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Effect of Seasons, Mulching Materials, and Fruit Quality on a Cucumber (*Cucumis sativus* L.) Variety

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Authors' contributions

This work was carried out in collaboration between the two authors. Author OVA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BJA managed the analyses of the study, managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: The experiment aimed to investigate the effect of seasons (early raining and late raining) and mulching materials (Black polyethylene, White polyethylene, Grass-mulch and control) on marketable fruit yield of cucumber.
Study Design: The experimental design was a 4 x 4 factorial laid out in a randomized complete block design (RCBD) with three replications. Data were collected on plant morphology and fruit components; number of leave, vine length, branch number, tendril number, stem diameter; number of fruits per plant, fruit length, fruit circumference, fruit weight, number of marketable fruits per plot and number of non-marketable fruit per plot and fruit yield per plot (converted to per hectare).
Place and Duration of Study: The present study was carried out at Teaching and Research Farm of Obafemi Awolowo University (OAU), Ile-Ife, Nigeria (located on longitude 04º33^{l}E and latitude 08º28^{l}N at 244 m above sea level) during the growing seasons of 2017 and 2018.
Methodology: The data collected were subjected to analysis of variance (ANOVA) using (SAS, 2003 version). Means of significant treatments were separated using Duncan`s Multiple Range Test (DMRT).

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Results: The obtained results revealed that seasons and mulching materials had significant effect on some of the parameters investigated. Late season significantly enhanced the fruit length, fruit weight and total fruit yield when compared with the early seasons. The mulching materials, black polyethylene mulching materials significantly enhanced the morphology and some of fruit components; fruit length and fruit weight while white plastic mulch significantly improved the number of fruit per plant, fruit diameter and total yield of cucumber at both early and late seasons followed by grass-mulch. However, control consistently produced the highest number of non-marketable fruits when compared with other treatments investigated.
Conclusion: Therefore, planting of Poinsett76 variety towards the ending of raining seasons with the application of white plastic mulching is highly recommended for the small holder farmers.

Keywords: Mulching; poinsett76 and marketable; season.

1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important fruit vegetable grown in the tropic and temperate region of the world. It belongs to the gourd family Cucurbitaceae, it is a thermophile crop that requires a stable warm temperature for good marketable fruit yield. Cucumber is one of the oldest crop domesticated by man about 5,000 years ago [1], it is known to be originated from India, which has now spread all over the world. Cucumber is one of the most popular fruit vegetable cultivated in both Europe and Asia. It has been reported [2] that China is the leading producer of cucumber with average fruit yield of 54.3 million tonnes per year followed by Turkey with 1.7 million tonnes per year. In Africa, Egypt is the leading producer of cucumber with a fruit yield of 613 thousand tonnes per year and it is ranked 9th while Cameroon ranked 21st with the fruit yield of 224 thousand tonnes per year in the world [2].

Cucumber belongs to annual crop and a climbing herb; the leaves are alternate, simple and triangular-ovate. Leaf-blades are 3-7 lobed and deeply cordate at base. The stems of the cucumber produce vines which are sparingly branched. The fruit is composed mostly of water and more than 96% of the edible unpeeled fruit is water [3].

Cucumber has been listed among the most important fruit vegetable for medicinal properties; vitamins and minerals like A, B6, C, K, potassium and also provides dietary fibres, pantothenic acid, magnesium, phosphorus, copper, and manganese [4]. It contains ascorbic and caffeic acid, both of which help to smoothen skin irritation and reduce swelling. It was indicated [5] that the skin of cucumber fruit has chlorophyll and silica; two beneficial elements that are lost when the vegetables are peeled. The cucumber juice is often recommended as a source of silicon to improve the complexion and health of the skin. Pickling process removes or degrades much of the nutrient content, especially vitamin C [6]. Presently, cucumber is now becoming popular in most of the developing countries which could be as a result of high nutritional and medicinal values, as well as being a useful component ingredient in pharmaceutical and in the preparation of salad, liquor drink in homes and fruits drinks industries. Due to little quantity of sugar present in the cucumber fruits which helps in the burning of excess fat in the body [7] makes it very good for diabetic patients. In spite of the above importance of the crop in developing country like Nigeria, cucumber is still produce by the few farmers who has little or no knowledge about the agronomical practices of the crop in order to produce high marketable and fruit quality of the crop. Moreover, the production of the cucumber fruit in Nigeria is very low [8] due to some constraints such as lack of production knowledge, poor vine management, low soil fertility and mulching materials technology [8,9]. The problems are compounded by the farmers' practice of allowing the vines to trail on the ground leading to the production of low-quality fruits. The practice also promotes overcrowding of the vines with the subsequent attack by mould as a result of high canopy architecture [8].

The need to develop an appropriate agronomical technology required to produce marketable and fruit quality cucumber to meet the nutritional need of the ever growing population. The need to document the influence of mulching materials, effects of seasons on marketable fruit yield and nutritional quality of cucumber is the aim of this study.

2. MATERIALS AND METHODS

The study was conducted during early and late raining seasons (March – June and August –

October) of 2017 and 2018 at the Teaching and Research Farms of the Obafemi Awolowo University, Ile-Ife, Nigeria-situated within the rain forest zone on latitude 7º28'N and longitude 4º33'E at an elevation of about 200 m above sea level. The region experiences approximately 7 months (April-October) of bimodal rainfall and 5 months (November – March) of dry season annually with slight irregularity in the rainfall distribution pattern occurring between April-October. Mean rainfall for 2017 and 2018 were 1683.7 mm and 1678.9 mm respectively. The experimental plots were previously cropped to maize (*Zea mays* L.) and have been allowed to rest over four cropping seasons before the experiments. Pre planting soil samples were collected using an Auger to soil depth of about 15 cm and was analysed for physical and chemical analyses.

The soil is in the Iwo series derived from coarse grained granite gneiss parent rock and classified as Ultisol (low base status forest soils). It is well drained, grayish brown to brownish red with predominantly high low acidity clay-kaolinite [10]. The growing horizon was generally loamy, acidic, pH 6.50 to 6.60, and with K 0.02-2.06 C mol kg-1, N 0.06-0.09%, and available P 23.03-31.16 mgkg-1. Cucumber *Poinsett 76* cultivar, was used, and obtained commercially from a local seed company. The experiment was laid in a 4 x 4 factorial arranged in a Randomized Complete Block Design (RCBD) with 3 replications. The treatments include four seasons (early and late) for two years and four mulching materials (Black Polyethylene mulch, Transparent Polyethylene mulch, dried plants straw and control (without mulch)). The soil amendment used was inorganic fertilizer NPK 15:15:15 at 200 kg/ha. Conventional tillage method was used to prepare the land. The land was ploughed twice using a tractor mounted disc plough after which it was harrowed. Planting was carried out on flat land. The land was divided into three blocks and thereafter subdivided into plots. Each plot was made into beds size of 2 X 2 m and 0.5 m were the pathway between the plots. The experimental field had three replications. The synthetic mulching materials (Black and white transparent Polyethylene 45 µm) measured and cut to the bed sizes of 2 m x 2 m and thereafter perforated with the help of improvised jig (20 cm circumference) according to the planting spacing of 0.5 x 0.5 m The perforated mulching materials were randomized on the beds. Thereafter, the seeds were sown at the rate of 2 seeds per hole giving a plant population of 80,000 plants/ha. The mineral fertilizer was applied in a split applications at 2 and 4 Weeks After Sowing (WAS) using the ring method. Weed control was done manually. Insect pest and fungi were controlled when pest incidence were observed using Insecticide (*Cypermethrine,* a.i) and Fungicide (*Mankozeb* 75% a.i) applied at the rate of 40 ml per 20 liters of water. The spraying started from 3, 4 and 5 weeks after sowing prior fruiting.

Data were collected on 5 randomly tagged plants on rows 2 and 5 in each plot on the following parameters: number of branches, vine length, number of leaves/plant, and tendril length/plant. Fruit yield were harvested from plants in rows 3 and 4 for fruit yield and fruits parameter were taken on 10 randomly selected for Fruit length, Fruit circumference and number of fruits per plant. Fruit yield and yield parameters ha-1 was determined as described [11]. Marketable fruits were determined based on uniformity in color, size and shape; and undamaged by pests or disease. Data were subjected to analysis of variance (ANOVA) using SAS [12] and significant means were separated using Duncan Multiple Range Test.

3. RESULTS

From the results obtained from the soil analysis, the soils were slightly acidic, pH 6.4, 6.6 in water (CH_2O) and pH 6.3, 6.1 in Calcium chloride ($CaCl_2$), very low in organic carbon (0.96%), organic matter (1.76%, 1.52%) and total nitrogen 0.08, 0.09 (Table 1). The low nutrient content in these sites might be due to the effects of continuous cropping of sites to various arable crops which might have depleted soil nutrients through several process of denitrification [13]. Adepetu et al. [13] noted that some nutrients are temporarily immobilized by microorganisms which were responsible for organic matter decomposition. Available P were 22.01, 42.46 mgkg-1 and was high when compared with the critical value of 10^{-16} mg kg^{-1} for southwestern Nigeria [14]. This is due to the mobile nature of P in soil [14]. The physical properties of both sites were similar (Sand soil 526.4, 535.7 g kg^{-1}), respectively. While silt, clay and textural classes were comparable (Table 1).

The response of leaves number and vine length of cucumber as influenced by seasons and mulching materials at 4, 5 and 6 weeks after planting (WAP) varied (Table 2). Results shows that season and mulching materials had highly significant effects ($p<0.001$) on leave number and

vine length however, the interaction between season x mulching materials were not significant at ($p<0.001$).

The data presented in (Table 3) revealed that the cropping seasons and mulching materials significantly influenced ($p<0.001$) the leave number and vine length as the week increases, season three significantly improved ($p<0.001$) the leave number as well as vine length across the weeks while the black plastic mulched subsequently increases the number of leaves and vine length respectively.

There were highly significant improvement ($p<0.001$) on number of branches and stem diameter as influenced by seasons and mulching materials throughout the period of the studies (Table 4). The results revealed that the number of branches were highly improved in season two at 4 and 5 weeks after planting but at 6 weeks after planting season three was better than the two previous weeks while black plastic mulched consistently increased the number of branches while white transparent plastic mulch, dried straw mulch and control followed in that order (Table 5). Season one was noticed to favored the stem diameter though it was not significantly different at ($p<0.001$) from season three while season two and four were not significantly different ($p<0.001$) from each other. The black plastic mulch influenced the stem diameter of cucumber at four weeks after planting at week 5 dried straw mulch perform better while at 6 weeks after planting control and black plastic mulch did not significantly different ($p<0.001$).

The effects of season significantly ($p<0.001$) affected tendril number and tendril length while the mulching materials did not affected the parameters significantly (Table 6). Season significantly affected ($p<0.001$) the both the number of tendril and tendril length (Table 7). Season three affected the number of tendril at 4 and 5 but at 6 weeks after planting season 4 improved the tendril number while tendril length was noticed to be improved by season three at 4 and 5 while at 6 WAP season 4 performed better when compared with others seasons. Mulching materials at 4 and 5 WAP were not improved the tendril number while at 6 WAP black mulch increased the number of tendril, the tendril length was significantly influenced ($p<0.001$)at early stage (4 WAP) but at 5 and 6 WAP mulching materials were not affected the tendril length.

Table 1. Pre cropping soil chemical and physical properties of the experimental sites

Chemical property	2017	2018
pH (H_2O) (1:2)	6.4	6.6
pH ($CaCl_2$)	6.3	6.1
Organic carbon (%)	0.96	0.52
Organic matter (%)	1.76	1.52
Total N (%)	0.08	0.09
Available P ((mg kg^{-1}))	22.01	42.46
Exchangeable cations (cmol kg^{-1})		
K^+	2.06	0.20
Ca^{2+}	2.28	0.24
Mg^+	0.27	0.11
Na^-	0.29	0.008
Physical property		
Sand g kg^{-1}	526.4	535.7
Silt g kg^{-1}	124.0	230.4
Clay g kg^{-1}	243.2	307.9
Textural class	Sandy loam	Sandy loam

Table 2. Mean squares from the combine analysis of variance on leaf number and vine length of cucumber at 4, 5 and 6 weeks after planting (WAP)

Source of variation	DF	Leaf numbers			Vine length (cm)		
		4	5	6	4	5	6
Rep	2	25.56	34.56	363.06	316.11	407.52	781.79
Season	3	1382.25**	3366.04**	1975.01**	33876.78**	138962.03**	79547.78**
Mulch	3	35.32*	206.37**	602.58**	372.05*	724.71	718.83
Season*Mulch	9	9.57	33.62	65.85	97.17	163.15	822.61
Error	30	10.61	37.99	73.75	129.35	482.45	847.42

Key: DF-degree of freedom, REP- replication

Table 3. Effect of seasons and mulching materials on morphological parameters of cucumber at 4, 5 and 6 WAP

Treatment	Leaf numbers			Vine length (cm)		
	4	5	6	4	5	6
Season 1	5.41	7.77	14.79	15.08	38.64	75.65
Season 2	6.06	13.16	26.06	14.79	41.36	93.33
Season 3	16.56	27.4	28.27	68.50	148.66	167.60
Season 4	6.06	14.16	24.06	16.29	43.36	95.35
$LSD_{0.05}$	**1.31**	**2.49**	**3.46**	**4.59**	**8.87**	**11.75**
White	8.81	16.27	25.66	28.47	71.21	108.33
Black	9.58	18.20	28.37	30.87	70.89	113.21
Mulch	7.62	14.70	20.10	30.52	66.97	104.16
Control	8.08	13.39	23.04	24.80	62.95	106.30
$LSD_{0.05}$	**1.31**	**2.49**	**3.46**	**4.59**	**8.87**	**11.75**

Key: Season 1-Early Raining Season 2017, Season 2 - Late Raining Season 2017, Season 3- Early Raining Season 2018 and Season 4 - Late Raining Season 2018. White - White polyethylene, Black Polyethylene, Mulch-Dried Plant Straw and Control – Un-mulched

Table 4. Mean squares from the combine analysis of treatments on branch number and stem diameter on cucumber at 4, 5, and 6 weeks after planting (WAP)

Source of Variation	DF	Branch number			Stem diameter (cm)		
		4	5	6	4	5	6
Rep	2	7.99	52.79	6.78	0.44	1.51	6.78
Season	3	84.17**	191.70**	31.58**	40.32**	28.23**	31.58**
Mulch	3	2.52*	97.37*	3.71*	0.40	1.68	3.71*
Season*Mulch	9	0.45	25.10	0.91	0.22	1.16	0.91
Error	30	0.970	29.06	1.23	0.27	1.14	1.23

Key: DF-degree of freedom, REP- replication

Table 5. Effect of seasons, mulch and population densities on morphological parameters (stem branch number and diameter) of cucumber at 4, 5 and 6 WAP

Treatment	Branch number			Stem diameter (cm)		
	4	5	6	4	5	6
Season 1	1.49	0.58	2.47	4.05	4.21	4.38
Season 2	3.06	4.14	5.00	2.37	2.79	2.88
Season 3	0.27	5.12	6.93	4.05	4.21	4.38
Season 4	0.27	4.14	5.00	2.57	2.99	3.08
$LSD_{0.05}$	**0.39**	**2.17**	**0.78**	**0.21**	**0.43**	**0.44**
White	1.34	3.20	4.81	3.22	3.49	3.47
Black	1.57	5.58	5.68	3.39	3.61	3.78
Mulch	1.09	2.77	4.00	3.26	3.77	3.44
Control	1.09	2.43	4.91	3.17	3.32	4.03
$LSD_{0.05}$	**0.39**	**2.17**	**0.78**	**0.21**	**0.43**	**0.44**

Key: Season 1-early raining season 2017, season 2 - late raining season 2017, season 3- early raining season 2018 and season 4 - late raining season 2018. white - white polyethylene, black polyethylene, mulch-dried plant straw and control – un-mulched

Table 6. Mean squares from the combine analysis of treatments on tendril number and tendril length on cucumber at 4, 5 and 6 Weeks after Planting (WAP)

Source of variation	DF	Tendril number			Tendril length (cm)		
		4	5	6	4	5	6
Rep	2	33.39	85.89	120.02	9.38	145.39	243.97
Season	3	506.25*	3700.69*	365.06**	4010.77**	460.96*	84.53**
Mulch	3	9.27	29.13	148.79	20.74	46.24	7.95
Season*Mulch	9	2.15	11.19	32.32	15.65	6.41	10.99
Error	30	5.51	35.07	66.05	11.86	36.82	10.99

Key: DF-degree of freedom, REP- replication

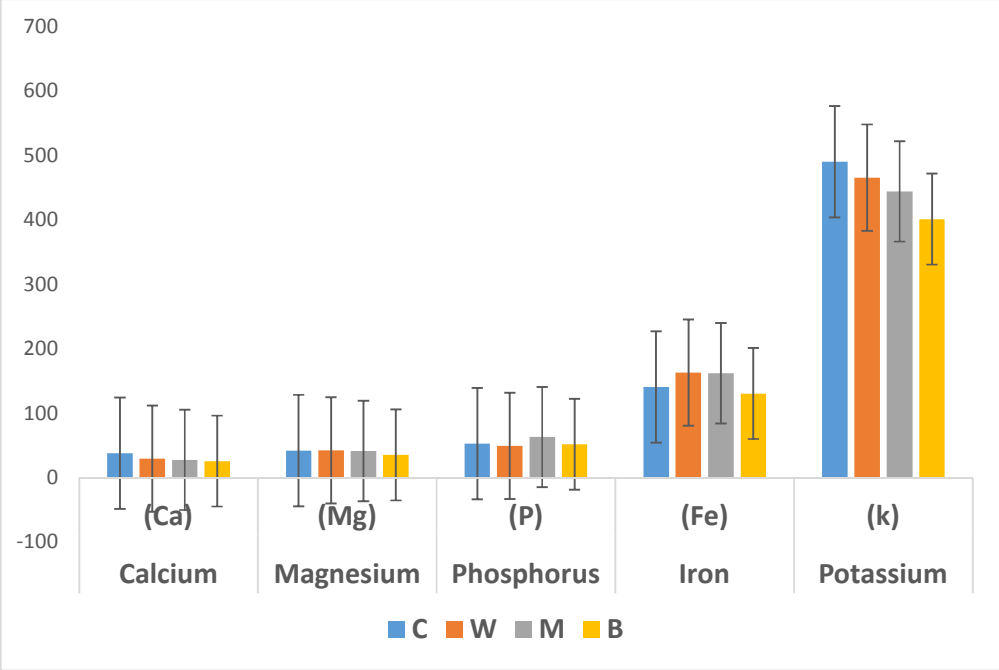

Fig. 1. Influence of mulching materials on the nutritional quality of cucumber fruit
Key: C- control, W- white transparent plastic mulch, M- dried straw mulch and B- black plastic mulch

Season and mulching materials influenced the yield parameters of cucumber (Table 8). There is high influenced of season and mulching materials on all the yield parameters of cucumber measured. Effects of treatments are presented in (Table 9). The results indicates that season two and four significantly increased ($p<0.001$) the number of fruits, fruit Length, fruit diameter, fruit weight, marketable fruit and non- marketable and total yield, respectively. All the mulching treatments used were significantly improved all the yield parameter measured when compared with control. White transparent plastic mulch, black plastic mulch, dried straw mulch were not significantly different from each other but white transparent plastic mulch gave the highest ton/ha.

Fig. 1 shows the influence of mulching materials on the nutritional quality of cucumber fruit. The results revealed that calcium, magnesium, phosphorus, iron and potassium did not show significant different when compared with the different mulching materials, however, there is little effect of black plastic mulch on Potassium.

4. DISCUSSION

The data recorded on plant growth characteristics expressed as leaf number, vine length, branch number, stem diameters, number of tendril and tendril length clearly revealed the influence of season and mulching materials on the cucumber crop. Season one (early raining seasons in both years) significantly improved the growth and development of the crop compared to season 2 and 4 (late raining season) which indicates the importance of abundance of soil moisture availability in the soil for proper usage of available soil mineral nutrients compared with when there is little or shortage of water in the soil for plant to make use. Mulching materials showed a unique improvement on the agronomical parameters investigated. Black plastic mulch influenced the growth and development of cucumber parameters investigated; leave number, vine length and number of branches, stem diameter, number of tendril, and tendril length were highly improved. This could be as a result of suppression of weed competition and high use water efficiency [15,16]. Also, black plastic mulch is capable of maintaining high soil water contents compared to the control (no mulch) treatments [17]. Improvement of the water use efficiency by better utilization of soil water appears to be the best way to increase fruit and vegetable yield [18]. As well as reducing soil water evaporation and exploiting deep soil water so as to support shoot biomass accumulation and optimize the dry matter [17]. The continuous

influence of the effect of black plastic mulch could be linked with the decomposition of organic residues under plastic mulch which in turns add more nutrients and as well resulting to low soil pH, which may increases the bioavailability of trace elements. Arora et al. [19] reported that Black polyethylene mulch significantly improved plant height, number of branches, flower size and yield. However, white transparent plastic mulch and plant straw mulch were significantly better than the control and were not significantly different from each other on leaf number at 4 and 5 WAP, branch number at 4 and 5 WAP, stem diameter at 4 and 6 WAP, number of tendril at 4, 5 and 6 WAP, and as well as tendril length at 4, 5 and 6 WAP respectively. This may be as a result of the good environment modulation potentials of mulching technology. Stable moisture content and well textured soil leading to unrestricted expanded root growth and subsequent increase in nutrient absorption, it might also, due to the fact that mulch has been reported to be beneficial in fruit vegetable production in providing favourable conditions for the plant growth, prevent nutrient leaching, wind and soil erosion and as well as reduction in evapotranspiration. In all the mulching materials used in this study (white transparent plastic mulch, black plastic mulch, dried plants straw and bare soil-control) were significantly different from each other and control was noticed to be the least among the treatments. This could be as a result of allowing the plant to craw on a bare soil where it is exposed to soil borne pathogens, insect pest and diseases which will invariably hinder the growth and development of the plant. This observation confirms the report of Ba [20] who found that the non- mulched plots produced cucumber plants with the least plant height, number of branches, flowers, and fruits.

Concerning the effects of seasons on the fruits yield component of cucumber, the results revealed that seasons significantly improved all the parameters measured (fruit number, fruit length, fruit diameters, fruit weight, marketable fruits, non-marketable fruits and total yield). It is noticed that season 2 and 4 (late raining seasons) in two years of the studies consistently increased all the cucumber yield parameters measured (fruit number, fruit length, fruit diameters, fruit weight, marketable fruits and total yield except non-marketable fruits, and) when compared with raining seasons (1 and 3). There was a reduction in number of fruits, marketable fruits, total yield and an increased in nonmarketable fruits during the raining season due to incessant heavy rainfall experienced in the location thereby favours the insect pest, disease build up and disruption of insecticide application to control the pest and diseases. In addition, there is a little sunlight for the plant to photosynthesize which will leads to dropping in temperature as against the plant growth requirements. As it is reported by Cobeil and Gosselin, [21] that cucumber is a thermophile plant that requires a stable warm temperature for good yield. The improvement seen in the season 2 and 4 was as a result of adequate temperature and sunlight, moderate rainfall and little pest and disease infestation. Furthermore, the flowers were well pollinated with active insect pollinator without been affected by incessant rainfall.

Table 7. Effect of seasons, mulch and population densities on morphological parameters of cucumber at 4, 5 and 6 WAP

Treatment	Number of tendril			Tendril length (cm)		
	4	5	6	4	5	6
Season 1	5.72	18.37	13.29	0.68	10.92	11.21
Season 2	0.10	3.16	16.85	0.72	11.28	13.54
Season 3	5.72	18.37	13.29	18.99	17.35	12.83
Season 4	0.10	3.16	18.85	0.72	11.28	14.32
$LSD_{0.05}$	**0.94**	**2.39**	**3.28**	**1.39**	**2.45**	**1.33**
White	3.28	10.83	16.45	5.11	13.82	12.54
Black	3.37	11.83	17.58	5.99	12.91	13.50
Mulch	2.50	10.04	13.75	5.56	12.66	13.06
Control	2.58	10.37	14.50	4.45	11.44	12.80
$LSD_{0.05}$	**0.94**	**2.39**	**3.28**	**1.39**	**2.45**	**1.33**

Key: Season 1-Early Raining Season 2017, Season 2 - Late Raining Season 2017, Season 3- Early Raining Season 2018 and Season 4 - Late Raining Season 2018. White - White polyethylene, Black Polyethylene, Mulch-Dried Plant Straw and Control – Un-mulched

Table 8. Combined analysis of variance showing the mean squares of treatments on cucumber yield parameters as influenced by season and mulching materials

Source of variation	DF	Number of fruit/plot	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (gram/kg)	Marketable	Non-Marketable	Total yield (ton/h)
Rep	2	7.64	1.85	1.23	145.98	14.88	5.35	5.66
Season	3	388.00**	352.95**	196.12**	45308.86**	403.86**	4.31*	447.56**
Mulch	3	88.92**	4.79	5.98	8065.89	171.53**	11.17**	39.45**
Season*Mulch	9	14.76	3.28	7.35	7107.92	18.21**	4.83	6.44
Error	30	9.33	4.73	3.29	3835.07	7.12	1.54	6.13

Key: DF-degree of freedom, REP- replication

Table 9. Effect of seasons and mulching materials on cucumber yield parameters

Treatment	Number of fruit/plot	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (gram/kg)	Marketable	Non- Marketable	Total yield (ton/ha)
Season 1	4.31	15.42	13.17	101.81	3.00	1.35	1.31
Season 2	7.43	16.79	14.61	148.44	6.54	0.70	3.09
Season 3	3.97	18.91	15.50	230.21	2.89	1.10	2.45
Season 4	10.00	21.64	17.99	322.92	8.85	1.33	8.21
$LSD_{0.05}$	**1.23**	**0.87**	**0.73**	**25.01**	**1.07**	**0.50**	**1.00**
White	7.62	17.72	15.48	204.75	6.72	0.95	4.52
Black	6.93	18.41	15.41	206.98	6.18	0.75	4.07
Mulch	6.68	18.35	15.58	209.98	5.83	0.95	4.01
Control	4.47	18.28	14.80	181.67	2.54	1.83	2.45
$LSD_{0.05}$	**1.23**	**0.97**	**0.73**	**25.01**	**1.07**	**0.50**	**1.00**

Key: Season 1- Early raining Season 2017, Season 2 - Late Raining Season 2017, Season 3- Early Raining Season 2018 and Season 4 - Late Raining Season 2018. White - White polyethylene, Black Polyethylene, Mulch-Dried Plant Straw and Control – Un-mulched

Table 10. Effects of season by mulching interactions on the marketable fruit

	Mulching materials				
season	**White**	**Black**	**Mulch**	**Control**	**$LSD_{0.05}$**
1	7.00	4.66	5.33	1.66	**5.27**
2	13.66	9.33	9.33	3.66	**8.52**
3	5.00	2.33	4.00	3.33	**1.76**
4	5.33	12.66	10.00	3.00	**4.52**
$LSD_{0.05}$	**4.67**	**2.95**	**6.48**	**4.45**	

Key: Season 1-raining season 2017, season 2 - late raining season 2017, season 3- raining season 2018 and season 4 - late raining season 2018. white - white polyethylene, black polyethylene, mulch-dried plant straw and control – un-mulched.

Mulching materials significantly promoted the fruit yield component of cucumber over the control except nonmarketable fruits. There was no significant different among the mulching materials (White transparent plastic mulch, black plastic mulch, and dried-plantsstraw mulch) on number of fruits, fruit length , fruit diameter, fruit weight, marketable fruits, nonmarketable fruits and total yield but had highly significant different from control. This study confirmed the report of Ajibola and Amujoyegbe [8], who reported that higher yield was obtained from the late season production of cucumber. The consistent increment noticed on all the yield component confirmed the report of Liu et al. [22], Khurshid et al. [23], and Muhammad et al. [24] agreed that mulching improves the ecological environment of the soil, increases soil water contents, reduces infiltration rate, increases the total intake of water due to formation of loose soil surface, reduces sealing of soil particle pores, reduces wind and water erosion and weed problems, decomposed crop residue improves soil aggregation, fertility and increases crop yields [25,26,27,28,29,30,31,32,33].

The interaction effect of seasons x mulching materials on marketable fruits of cucumber revealed that white transparent plastic mulching materials produced higher number of marketable fruits when planted in season 2 and 4 which could be as a result of beneficial characteristics of transparent polyethylene mulch as it repel and reduces the whitefly populations which helped in catching aphids in yellow traps and reduced virus diseases incidence, in comparison to bare soil. Transparent poly-ethylene mulch has a repellent effect on pest and vector insects, such as aphids [34,35,36].

The influence of mulching materials on the mineral elements of cucumber fruit results showed that the mineral element did not affected by the applications of mulching materials irrespective of the color or source (Ca, Mg, K, P, Fe) however, there was a little drop from the result of potassium produced with black plastic mulching materials.

5. CONCLUSION

The results from the study showed that seasons and mulching materials significantly improved the growth and fruit yield of cucumber produced in this ecological zone. Raining seasons favors the agronomical parameters while the late raining season improved the fruit yield and yield components of cucumber. All the mulching materials used significantly improved the growth and fruit yield components of cucumber. In addition, the interaction of white transparent plastic mulch in late raining season production significantly produced the highest yield when compared with other seasons and mulching materials used.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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