Growth and Yield Responses of two Accessions of Bitter Leaf to Stem Pruning

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ABSTRACT

A two season (rainy and dry seasons) experiment was conducted to determine the effects of stem pruning on growth and leaf yield of two accessions of bitter leaf in 2021 and 2022 cropping seasons. The experiment was carried out at the Demonstration Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. The two accessions (Nimo and Nnewi) received four levels of stem pruning which were no pruning, pruning to 1, 2 and 3 stems. The experiment was laid out as a 2 x 4 factorial in randomized complete block design (RCBD) and replicated three times. The result indicated that stem pruning had significant (P<0.05) effect on the growth and leaf yield of bitter leaf. The tallest plants, highest number of leaves, widest stems, highest leaf fresh and dry weight were observed in plants that were pruned to 3 stems while unpruned plants significantly (P<0.05) produced the lowest mean values for both growth and leaf yield. Growth and leaf yield did not show significance among the accession though results showed that Nimo accession produced higher number of leaves, tallest plant and highest fresh leaf yield in the two seasons. Combined effect of stem pruning and accessions showed that pruning Nimo accession to 3 stems produced most vigorous plants and highest leaf yield. Considering the results obtained, stem pruning of bitter leaf, especially Nimo accession, to 3 stems was recommended for farmers in Awka since it recorded most vigorous plants and highest leaf yield.

INTRODUCTION

Bitter leaf (*Vernonia amygdalina* Del.) is a vegetable widely grown throughout Africa. It grows primarily in tropical Africa especially in Nigeria, Zimbabwe and South Africa (Faromi, 2003). It is domesticated in parts of West Africa. It belongs to the family, Asteraceae (Okafor, 2002). The crop has been reported to possess high nutritional and medicinal values (Oyeyemi *et al*., 2018). Extracts from bitter leaf have been shown to have anti-bacterial, anti-fungal, anti-plasmodial, anti-cancer, anti-oxidant, anti-diabetic and nephron-protective effects (Ijeh and Ejike, 2012). Other popular medicinal use of bitter leaf includes traditional treatments of diseases such as malaria, infertility, diabetes, gastro-intestinal problems and sexually transmitted diseases (Farombi and Owoeye, 2011). In Nigeria, the leaves are consumed as green leafy vegetables where they are used as soup condiments after washing and boiling to get rid of the bitter taste (Abosi and Raseroka, 2013).

Pruning is a horticultural practice involving the selective removal of certain parts of a plant, such as branches, buds or roots (Nelson, 2017). It increases branches in plants resulting in increased leaf production (Hossain *et al*., 2007). In some cases, pruning is used as a preventive measure to make space for any new seedling or growth. It is important to prune trees and shrubs at the proper time (Maximum Yield Inc, 2019). Pruning focuses more on the removal or reduction of parts of a plant, tree or vine that are not requisite to growth or production and are no longer visually pleasing. Commercial bitter leaf farmers in Anambra State practice coppicing at the onset of rainy season in order to facilitate new shoot and leaf growth (Field Survey, 2019) but there is scarcity of information on the effect of pruning stem to specific number of shoots, at the juvenile stage, on growth and yield of bitter leaf. Earlier preliminary findings (Ndukwe *et al*., 2021) on bitter leaf in the same study area revealed that the crop responds positively to stem pruning although the research was conducted within four months. The objective of this study, therefore, was to ascertain the growth and yield response of bitter leaf to stem pruning.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Teaching and Research Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka, Anambra State Nigeria. Awka is a tropical rain forest with an average temperature of between 27°C and 30°C. The area is located between latitude 06° 151'N and longitude 07° 081'E, with an average rainfall of 1810.3 mm per annum and a humidity of 75- 80% (GEOMET NAU, 2019).

Sources of Planting Material and Manure: Stem cuttings of two accessions of *V. amygdalina* (Nimo and Nnewi accessions) were collected from commercial farms located at Nimo and Nnewi, respectively. The stems were cut into an average length of 15cm, bearing 3-5 nodes. Poultry manure was collected from battery caged poultry farm in Awka, Nigeria.

Treatments and Experimental Design: Treatments comprised two accessions of bitter leaf (Nimo and Nnewi) and four levels of stem pruning namely no pruning, pruning to one stem, two stems and three stems**.** These treatment combinations were laid out as split plot in randomized complete block design (RCBD) and replicated three times. Blocks were separated from each other with a space of 1 m. Each plot measured 2.5 m by 2.5 m and were separated from each other with a space of 0.5 m.

Land Preparation, Planting and other Cultural Practices: The land was cleared of existing vegetation and ploughed. The soil was raised to beds measuring 2.5 m x 2.5 m. Stem cuttings of 10-15 cm long were planted on the beds at 1 m x 1 m spacing. Unsprouted stems were replaced after four weeks of planting. Blanket poultry manure was applied at 10t/ha to the soil at 20 cm diameter from each plant using ring method of application. Pruning was done at eight weeks after planting, the plants were pruned to one, two and three branches, No pruned plants represented the control. Observational units were the three middle plants in each experimental unit. The main plot was the two accessions of bitter leaf (Nimo and Nnewi accessions) while the sub plot was the levels of pruning (no pruning, pruning to one, two and three stems.

Data Collection and Analysis

Growth data were collected at two weeks interval and comprised height of tallest branch, stem girth of tallest branch and total number of leaves. Height of tallest branch was recorded using a flexible measuring tape while stem girth was recorded with digital vernier caliper. Total number of leaves was obtained by counting the number of fully opened leaves on each branch of the plant. Fresh and fully opened leaves were harvested by picking at 3 weeks interval. All data collected were subjected to analysis of variance following the procedures outlined for the design for split plot experiment RCBD using GENSTAT (2012). Correlation was carried out on some growth and yield parameters by using SPSS (2013).

RESULTS

Main effect of stem pruning and accessions on the height of tallest branch

Plant height in 2021 was significantly ($P<0.05$) influenced by pruning in all the sampling periods except in 11 weeks after planting (Table 1). The tallest plants were produced by plants that were pruned to three branches while shortest plants were observed in plants that were not pruned. In 2022, the shortest plants were observed in plants that were pruned to one stem in all the sampling periods while the tallest plants were produced by plants that were pruned to three branches.

Nimo accession was significantly ($P<0.05$) taller than Nnewi accession in 2021 but in 2022 there was no significant difference in the plant of height of both Nimo and Nnewi accessions (Table 1). However, the mean values of plant height for Nimo accession were higher than the values recorded in Nnewi accessions.

The interaction of bitter leaf accession and stem pruning showed that there were significant ($P<0.05$) difference in all the sampling periods in both 2021 and 2022 cropping seasons (Table 2). The plants that produced the tallest branch was Nimo accession pruned to three stems specifically at 9, 11, 13 and 16 weeks after planting in 2021 season. This trend was repeated in 2022 cropping season. It was also observed that unpruned plants were shortest irrespective of the accession.

Table 1: Main effects of stem pruning and accession on height (cm) of tallest shoot in 2021 and 2022 cropping seasons

	Weeks after planting in 2021				**Weeks after coppicing in 2022**							
Stem pruning	9	11	13	16	10	12	14	16	18	20	23	26
Pruning to 1 stem	36.0	44.0	48.1	56.2	39.3	48.2	55	61.1	61	59.2	62.4	67
Pruning to 2 stems	39.0	44.0	48.2	58.4	41.4	53	64	71.1	67.3	69	71	77
Pruning to 3 stems	42.1	44.0	52.0	77.0	45.3	56	65.4	75.4	73.4	86	97.4	105
No pruning	28.0	27.0	31.0	42.3	42	51.2	59.4	65.2	66	70	75	79
$LSD_{0.05}$	12.6	ns	13.6	16	ns	Ns	ns	12.1	ns	13	14.2	14
Accessions												
Nimo	40	47	52	67.4	44	54.3	63	70.4	69	73	80.4	87.4
Nnewi	30	31	38	50	41	50.2	58.2	65.3	65	69.2	72.4	76.1
$LSD_{0.05}$	9.5	15.1	15	ns	ns	Ns	ns	ns	ns	ns	ns	ns

Table 2: Interaction of stem pruning and accessions of bitter leaf on height (cm) of tallest branch in 2021 and 2022 cropping seasons

		Weeks after planting in 2021				**Weeks after coppicing in 2022**							
Accession	**Stem pruning**	**9**	**11**	**13**	**16**	**10**	**12**	**14**	**16**	**18**	**20**	**23**	**26**
Nimo	Pruning to 1 stem	44	51.4	44	54.1	39.3	47.3	54.2	61.2	60.4	58	61	86.4
	Pruning to 2 stems	43	49.3	54	64	40	55.3	66	73	70	70.2	73	81
	Pruning to 3 stems	49	61.2	68	89	49	60.4	68.4	78.3	75	90.1	112	122
	No pruning	24	26.3	31	40.2	46.1	53.2	63.4	68.4	69	74	77	80
Nnewi	Pruning to 1 stem	22.4	26	29	35.4	39.3	49.1	54.3	60.2	61	61	64.1	68
	Pruning to 2 stems	35	39	43	53	43.3	52.3	62	70	65	67	69	72
	Pruning to 3 stems	40.4	37	49	65.2	42	53	63	70.2	72	81.1	83.1	88
	No pruning	22	27	31	44.4	39	47	55.3	62.4	62.3	68	74	77.2
	$LSD_{0.05}$	15.8	14	18.1	22	ns	ns	ns	16.9	ns	20.3	20.9	20.7

Effects of stem pruning and accession on number of leaves

The number of leaves of bitter leaf was significantly ($P<0.05$) influenced by stem pruning all through 2021 and 2022 seasons (Table 3). Highest number of leaves was observed in plants that were pruned to three stems in both 2021 and 2022 cropping seasons. This was followed by plants pruned to two stems in all the sampling periods in both cropping seasons. Table 5 also showed that Nimo accession produced higher number of leaves than Nnewi accession in all the sampling periods in 2021 and 2022 seasons. The combined effects of accessions and pruning indicated significant influence on the number of leaves as shown in Table 4. Pruning of Nimo and Nnewi accessions to three branches significantly enhanced the production of highest number of leaves all through the sampling periods in 2021 and 2022 cropping seasons. This was followed by plants pruned to two stems.

Table 3: Main effects of stem pruning and accession on number of leaves in 2021 and 2022 cropping seasons

	Weeks after planting in 2021				**Weeks after coppicing in 2022**							
Stem pruning	**9**	**11**	**13**	**16**	**10**	**12**	**14**	**16**	**18**	**20**	**23**	**26**
Pruning to 1 stem	20	12.1	19.2	35	37.3	35.1	41.1	24.2	27	18.2	20	22
Pruning to 2 stems	34	16.1	27.2	47.3	34.2	53.3	65	34	32	23	26	29
Pruning to 3 stems	43.1	24	44.1	76.2	53.1	76	77	55.1	45	46	87	83.3
No pruning	23.3	13.2	14.4	36.1	40	39.4	48.3	29.2	33.2	25	25.4	28.1
$LSD_{0.05}$	14.7	5.2	14	17.8	16.8	10.2	20.8	12.9	7.8	4.3	11.1	7.8
Accessions												
Nimo	34.3	19	35.3	58.4	52	56.4	67	44	42	33	50.2	49.3
Nnewi	26	14	17.2	40	30.4	45.4	48	27	26.4	23.2	29	32
$LSD_{0.05}$	13.2	ns	ns	28.3	19.7	Ns	ns	ns	13.1	7.4	16.6	15.3

Table 4: Interaction of stem pruning and accessions of bitter leaf on number of leaves in 2021 and 2022 cropping seasons

		Weeks after planting in 2021				Weeks after coppicing in 2022							
Accession	**Stem pruning**	**9**	**11**	**13**	**16**	**10**	**12**	**14**	**16**	**18**	**20**	**23**	**26**
Nimo	Pruning to 1 stem	32	15.1	31	47	47.3	38	49	25.1	34	20	21	24
	Pruning to 2 stems	35	17	35.2	55	55.3	60	73	41.1	38.4	29	31	34
	Pruning to 3 stems	46	28	56	88.4	59.1	81.1	86.4	73	56	53	119	110
	No pruning	25	15	19.4	38.3	55.6	47	57.3	36.2	38.4	29	30	30.2
Nnewi	Pruning to 1 stem	7.8	9.1	8	22.1	49.1	32.2	34	23.3	19.2	17	18.1	20.4
	Pruning to 2 stems	33	15.2	19.2	40	52.3	47	55.3	27	25	17	20.3	25
	Pruning to 3 stems	40.3	20.1	32.4	64	53	71	65	37.3	34	38.4	55	57
	No pruning	22	11.4	9.4	34	47	32.1	39.3	22.2	28	21	21	26
	$LSD_{0.05}$	19	7.1	19	26.2	ns	16.4	28.1	19	11.7	6.6	16	12.8

Effect of stem pruning and accession on leaf yield of bitter leaf

The main effect of stem pruning on leaf yield of bitter leaf indicated that stem pruning had significant influence on the total leaf fresh and dry leaf weight in 2021 and 2022 cropping seasons (Table 5). Pruning the stems to three significantly ($P<0.05$) produced highest fresh leaf weight (0.9 t/ha) and dry leaf weight (0.26 t/ha) in 2021. The same trend was repeated in 2022 with highest fresh leaf weight (1.2 t/ha) and dry leaf weight (0.3 t/ha) recorded by plants pruned to three stems. Lowest fresh and dry leaf yield were recorded in either the unpruned plants or plants pruned to one stem. The main effect of accessions showed that Nimo accession consistently produced higher fresh and dry leaf yield than Nnewi accession in both 2021 and 2022 cropping seasons (Table 5).

The interaction of accession and stem pruning had significant ($P<0.05$) influence on the fresh and dry leaf weights of bitter leaf as indicated on Table 6. Pruning the stems of Nimo accession to three stems resulted in highest leaf fresh and dry yield while lowest leaf yield was obtained from Nnewi accession pruned to one stem.

Table 5: Main effects of stem pruning and accession on leaf yield of bitter leaf in 2021 and 2022 cropping seasons

	2021		**2022**	
Stem pruning	**Total leaf fresh weight (t/ha)**	**Total leaf dry weight (t/ha)**	**Total leaf fresh weight (t/ha)**	**Total leaf dry weight (t/ha)**
Pruning to 1 stem	0.4	0.13	0.5	0.14
Pruning to 2 stems	0.5	0.17	0.8	0.2
Pruning to 3 stems	0.9	0.26	1.2	0.3
No pruning	0.41	0.13	0.6	0.17
$LSD_{0.05}$	0.25	0.06	0.2	0.05
Accessions				
Nimo	0.71	0.21	0.9	0.3
Nnewi	0.42	0.13	0.6	0.16
$LSD_{0.05}$	ns	0.07	ns	0.05

The interaction of accession and stem pruning had significant ($P<0.05$) influence on the fresh and dry leaf weights of bitter leaf as indicated on Table 6. Pruning the stems of Nimo accession to three stems resulted in highest leaf fresh and dry yield while lowest leaf yield was obtained from Nnewi accession pruned to one stem.

Table 6: Interaction effects of stem pruning and accession on leaf yield of bitter leaf in 2021 and 2022 cropping seasons

		2021		2022	
Accession	Stem pruning	Total leaf fresh weight (t/ha)	Total leaf dry weight (t/ha)	Total leaf fresh weight (t/ha)	Total leaf dry weight (t/ha)
Nimo	Pruning to 1 stem	0.6	0.16	0.6	0.17
	Pruning to 2 stems	0.7	0.21	0.8	0.23
	Pruning to 3 stems	1	0.31	1.5	0.41
	No pruning	0.5	0.15	0.7	0.2
Nnewi	Pruning to 1 stem	0.2	0.09	0.4	0.12
	Pruning to 2 stems	0.4	0.1	0.7	0.17
	Pruning to 3 stems	0.7	0.2	0.9	0.22
	No pruning	0.3	0.09	0.5	0.14
	$LSD_{0.05}$	0.4	0.1	0.2	0.08

DISCUSSION

Result showed that pruning had significant effect on plant height, number of leaves, stem girth and yield at harvest, with pruning to three stems recording significantly highest mean values for these variables. Unpruned plants produced shortest plants; this could be as a result of competition for resources especially solar radiation as a result of many branches produced by the unpruned plants. Pruning to three stems must have enhanced solar distribution within the canopy thereby increasing their photosynthetic capacity and quantum yield of leaves as stated by Hossain, Amru and Normaniza (2017). More vigorous plants and higher leaf yield were produced by Nimo accession, indicating that Nimo accession had easier adaptation to Awka environment (location of the experiment) than Nnewi accession. This is in agreement with the findings of Ndukwe *et al.* (2021). Nimo and Awka belong to the same agroecological zone in Anambra State.

CONCLUSSION

The study concluded that stem pruning of bitter leaf especially pruning to three stems good and was recommended for adoption to farmers because it produced most vigorous plants and the highest leaf yield throughout the sampling periods. Nimo accession was recommended as promising planting material for bitter leaf farmers within Awka metropolis and environs.

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