Hanson and Heering, 1992) might be an added advantage for their survival and establishment.

Conclusion

The two *Stylosanthes* species tolerated the drought of dry season. Irrespective of the tillage or sowing methods employed, the two oversown legumes survived high competition from companion or existing species over the growing seasons. They showed similar height pattern in both seasons and similar population dynamics in wet season. Hence,

manual broadcast of either of the two Stylosanthes species with zero tillage would be more economical as it is easier, requires lesser labour and time.

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Table 1: Effect of tillage and sowing methods on growth and population dynamics of two oversown Stylosanthes species, *Panicum* and other plant species in dry season

Species	Tillage	Sowing	Plant Height (cm)			Soil Cover (%)		
			L	G	W	L	G	W
S. guianensis	Minimal	Broadcast	19.25	13.75^{a}	19.25	57.50^{ab}	3.75	37.50^{ab}
	Zero	Broadcast	18.75	12.75^{ab}	28.75	65.00^{a}	6.75	30.00^{ab}
	Minimal	Drill	20.25	16.00^{a}	38.75	52.50^{ab}	8.75	31.25^{ab}
	Zero	Drill	17.50	14.75^{a}	41.25	35.00^{b}	3.75	62.50^{a}
S. hamata	Minimal	Broadcast	17.25	15.50^{a}	34.50	45.00^{a}	5.00	33.75^{a}
	Zero	Broadcast	21.25	14.75^{a}	27.50	37.57^{b}	7.50	40.00^{a}
	Minimal	Drill	21.50	10.25^{ab}	27.50	32.50^{b}	5.00	45.00^{a}
	Zero	Drill	22.25	12.75^{a}	31.50	47.50^{a}	13.75	27.50^{b}
SEM			0.96	0.46	2.43	3.69	1.52	3.60

^{a,b}: Means on the same column with the same superscripts are similar ($p>0.05$); SEM: Standard error of means; L: sown legume: G: existing dominant grass; W: other herbaceous species

Table 2: Effect of tillage and sowing methods on growth and population dynamics of two oversown Stylosanthes species, *Panicum* and other plant species in rainy season.

Species	Tillage	Sowing	Plant Height (cm)			Soil Cover (%)		
			L	G	W	L	G	W
S. guianensis	Minimal	Broadcast	42.50	73.75	48.75	50.00	22.50	15.00
	Zero	Broadcast	47.50	67.50	35.00	43.50	23.75	10.00
	Minimal	Drill	46.25	76.25	35.50	42.50	26.25	11.25
	Zero	Drill	38.75	67.50	52.50	40.00	13.75	13.75
S. hamata	Minimal	Broadcast	35.00	62.50	37.75	35.00	17.50	19.75
	Zero	Broadcast	37.50	78.75	51.25	38.75	21.25	16.25
	Minimal	Drill	43.75	78.75	46.25	53.75	15.00	15.50
	Zero	Drill	34.25	65.00	48.00	47.50	33.75	18.25
SEM			1.95	1.60	2.51	2.64	2.83	1.56

^{a,b}: Means on the same column without superscripts are similar ($p>0.05$); SEM: Standard error of means; L: sown legume; G: existing dominant grass; W: other herbaceous species; ns: not significant ($p>0.05$).

Appendix 1: The botanical inventory of other prominen t herbaceous species on the oversown natural pasture

	BOTANICAL NAME	COMMON NAME	FAMILY
1.	*Talinium triangulare*	Water leaf	Portulacaceae
2.	*Chromolaena odorata*	Siam weed	Asteraceae
3.	*Cyperus esculentus*	Yellow nutsedge	Cyperaceae
4.	*Tridax procumbens*	Tridax/coat buttons	Asteraceae
5.	*Mariscus alternifolius*		Cyperaceae
6.	*Trianthema potulacastrum*	Horse purslane	Aizoaceae
7.	*Aspilia africana*	Haemorrhage plant	Asteraceae
8.	*Cassia mimosoides*	Japanese tea/Senna tea	Caesalpiniaceae
9.	*Sida acuta*	Broom weed	Malvaceae
10.	*Cyperus rotundus*	Purple nutsedge	Cyperaceae
11.	*Axonopus compressus*	Carpet grass	Poaceae
12.	*Eleusine indica*	Goose grass/Bull grass	Poaceae