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Effect of Some Selected Organic Mulches on Flowering, Ripening and Suckering of Pineapple *Va. Smooth cayenne*

Nze, E.O. [a*], Orji, J.O. [b], Tom, C.T. [a], Udo, U.K [c] and Ogu, C.E. [d]

[a] Department of Crop Science and Technology, Federal University of Technology, Owerri, Nigeria.
[b] Department of Crop Science, Faculty of Agriculture, University of Agriculture and Environmental Sciences, Umuagwo, Nigeria.
[c] Department of Crop Science, University of Uyo, Nigeria.
[d] Department Agricultural Science, Alvan Ikoku Federal University of Education, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The gains obtained from organic mulching of pineapple farms can never be overemphasized. Despite this fact many developed countries still patronize synthetic mulching due to its efficiency in large pineapple farms. However in developing countries of Africa and Nigeria in particular where small scale pineapple farmers still contribute to the national gross domestic product (GDP), the need for cheaper organic mulching techniques which do not only suppress weed and improve soil fertility but have positive influence on pineapple flowering, ripening and suckering is required. Based on this, a research was carried out at the Teaching and Research Farm, Federal University of Technology Owerri to assess the effect of some selected organic mulch types on the maturing

**Corresponding author: E-mail: onuawuchi1000@gmail.com;*

trends of *Smooth Cayenne* pineapple. A 3^2 factorial fitted into a Randomized Complete Block Design (RCBD) with three replications was used. Result showed that main effects from mulch rates and mulch types independently had significant influence on days to first flowering, days to 50% flowering, the interval between time of first flowering and attainment of 50% flowering, days to ripening, interval from flowering to ripening and number of suckers produced at 50% flowering stage while interaction of mulch rates and mulch types only had significant effect on days to first flowering. This study revealed that the utilized organic mulch materials had tremendous positive influence on flowering, ripening and suckering of *Smooth Cayenne* pineapple.

Keywords: Organic mulch; mulch rates; mulch types; maturing trends; smooth cayenne pineapple.

1. INTRODUCTION

The dangers encountered by consumers with regard to food safety and environmental degradation has contributed to the expansion of organic farming systems in recent years [1-4]. The above scenario was also observed in fruit production with reference to pineapple farming [5-7].

As we know, pineapple (*Ananas comosus L*. Merril) is one of the prominent tropical fruits in international market. It is highly nutritional and very unique as a plant. It is a perennial herb which belongs to Bromeliaceae family. It has the ability to survive drought due to the fact that it undergoes crassulacean acid metabolic (CAM) process [8]. This unique quality of pineapple coupled with awareness in its utilization led to its world production increase to 90% between 1998 (13.1 million tons) to 2013 (24.8 million tons) [9].

Generally pineapple cropping is dominated by conventional mono-cropping which utilizes high level of agrochemical inputs due to high demand of nitrogen, phosphorus and potassium [10-12]. This intensive mono-cropping in pineapple productions enhances soil depletion, pollution and erosion [13-14]. On the other hand, the few existing organic pineapple crops do not have adequate publications and documentations [15] especially here in Nigeria.

Mulching is an age-long agronomic practice in agriculture. It is generally divided into two major types: namely organic and inorganic (synthetic) mulch. Organic mulching materials are obtained from organic substances such as agricultural wastes like palm fronds, banana and plantain leaves, straw, stalks, palm bunch etc; industrial wastes like sawdust, wood-shavings etc, processed residues like rice husk, wheat offal, coffee husk etc and animal waste manure etc. The inorganic or synthetic mulching materials include polythenes, plastic films, synthetic polymers etc. Which are petroleum based products [16].

Any type of mulch material has peculiar characteristics for which it is known. The selection of any mulch material generally depends on local climate, cost effectiveness, availability, skill in utilization and feasibility for the crop [17].

Research has shown that synthetic mulch materials are more effective than organic mulch materials in controlling soil environment and yield increase, however organic mulch materials are cheaper and environmentally friendly [18]. Furthermore, according to findings of several studies mulching with organic materials has the capability of increasing soil nutrients, maintains optimum soil temperature, prevents high rate of evaporation from surface of the soil, smoothers weed seeds and reduces erosion [7].

For the purpose of this research, our focus is on organic mulch because our target audience are small scale farmers who are mostly poor but their contribution still influence the nations agricultural output. Furthermore, these organic mulch materials are available and cheap within their localities e.g sawdust and wood-shavings are waste materials in our timber markets while palm bunch is a waste material from most local oil mills.

Numerous work has been carried out on pineapple regarding mulch effect on weed and erosion control [19,20], some on yield and quality of pineapple [21,22], others on soil properties and other related aspects [23]. However, there is little or no work on effect of organic mulch specifically on maturing trends of pineapple like flowering, ripening and suckering in Nigeria. Hence, the need for this research which tries to assess both the main and interaction effect of these selected organic mulch types and rates on maturing trends of *Smooth Cayenne* pineapple.

2. MATERIALS AND METHODS

A field experiment was conducted at the Teaching and Research Farm, Federal University of Technology Owerri, Imo State from 2013 to 2015. This area is located between latitudes 5^0 27^1 and 5^0 29^1 North and longitudes 7^0 02^1 and 7^0 20^1 East at an elevation of 55.6m above sea level.

The climate of Owerri is characterized by two major wet and dry seasons. The area is also known for its deep porous soils which were obtained from sandy deposits in the coastal plains which are highly weathered and at the same time very low in mineral reserves and natural fertility [24].

The organic mulches used for the experiment were procured within the localities as follows; Sawdust and wood-shavings were obtained from Naze Timber Market in Owerri North L.G.A while palm bunch was procured from a local oil mill in Umuagwo in Owerri West L.G.A of Imo State. The organic mulch materials were analysed in the laboratory to ascertain their chemical contents.

The area mapped out for the experiment was divided into three blocks. Each of the blocks contained nine (9) experimental plots measuring 3.0 m X 0.6 m each giving a total of twenty seven (27) experimental plots. The nine treatments in each block were completely randomized. A distance of one meter (1 m) was maintained within each block while the blocks and the surrounding perimeters were spaced two meters (2 m) apart.

Suckers of *Smooth Cayenne* pineapple were obtained from Pineapple Orchard of Crop Science and Technology, Federal University of Technology Owerri. In order to minimize experimental error, suckers of fairly the same size were used for planting. A double row planting with an inter and intra row spacing of 0.6 m X 0.6 m and inter double row spacing of one meter (1 m) was used. Ten (10) suckers were planted in each experimental plot.

The design was a 3^2 factorial experiment fitted into a Randomized Complete Block (RCBD). The experiment comprised two treatments with three levels each. The two treatments were organic mulch types with three levels of Palm bunch (Pb), Sawdust (Sd) and Wood-shavings (Ws) and mulch rates with three levels of 0.0, 10.0 and 20.0 th^{-1}

Data were collected on the following parameters; Days to first flowering, Days to 50% flowering, Days to ripening, Days to suckering, Rate of fruit ripening, Number of suckers produced at both 50% flowering stage and Ratoon- flowering stage, also intervals in days between flowering to 50% flowering, flowering to ripening and flowering to suckering.

3. DATA ANALYSIS

All collected data were statistically analysed using GenStat software. Mean separations was done using Least Significant Difference (LSD) at 5% probability level.

4. RESULTS AND DISCUSSION

Table 1 presented the chemical contents of the mulch types used in the experiment.

The result showed that sawdust and wood-shavings were slightly acidic while palm bunch was slightly alkaline. Also sawdust and wood-shavings contain higher values of lignin, cellulose, organic matter, organic carbon and C:N ratio than palm bunch, however palm bunch contain higher value of potassium more than sawdust and wood-shavings. Furthermore, there were varying quantities of other remaining macro and micro nutrients in the three organic mulch materials.

Table 2 reveals that rates of mulch significantly improved days to first flowering, days to 50% flowering and flowering to 50% flowering interval. The control plot (0.0 th^{-1}) took the longest period of time to flower (473.0 days) while the highest mulch rate of 20.0 th^{-1} resulted to early flowering within (437.3 days). The longest number of days (548.5) to attain 50% flowering was obtained from control when compared to other higher mulch rates. Furthermore the longest interval between the times of flowering to the time of attainment of 50% flowering was recorded in control (60.5 days) while the shortest interval within (24.3 days) was observed in 20.0 th^{-1} mulch rate. This implies that as mulch rate increased from 0 – 20.0 th^{-1}, the number of days to first flowering, days to attain 50% flowering and the interval in days between flowering and attainment of 50% flowering reduces. This is in conformity with the work of [22] who recorded

pronounced increment in developmental traits of pineapple with increasing rates of organic mulch.
Table 3 showed effect of mulch types on days to first flowering, days to 50% flowering and flowering to 50% flowering interval. This table revealed that mulch types did not affect days to first flowering but significantly influenced days to 50% flowering and flowering to 50% flowering interval. Pineapples mulched with palm bunch attained 50% flowering very early with mean value of 524.7 days while pineapples mulched with wood-shavings took the longest time to attain 50% flowering with mean value of 548.4 days. Also pineapples mulched with palm bunch had the shortest interval from the time of flowering to the time it attained 50% flowering with mean value of 38.1 days while those that were mulched with wood-shavings had the longest interval with mean value of 48.4 days. This could be as a result of the fact that palm bunch contain less lignin and cellulose than sawdust and wood-shavings which aided faster decomposition and release of major nutrients like nitrogen phosphorus and potassium which has capability of boosting development and maturity of pineapples [25].

Table 4 presented the effect of mulch rates on days to ripening, ripening rate, flowering to ripening interval and flowering to suckering interval. Result showed that mulch rate only had significant effect on days to ripening and the interval from flowering to ripening. The longest time in days from time of planting to ripening and flowering to ripening interval were recorded in the un-mulched control plots with mean values of 582.0 and 138.1 days each while increasing the mulch rate reduced days to ripening and flowering to ripening interval. The reason could be traced to the fact that any higher mulch rate irrespective of the type contains higher concentration of the needed nutrients, hence the positive effect in higher rates are more pronounced on pineapple ripening than lower rates[26].

Table 5 highlighted the effect of mulch types on days to ripening, ripening rate, flowering to ripening interval and flowering to suckering interval. Result revealed that mulch types only had significant influence on days to ripening. The pineapple plots mulched with wood-shavings spent the longest time to ripen with mean value of 595.1 days while those mulched with palm bunch spent shortest time to ripen when compared with the three mulch types with mean value of 546.5 days. This could be attributed to high content of potassium and phosphorus in palm bunch which enhanced fruiting and ripening. This supports earlier work of [27] who reported that potassium and phosphorus are essential elements that activate enzymes necessary for fruiting and ripening.

Table 6 showed the effect of mulch rates on the number of days taken from planting to suckering, number of suckers produced at 50% flowering stage and number of suckers produced at first ratoon flowering stage. From the result, it was observed that mulch rates application only had significant effect on the numbers of suckers produced at 50% flowering stage. The un-mulched control produced the least number of suckers with mean value of 3.6 while increasing the mulch rates to 10.0 and 20.0 th^{-1} subsequently increased the number of suckers with mean values 6 and 8.4 each. The reason could be the same as adduced in Table 4. Automatically higher mulch rates have higher residual nutrient reserve which helps the pineapple to produce suckers after fruit production. In other words the higher the mulch rate the more the number of suckers produced. This conforms to the work of [26] who stated that mulch acts as nutrient source when they decay which improved sucker production in plantain.

Table 7 also presented effect of mulch types on days to suckering, number of sucker at 50% flowering stage and number of sucker at first ratoon-flowering stage. Result still showed that mulch types had significant improvement only on number of suckers produced at 50% flowering stage as it was with mulch rates.

Table 8 showed the interaction effect of mulch types and rates on days to first flowering, days to 50% flowering and the interval between time of first flowering and time of attainment of 50% flowering. Result revealed that the interaction effect of mulch types and rates only had significant improvement on days to first flowering. From the table, the interaction of palm bunch at the highest rate of 20 th^{-1} had earliest flowering within (405.2 days) while sawdust at the same rate took the longest time before flowering within (458.7 days).

Table 1. Chemical contents of mulch types used in the experiment

Sample	P^H	N◄◄ --	Lignin-- ------	O.C - -%-	Cellulose- ----------	O.M ►	Ca ◄-- --	K -- ------	Mg -- -----	Cucm olkg^{-1}	Fe -- ----	Zn -- ----	Mn -►	Pmgkg^{-1}	C:N Ratio
Palm-bunch	8.92	0.87	4.03	3.76	10.52	32.01	2.01	7.02	2.05	0.06	0.04	0.03	0.03	3.92	12:1
Sawdust	6.72	0.17	17.57	6.24	48.53	53.21	1.91	4.25	1.60	1.37	2.24	3.98	1.02	5.38	200:1
Wood-shavings	6.91	0.15	18.04	6.34	49.01	54.01	1.72	4.27	1.69	1.36	2.21	3.96	1.01	4.98	250:1

Table 2. Effect of mulch rates on days to first flowering, days to 50% flowering and flowering to 50% flowering interval.

Mulch-rate (t ha^{-1})	Days to first flowering	Days to 50% flowering	Flowering to 50% flowering interval
0.00	473.00	548.50	60.50
10.00	465.60	533.40	47.20
20.00	437.30	524.80	24.30
Mean	458.60	535.60	44.00
$LSD_{(0.05)}$	17.68	20.88	4.80

Table 3. Effect of mulch types on days to first flowering, days to 50% flowering and flowering to 50% flowering interval.

Mulch type	Days-to-first-flowering	Days-to-50% flowering	Flowering to 50% flowering interval
Palm-bunch	453.60	524.70	38.10
Sawdust	460.00	533.60	45.40
Wood-shavings	462.20	548.40	48.40
Mean	458.60	535.60	43.90
$LSD_{(0.05)}$	NS	20.88	4.80

Table 4. Effect of mulch rates on days to ripening, ripening rate, flowering to ripening interval and flowering to suckering interval.

Mulch-rate (t ha^{-1})	Days to ripening (Days)	Ripening rate (Days)	Flowering to ripening interval (Days)	Flowering to suckering interval (Days)
0.00	582.00	11.90	138.10	125.40
10.00	580.00	11.30	127.60	121.40
20.00	554.70	11.20	113.50	118.70
Mean	572.20	11.50	126.40	121.80
$LSD_{(0.05)}$	24.00	NS	9.00	NS

Table 5. Effect of mulch types on days to ripening, ripening rate, flowering to ripening interval and flowering to suckering interval.

Mulch-type (t ha^{-1})	Days to ripening	Ripening rate	Flowering to ripening interval	Flowering to suckering interval
Palm bunch	546.60	11.30	124.40	122.60
Sawdust	574.80	11.80	127.10	115.20
Wood-shavings	595.10	11.30	127.60	127.70
Mean	572.20	11.50	126.40	121.80
$LSD_{(0.05)}$	24	NS	NS	NS

Table 6. Effect of mulch rates on days to suckering, number of sucker at 50% flowering stage and number of sucker at first ratoon flowering stage.

Mulch-rate (t ha^{-1})	Days-to- suckering	Number-of- sucker-@-50%- flowering stage	Number-of sucker-@-first ratoon-flowering stage
0.00	591.00	3.60	11.00
10.00	594.40	6.00	11.60
20.00	570.10	8.40	11.00
Mean	585.20	6.00	11.10
$LSD_{(0.05)}$	NS	1.50	NS

Table 7. Effect of mulch types on days to suckering, number of sucker at 50% flowering stage and number of sucker first ratoon-flowering stage.

Mulch type	Days to suckering	Number of sucker @ 50% flowering stage	Number of sucker @ first ratoon-flowering stage
Palm bunch	590.40	7.10	10.70
Sawdust	575.20	6.10	11.40
Wood-shavings	589.90	4.70	11.00
Mean	585.20	6.00	11.10
$LSD_{(0.05)}$	NS	1.50	NS

Table 8. Effect of mulch types and rates interaction on days to first flowering, days to 50% flowering and flowering to 50% flowering interval.

Mulch type	Mulch-rate (t ha^{-1})	Days-to-first flowering	Days-to-50% flowering	Flowering-to-50%-flowering interval
Palm bunch	0.00	484.20	504.40	54.90
Sawdust	0.00	464.30	525.30	62.20
Wood-shavings	0.00	461.00	539.60	64.30
Palm bunch	10.00	471.30	525.70	40.60
Sawdust	10.00	457.10	528.10	47.70
Wood-shavings	10.00	477.70	546.40	53.30
Palm bunch	20.00	405.20	539.00	18.90
Sawdust	20.00	458.70	547.30	26.40
Wood-shavings	20.00	447.90	559.20	27.60
Mean		458.60	535.60	44.00
$LSD_{(0.05)}$		36.20	NS	NS

5. CONCLUSION

The result of this research indicated that the main effects had significant influences as follows; Mulch rates had significant improvement on days to first flowering, days to 50% flowering, flowering to 50% flowering interval, days to ripening and number of suckers produced at 50% flowering stage while mulch types improved days to 50% flowering, flowering to 50% flowering interval and days to ripening. However, the interaction of mulch types and rates did not have any significant improvement on any of the assessed parameters except on days to first flowering. In conclusion, the experiment revealed that the application of these selected organic mulches significantly improved the above mentioned maturity trends of *Smooth Cayenne* pineapple.

COMPETING INTERESTS

Authors have declared that no competing interests exist**.**

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