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Effect of Controlled Bush Burning and Mulching on the Fresh Weight of Leaves, Corms and Cormels of Four Cocoyam Cultivars

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Abstract

The experiment was conducted at the University of Uyo Teaching and Research farm in 2022 to evaluate the effects of bush burning and mulching on the fresh weight of leaves, corms and cormels of four cocoyam cultivars – NCY 001, NCY 002, NCY 004 and NCY 005. The experiment was laid out on a split – split plot design using randomized complete block design and replicated three times. The effects of the treatment combinations were investigated and the study indicated that burning increased the fresh weight of corms and cormels irrespective of the cultivars. Mulching at level of 10 tonnes per hectare on the burnt plots showed significant increase in the fresh weight of the corms and cormels (2.99, 2.98) at 60, 90DAP with NCY 005 while NCY 001 gave a higher value of 2.99 at 120 DAP. Mulching at zero tonne per hectare gave the highest fresh weight of corms and cormels (1.97, 1.98) on unburnt plot at 60,90DAP with NCY 005 and 2.98 at 120DAP with NCY 002. The lowest fresh weight of corms and cormels (1.37, 1.60, 1.70) was recorded with 20 tonnes per hectare mulch levels on the unburnt plots at 60, 90 and 120DAP with NCY004. The fresh weight of leaves (0.30, 0.32, 0.38) was highest with 20 tonnes per hectare mulch level on the unburnt plots with NCY004 at 60,90,120DAP while zero tonnes per hectare recorded lowest fresh weights of leaves on both NCY 001 and NCY 005 on the burnt plots at 60, 90 and 120 DAP respectively. It appears therefore that the cultivation of NCY 001 - Xanthosoma sagittifolium (white) on burnt plots and 10 tonnes per hectare mulch level may give more economic returns to management on the corms and cormels whereas NCY 004 with 20 tonnes per hectare level mulch on unburnt plots may give higher fresh weight of leaves.

Key words: Cocoyam, NCY 001, NCY 002, NCY 004, NCY 005, *Xanthosoma sagittifolium, Colocasia esculenta*, corms, cormels

1.0 Introduction

Cocoyam is an herbaceous plant of the family Araceae. The term cocoyam is used to refer collectively to members of the genus *Colocasia* and the genus *Xanthosoma* which are used as food (Onwueme and Sinha, 1991). Agboola (1987) recognized two types viz: *Colocasia esculenta* and *Xanthosoma sagittifolium*. When referred to separately, colocasia are called taro and Xanthosoma are called tannia. Taro is referred to botanically as *Colocasia esculenta* (L) Schott. It originated in South Central Asia and spread to the Pacific and later to West Africa. Tannia consist of several species of Xanthosoma with *Xanthosoma sagittifolium* being the most important. According to FAO (2012), *Xanthosoma sagittifolium* is among the world's sixth most important root and tuber crop. It originated in central and South America where it spread to southeast Asia and Pacific Islands. It was introduced to Africa in the nineteenth century much later than taro (Onwueme and Sinha, 1991). Cocoyam is cultivated in rich, well drained soils, though some varieties have adapted to swampy lowlands. The soil may be clayey loam or sandy and it does best on acidic soils (Ojinaka *et al.*,2009). Cocoyam is a staple crop cultivated for its large starchy, spherical or elongated undergrowth tubers, consumed as cooked vegetables (Ramanatha *et al.,* 2010) made into puddings and eaten for its starch content. Cocoyam contains dietary fibre and high protein content than other tropical root crops. It also contains thiamine, calcium, niacin, manganese, vitamins B, C, E, Magnesium, copper and riboflavin (Ojinaka *et al.,* 2009).

Generally, all plant parts (cormels, petioles, leaves and inflorescence) of cocoyam are edible (CABI, 2014, Vanekar and Slaats, 2013). The nutritional attributes of cocoyam make it a good base for food preparation for infants and highly digestible and acceptable to low income earners (Oti and Akobundu, 2008). Cocoyam is postulated to have superior nutritional values over other major root and tuber staple crops of West Africa (Chukwu *et al* 2008, Ekwe *et al.,* 2009, Lim, 2008, Opara, 2003).

The agricultural practices of vegetation burning done in many parts of tropical Africa, has been a problem in agricultural production and causes losses in gaseous forms of non-metallic nutrients such as carbon, nitrogen, sulphur and phosphorus (Akinsanmi, 1982). Fire destroys soil organic matter whose colloidal components adsorb many plant nutrients. The ash derived from burning of crop residues contains mineral plant food in an available form. Bush burning is a cheap, convenient and fast way to clear the land in preparation for planting. This is why it is commonly practiced among rural farmers and its negative effects are often ignored. Mulching is soil conservation method which involves the addition of any kind of material on the surface of a soil. Its benefits include: preventing loss of water by evaporation, keeping the soil damp and permeable by water, keeping down weeds, controlling soil temperature as well as erosion (Akinsanmi, 1982; Edem, 2015). This project assessed the effect of combining bush burning and mulching on the production of cocoyam corms, cormels as well as leaves.

2.0 Materials and Method

An experimental site was selected at the University of Uyo Teaching and Research farm for the project. The selected area lies between latitude 4^0 30 and 5^0 30 North and longitude 7^0 30 and 8^0 20 East with a mean altitude of 38.1m above sea level. The mean annual rainfall is 2115mm. The mean monthly relative humidity is 79% with temperature of 26.86^0C. The soil sample was taken for assessment of both chemical and physical analysis since the selected plot has been put through continuous cropping over the year.

Two seasons characterized the macroclimate of the experimental site – a wet season which last for about 9 – 10 months and a short dry season. The soil of the experimental area is

derived from sandy parent materials and are widely weathered and dominated by low activity clays (SLUS-AK, 1989). The experimental design used for the experiment was a factorial laid out as a split-split plot using randomized complete block design.
The site of the experiment measuring 25.4 x 13.2 m (335.28m^2) was cleared manually using a cutlass and marked out for the research. Soil samples were collected from the marked plots at the depths of 0-15 and 15 – 30cm respectively for both chemical and physical analysis. The soil samples were air-dried, ground, sieved and used for the analysis.
Half of each plot after clearing was burnt and the other half was not burnt. Burnt plots were taken as main plots, levels of mulch as sub-plots and cocoyam cultivars as sub-subplots. The levels of the grass mulch used were 0 t/ha, 10 t/ha and 20 t/ha applied in split doses. The four (4) cocoyam cultivars used were *Xanthosoma sagittifolium* (White, NCY001), *Xanthosoma sagittifolium* (Red, NCY002), *Colocasia esculenta* (NCY 004), *Colocasia esculenta* (NCY 005). A total of twenty-four (24) treatment combinations were used for the experiment viz:

1. *X sagittifolium*(white NCY001) + burnt plot + 0t/h mulch
2. *X sagittifolium*(white NCY001) + unburnt plot + 0t/h mulch
3. *X sagittifolium*(white NCY001) + burnt plot + 10t/h mulch
4. *X sagittifolium*(white NCY001) + unburnt plot +10t/h mulch
5. *X sagittifolium*(white NCY001) + burnt plot + 20t/h mulch
6. *X sagittifolium*(white NCY001) + unburnt plot + 20t/h mulch
7. *X sagittifolium*(Red NCY002) + burnt plot + 0t/h mulch
8. *X sagittifolium*(Red NCY002) +unburnt plot + 0t/h mulch
9. *X sagittifolium*(Red NCY002) + burnt plot + 10t/h mulch
10. *X sagittifolium*(Red NCY002) + unburnt plot + 10t/h mulch
11. *X sagittifolium*(Red NCY002) + burnt plot + 20t/h mulch
12. *X sagittifolium*(Red NCY002) + unburnt plot + 20t/h mulch
13. *C esculenta* (NCY 004) + burnt plot + 0t/ha mulch
14. *C esculenta* (NCY 004) + unburnt plot + 0t/ha mulch
15. *C esculenta* (NCY 004) + burnt plot + 10t/ha mulch
16. *C esculenta* (NCY 004) + unburnt plot + 10t/ha mulch
17. *C esculenta* (NCY 004) + burnt plot + 20t/ha mulch
18. *C esculenta* (NCY 004) + unburnt plot + 20t/ha mulch
19. *C esculenta* (NCY 005) + burnt plot + 0t/ha mulch
20. *C esculenta* (NCY 005) + unburnt plot + 0t/ha mulch
21. *C esculenta* (NCY 005) + burnt plot + 10t/ha mulch
22. *C esculenta* (NCY 005) + unburnt plot + 10t/ha mulch
23. *C esculenta* (NCY 005) + burnt plot + 20t/ha mulch
24. *C esculenta* (NCY 005) + unburnt plot + 20t/ha mulch

The plant population for each cultivar was 12 for the burnt and unburnt plot. The experiment was replicated three (3) times. The growth and yield characters assessed were:

i. Fresh weight of leaves
ii. Fresh weight of corms
iii. Fresh weight of cormels

Onwueme *et al* (1991) stated that corm formation starts about 3 months after planting but the major period for corm bulking is about 5 – 6 months onwards. The fresh weight of the corms and cormels were then taken at the intervals of 60, 90, and 120 days after planting (DAP) at random with four stands per treatment plot. The statistical significance of the data collected was analysed using analysis of variance (ANOVA) and the means separated using the least significance difference (LSD).

3.0 Results

Table 3.1 shows the effect of mulching and burning on the fresh weight of leaves of the four cultivars of cocoyam. The result indicates significant differences ($P<0.05$) on the fresh weight of the leaves of cocoyam cultivars taken at 60, 90 and 120 days after planting (DAP). The application of 20 t/ha of mulch level on the unburnt plots showed significantly higher values of 0.34, 0.38 and 0.40 tons/hectare at 60, 90, 120 DAP with *Colocasia esculenta* (NCY 004). This was followed subsequently by *Xanthosoma sagittifolium* (NCY 002) with values of 0.31, 0.39 and 0.39t/ha applied on unburnt plots with 20 t/ha mulch level at 60, 90 and 120DAP. The least recorded values (0.10, 0.12. 0.17t/ha) were obtained with *Xanthosoma sagittifolium* (NCY 001) on unburnt plots with 0t/ha mulch level at 60, 90, 120DAP respectively. Generally, *Xanthosoma sagittifolium* showed significant results in comparison to all the treatments.

The result of the fresh weight of the corms and cormels with mulching and burning is shown in Table 3.2. The fresh weights of the corms and cormels were significantly influenced by the application of 10tns/ha mulch levels on the burnt plots. Higher values of 2.99, 2.98t/ha were obtained at 60 and 90 DAP with *Colocasia esculenta* (NCY 005) on burnt plots applied with 10t/ha mulch level. At 120DAP, *Xanthosoma sagittifolium* (NCY 001) recorded 2.99t/ha on burnt plots mulched with 10tns/ha mulch level. This was followed by *Xanthosoma sagittifolium* (NCY 002) with values of 2.95, 2.97 and 2.98t/ha obtained on burnt plots mulched with 10t/ha mulch level at 60, 90 and 120DAP respectively. The least values of 1.37, 1.60 and 1.70t/ha were obtained with *Colocasia esculenta* (NCY 004) on unburnt plots and mulched with 20t/ha mulch level at 60, 90 and 120DAP when compared with all the treatments. Generally, *Xanthosoma sagittifolium* showed significant results over other cultivars.

4.0 Discussion

The various cultivars showed varying significant differences at 60, 90 and 120 days after planting. The fresh weight of the cocoyam leaves increased with increase in the tonnage of mulch applied with both cultivars. The increase in tonnage of mulch provides additional water conservation required for the development of cocoyam. This assertion is confirmed by Udounang *et al* (2022) and Irvine (1969) in their submission that cocoyam requires much water during their early vegetative growth stage hence the planting of the crop in the onset of the rainy season. This was further supported by Akinsanmi (1982) and Ikeh *et al* (2012) who opined that mulching keeps the soil damp, preventing water loss through evaporation. Chukwu *et al.,* (2008) in his research on cocoyam, observed that good yield was obtained in early planting provided mulching was done. Edem (2021), had same observation in his work with sweet potato and cattle-cud mulches. The high yield on fresh weight of leaves, corms and cormels can be attributed to the ability of mulch to maintain good physical soil conditions and provide a boost to crop development and subsequent yield (Chukwu *et al.,* 2008; Ekpo *et al.,* 2011). Mulch, being a form of organic manure improves the soil aeration, water infiltration and nutrient-holding capacity of the soils (Sarka *et al.,*2002; Akata *et al.,* 2021) which invariably affects the yield of crops (Bayu *et al.*,2006; Belay *et al.*,2001; Tremblay *et al.,*2011). This however accounts for the high values of the weight of leaves, corms and cormels respectively. The agricultural practice of burning vegetation and crop residues causes loss in gaseous forms of non-metallic nutrients (Akinsanmi, 1982) as well as destroys ground cover. The ash gotten from burning contains minerals which serve as plant food in available form. This therefore suggests the increase yield of corms and cormels in burnt plots. The observation holds true according to Udounang *et al* (2019) in his research with selected crop residues on the performances of fluted pumpkin.

Table 3.1: Effect of mulching and burning on the fresh weight of leaves of four cocoyam cultivars

Treatments	Fresh weight of leaves (kg) Days after planting (DAP)		
	60	**90**	**120**
X sagittifolium(white NCY001) + burnt plot + 0t/h mulch	0.06	0.09	0.12
X sagittifolium(white NCY002) + burnt plot + 0t/h mulch	0.16	0.18	0.20
C esculenta (NCY 004) + burnt plot + 0t/ha mulch	0.20	0.25	0.30
C esculenta (NCY 005) + burnt plot + 0t/ha mulch	0.07	0.09	0.10
Mean	**0.12**	**0.15**	**0.18**
X sagittifolium (white NCY001) + burnt plot + 10t/h mulch	0.12	0.14	0.18
X sagittifolium (Red NCY002) + burnt plot + 10t/h mulch	0.18	0.20	0.25
C esculenta (NCY 004) + burnt plot + 10t/ha mulch	0.12	0.15	0.19
C esculenta (NCY 005) + burnt plot + 10t/ha mulch	0.21	0.26	0.31
Mean	**0.16**	**0.19**	**0.23**
X sagittifolium (white NCY001) + burnt plot +20t/h mulch	0.16	0.19	0.23
X sagittifolium (Red NCY002) + burnt plot + 20t/h mulch	0.29	0.30	0.34
C esculenta (NCY 004) + burnt plot + 20t/ha mulch	0.28	0.26	0.30
C esculenta (NCY 005) + burnt plot + 20t/ha mulch	0.20	0.25	0.27
Mean	**0.23**	**0.25**	**0.29**
X sagittifolium (white NCY001) + unburnt plot + 0t/h mulch	0.10	0.12	0.17
X sagittifolium (Red NCY002) + unburnt plot + 0t/h mulch	0.14	0.17	0.20
C esculenta (NCY 004) + unburnt plot + 0t/ha mulch	0.30	0.32	0.38
C esculenta (NCY 005) + unburnt plot + 0t/ha mulch	0.28	0.30	0.32
Mean	**0.21**	**0.23**	**0.27**
X sagittifolium (Red NCY001) + unburnt plot + 10t/h mulch	0.13	0.17	0.19
X sagittifolium (Red NCY002) + unburnt plot + 10t/h mulch	0.20	0.25	0.28
C esculenta (NCY 004) + unburnt plot + 10t/ha mulch	0.28	0.32	0.35
C esculenta (NCY 005) + unburnt plot + 10t/ha mulch	0.29	0.33	0.34
Mean	**0.23**	**0.27**	**0.29**
X sagittifolium (white NCY001) + unburnt plot +20t/ha mulch	0.19	0.20	0.22
X sagittifolium (Red NCY002) + unburnt plot + 20t/ha mulch	0.31	0.39	0.39
C esculenta (NCY 004) + unburnt plot + 20t/ha mulch	0.34	0.38	0.40
C esculenta (NCY 005) + unburnt plot + 20t/ha mulch	0.31	0.32	0.35
Mean	**0.29**	**0.32**	**0.34**
LSD (P<0.05) Burnt/ unburnt plots	NS	NS	NS
LSD (P<0.05) Mulch levels	0.23	0.27	0.29
LSD (P<0.05) Cocoyam cultivars	0.17	0.19	0.23

Table 3.2: Effect of mulching and burning on the fresh weight of Corms and Cormels of four cocoyam cultivars

Treatments	Fresh weight of Corms and Cormels (kg) Days after planting (DAP)		
	60	**90**	**120**
X sagittifolium(white NCY001) + burnt plot + 0t/h mulch	2.43	2.93	2.96
X sagittifolium(white NCY002) + burnt plot + 0t/h mulch	2.76	2.80	2.84
C esculenta (NCY 004) + burnt plot + 0t/ha mulch	2.71	2.83	2.90
C esculenta (NCY 005) + burnt plot + 0t/ha mulch	2.93	2.96	2.98
Mean	**2.71**	**2.88**	**2.92**
X sagittifolium(white NCY001) + burnt plot + 10t/h mulch	2.91	2.98	2.99
X sagittifolium(Red NCY002) + burnt plot + 10t/h mulch	2.95	2.97	2.98
C esculenta (NCY 004) + burnt plot + 10t/ha mulch	2.80	2.88	2.90
C esculenta (NCY 005) + burnt plot + 10t/ha mulch	2.99	2.98	2.29
Mean	**2.91**	**2.95**	**2.79**
X sagittifolium(white NCY001) + burnt plot +20t/h mulch	2.87	2.19	2.95
X sagittifolium(Red NCY002) + burnt plot + 20t/h mulch	2.68	2.76	2.80
C esculenta (NCY 004) + burnt plot + 20t/ha mulch	2.91	2.92	2.97
C esculenta (NCY 005) + burnt plot + 20t/ha mulch	2.76	2.80	2.90
Mean	**2.81**	**2.85**	**2.91**
X sagittifolium(white NCY001) + unburnt plot + 0t/h mulch	1.37	1.97	1.99
X sagittifolium(Red NCY002) + unburnt plot + 0t/h mulch	1.87	1.98	2.98
C esculenta (NCY 004) + unburnt plot + 0t/ha mulch	1.73	1.80	1.90
C esculenta (NCY 005) + unburnt plot + 0t/ha mulch	1.97	1.98	1.99
Mean	**1.74**	**1.93**	**2.22**
X sagittifolium(Red NCY001) + unburnt plot + 10t/h mulch	1.82	1.91	1.97
X sagittifolium(Red NCY002) + unburnt plot + 10t/h mulch	1.73	1.80	1.90
C esculenta (NCY 004) + unburnt plot + 10t/ha mulch	1.94	1.97	1.98
C esculenta (NCY 005) + unburnt plot + 10t/ha mulch	1.85	1.90	1.95
Mean	**1.84**	**1.90**	**1.95**
X sagittifolium(white NCY001) + unburnt plot +20t/h mulch	1.61	1.80	1.85
X sagittifolium(Red NCY002) + unburnt plot + 20t/h mulch	1.82	1.91	1.95
C esculenta (NCY 004) + unburnt plot + 20t/ha mulch	1.37	1,60	1.83
C esculenta (NCY 005) + unburnt plot + 20t/ha mulch	1.71	1.80	1.83
Mean	**1.63**	**1.78**	**1.83**
LSD(P<0.05) Burnt/ unburnt plots	1.27	1.38	1.43
LSD(P<0.05) Mulch levels	1.30	1.37	1.37
LSD(P<0.05) Cocoyam cultivars	1.23	1.41	1.57

NS = Not Significant

5.0 Conclusion

It could be deduced from the foregoing that the cultivation of NCY 001 - *Xanthosoma sagittifolium* (white) on burnt plots and 10 t/ha mulch level may give more yield on the corms and cormels whereas NCY 004 with 20t/ha level mulch on unburnt plots may give higher fresh weight of leaves. Farmers are therefore advised to cultivate NCY 001 - *Xanthosoma sagittifolium* (white) on a burnt plot with 10 tonnes mulch level per hectare for higher yields of corms and cormels.

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