enhanced, and moreover after 30 days of cumulated sunny weather, soil sterilization at a depth of 20cm can be achieved to control nematodes and pathogenic fungi apart from *Fusarium solani*. The average daily temperature under the control was 29.93^{o}C, BPM was 30.64^{o}C, and TPM was as high as 31.30^{o}C, which was probably the reason for the enhanced growth parameters as implicated in the study.

Table 1: Effect of plastic mulches on the morning and evening soil temperatures (^{o}C) of the experimental plots

Mulch	Morning (07.00 GMT)		Evening (16.00 GMT)		Average temperature
	Depth				
	10cm	15cm	10cm	15cm	
ZM	28.70	28.75	31.00	31.00	29.93
TPM	29.80	29.80	32.80	32.80	31.30
BPM	29.42	29.42	31.86	31.86	30.64
Mean	29.31	29.32	31.92	31.92	

Key: ZM = zero mulch, TPM = transparent plastic mulch, BPM = black plastic mulch

On the aspects of weed control, the BPM was very effective in totally suppressing weed growth, whereas TPM allowed weeds to grow but was latter scorched. Comparing the financial implications of controlling weeds manually and using plasticulture techniques showed that it costs higher to apply plasticulture (₦110.00/plot) compared to weeding manually (₦90.00/plot), but the accruable revenue to the farmer was higher (₦1,009.00 afterwards compared to (₦938.00), because more fruit weight/plot was obtained under plasticulture than the manually weeded plots. Other workers [5] and [35] reported that use of plastic mulch increased cost of production, but the net economic returns are also greater. The reduced yield under the zero mulch (10.28 kg/plot) might have resulted from the disturbances made on the plants during weeding (Table 2). This agreed with [27] who observed such reasoning when 13.50 fruits/plot of cucumber was obtained on weeded plots, whereas, 15.50 fruits/plot were obtained on the plots where weeding was not carried out. The importance of this observation is predicated on the fact that manual weeding (hand picking or use of implements) was cheaper, but suppresses yield. The plasticulture techniques incidentally would be more sustainable for the smallholder farmers as the available workforce is dwindling due to strong rural-urban migration of able-bodied youths which can leave the agricultural labour force depleted. Carl Haub who is the senior demographer at the Population Reference Bureau (PRB), said that Africa has the fastest-growing and most youthful population in the world (>20% between the ages of 15-24), who will most likely continue the exodus to cities in search of education and training opportunities, gainful employment and adequate health care [37]. In the final analysis, the revenue accruing to the farmer would sufficiently pay for the cost of supplying plastic mulch, while he saves his energy, produces more fruits (11.19 kg/plot) of better quality, generates more income (₦1,009.00/plot) and maintains the soil in an environmentally-friendly conditions [3]. Also [13] reported cucumber production of 4.6t/ha in Puerto Rico by the use of plastic mulch.

Table 2: Economics of weeding manually and plastic mulch application in cucumber production

Activity	*Plastic mulch*	*Zero mulch*
Cost of weeding/plot @ ₦30.00/plot for 3 schedules	-	90.00
Cost of plastic mulches/plot @ ₦110.00/plot	110.00	-
Weight of fruits harvested/plot (kg)	11.19	10.28
Fruit sales @ ₦100.00/kg	1,119.00	1,028.00
Total revenue accruable to the farmer ₦/plot	1,009	938.00

Plastic mulch significantly ($p<0.05$) influenced all the growth and yield parameters of cucumber measured in this experiment, except in the fruit weight per plot, although the fruit weight obtained in both plastic mulches was higher than the weight from zero mulched plots (Table 3). The transparent plastic mulch appeared to have greater effect than the black plastic mulch on the growth parameters, whereas black plastic mulched plots slightly gave heavier fruit yield than clear mulched plots, but significantly ($p<0.05$) had higher number of fruits (41.00/plot) than the transparent plastic mulch (37.82/plot). This result agrees with [3] who reported that yields were higher in tilled black plastic mulched cocoyam plots when compared to tilled clear plastic mulched plots, no-till black plastic mulched plots and no-till clear plastic mulched plots by 29, 47 and 59%, respectively. The higher average daily temperature (31.30^{o}C) obtained under transparent plastic mulch (Table 1), can explain the high impact it had on the growth parameters, but why not on the yield parameters is not obviously clear. It is logical to expect that high leaf area of 335.22 cm^2 should translate to high yield as it conjures more solar energy and corollary high photosynthesis, except dry matter distribution in cucumber does not follow this logic. Further study on dry matter partitioning may unravel the situation.

Table 3: Effects of plastic mulches on the growth and yield parameters of cucumber

Treatment	Vine length (cm)	No. of branches	No. of leaves	Leaf area (cm^2)	Leaf area Index	Days to 50% anthesis	No. of flowers/ plant	No. of fruits/ plot	Fruit weight/ plot (kg)
BPM	236.84	8.36	127.50	322.98	27.17	34.33	131.75	41.00	11.29
TPM	276.06	8.86	134.84	335.22	30.00	34.42	134.65	37.82	11.09
ZM	221.75	6.29	130.06	312.18	27.35	35.42	108.79	37.08	10.28
F-LSD (p=0.05)	4.64	0.91	1.71	1.09	0.68	0.45	1.82	0.38	1.02

Key: BPM = black plastic mulch, TPM = transparent plastic mulch, ZM = zero mulch

The practice of staking plants significantly ($p<0.05$) improved the growth and yield parameters of cucumber (Table 4). Forked-stick stake had better improvement on all the growth and yield parameters measured than the straight stick pole stake (SSPS) and the zero staking. Forked-stick stake improved vine length by 2.57% over zero stake and

1.14% over the SSPS; number of branches was by 37.67% over zero stake and 35.74% over SSPS; number of leaves was by 20.26% over zero stake; leaf area was by 23.11% over zero stake and 14.81% over SSPS; number of flowers by 20.18% over zero stake and 13.45% over SSPS; number of fruits per plot by 21.15% over the zero stake and 4.96% over SSPS, while fruit weight per plot was improved by 20.63% over zero stake and 2.83% over SSPS. The observation agrees with [1] who reported that staking generally improves the growth and yield of climbing plants and this may be the reason why forked-stick stake effect on the parameters did not show much difference over the straight stick pole stake method. On the other hand, [19] found that trellised cucumber gave greater yield (55%) over the non-trellised ones (45%). It was also observed that staking led to early anthesis (33.58 days) for 50% of the plants per plot to flower in cucumber more than zero stake, while it took SSPS 34.75 days for 50% of the plants per plot to flower. Improved photosynthetic efficiency was also reported to have influenced yield in cucumber [16].

Table 4: Effects of plant staking on the growth and yield parameters of cucumber

Treatment	Vine length (cm)	No. of branches	No. of leaves	Leaf area (cm^2)	Leaf area Index	Days to 50% anthesis	No. of flowers/ plant	No. of fruits/ plot	Fruit weight/ plot (kg)
FSS	247.95	10.38	140.31	362.64	31.26	33.58	140.48	42.17	11.68
SSPS	245.13	6.67	140.21	308.92	27.11	34.75	122.58	40.08	11.35
ZS	241.57	6.47	111.88	278.82	26.14	35.83	112.13	33.25	9.27
F-LSD (p=0.05)	4.64	0.91	1.71	1.09	0.68	0.45	1.82	7.35	1.99

Key: FSS = forked stick stake, SSPS = straight stick pole stake, ZS = zero stake

The application of plastic mulch and staking together assisted in improving days to 50% flowering moderately in cucumber plants as shown in Table 5. This was in agreement with what [10] reported that mulching resulted in earlier flowering and increased yield compared to unmulched plots, which supports our result here. Days to 50% flowering were reduced more in fork-stick staked black and transparent plastic mulched plots (32.75, days) compared to that of zero mulched plots which was delayed to 35.00 days, while straight stick pole staked black and transparent plastic mulched plots moderately delayed flowering to 34. 50 and 34.75 days respectively compared to zero mulched plots that delayed it to 35.25 days. Also, zero staked black and transparent plastic mulched plots delayed flowering much more (35.75 days) than zero staked zero mulched plots (36.00 days). Black and transparent plastic mulch and staking practices in cucumber have proved to be a beneficial cultural practice for the resource-constrained rural farmers in this zone.

Table 5: Effect of plastic mulch and staking interaction on days to 50% anthesis in cucumber

Staking	Plastic mulch			Mean
	BPM	TPM	ZM	
FSS	32.75	32.75	35.00	33.50
SSPS	34.50	34.75	35.25	34.83
ZS	35.75	35.75	36.00	35.83
Mean	34.33	34.42	35.42	

F-LSD (p=0.05) = 0.45 for comparing two plastic mulch means
= 0.45 for comparing two staking means
= 0.29 for comparing plastic mulch and staking interaction means

The effect of black and transparent plastic mulch and staking interaction on vine length in cucumber is presented in Table 6. The longest vine length (289.32 cm) was obtained in fork-stick staked black plastic mulched plots, longer than that obtained in fork-stick staked transparent plastic and zero mulched plots by only 1.80% (284.11 cm) and 14.69% (246.81 cm). The longest vine length was longer than vine lengths obtained in zero staked black and transparent plastic mulched and zero mulched plots by 11.95% for 254.75 cm, 28.20% for 207.73 cm, and 20.37% for 230.40 cm respectively. Vine length obtained in straight stick pole staked black plastic mulched plot (284.11 cm) was longer than that obtained in transparent plastic (217.96 cm) and zero (233.31 cm) mulched plots. Also, zero staked black plastic mulched plot gave higher vine length (254.75 cm) than what was obtained in zero staked transparent plastic (207.73 cm) and zero staked, zero (230.40 cm) mulched plots. The suppression of vine length observed in transparent plastic mulched plots across all the staking methods is not in consonance with the report of [6], [43], that clear and coloured plastic mulches enhanced plant growth, increased vegetable production and earliness.

Table 6: Effect of black and transparent plastic mulch and staking interaction on vine length (cm) in cucumber

Staking	Plastic mulch			Mean
	BPM	TPM	ZM	
FSS	289.32	239.56	246.81	258.56
SSPS	284.11	217.96	233.31	245.13
ZS	254.75	207.73	230.40	230.96
Mean	276.06	221.75	236.84	

F-LSD (p=0.05) = 4.64 for comparing two mulch means
= 4.64 for comparing two staking means
= 2.68 for comparing mulch and staking interaction means

4. Conclusion

Plasticulture, the use of polyethylene polymer films as plastic mulch, drip-irrigation tubing and tape, and staking practice is helping in a great way in modernizing agricultural activities, reducing tedium and making farming somewhat attractive to the migrating youths. Literature is rife with the numerous benefits plasticulture offers to those farmers who employ the technique in their farming activities. Those benefits include: earlier harvest, reduced evaporation, fewer weed problems, reduced fertilizer leaching, reduced soil compaction, increased growth, cleaner produce, control of water logging on the soil surface, assists in insect and disease management, greater economic returns, and more, as implicated in this our work. However, the major snag with this technique is removal and disposal problems coupled

with the initial high cost of procuring the material. It is interesting to note that some research effort is now addressing this problem, and some new photodegradable and biodegradable films have been developed. This disposal issue is being vigorously debated by the plastic industries, university scientists and agricultural producers such as the American Society of Plasticulture, which has formed a plastic disposal committee to investigate recycling and energy reclamation of agricultural plastics [25]. Staking also contributed in no small measure to the enhancement of growth and yield of cucumber and other crops too as we indicated in this report, such as improved fruit quality, less damage vines, more thorough harvesting, yield increase, ease of work in the farm, ease of insect and disease management and more. These benefits however, did not exclude the extra cost of sourcing and transporting the stakes, cost of erecting, dismantling and removal, the labour expended in installing lead-stakes and directing the vines to the lead-stakes. Despite all this, plastic mulching and staking are good cultural practices that could promote cucumber production in this zone, hence, highly recommended for sustainable cucumber production in southeastern Nigeria.

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