EFFECT OF MULCHING MATERIALS AND PRUNING ON GROWTH AND YIELD OF CUCUMBER (*Cucumis sativus* L.)

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Abstract
The effects of two pruning treatments (main stem pruning and non-pruning) and four mulching materials (non – mulching, black plastic, white plastic and rice hull mulch) on the growth and yield of cucumber (Cucumis sativus L.) was studied. The experiment was a 2 x 4 factorial laid out in Randomized Complete Block Design (RCBD). There were a total of 8 treatments with four replications. Data collected was statistically analyzed for differences between mulching materials and pruning using analysis of variance (ANOVA) and separation of means for significant effect was by the use of Least Significant Difference (LSD) at 5% of probability. Vine length, number of leaves, number of flowers, total number of fruits, length, diameter and weight of fruits, number of marketable and non – marketable fruits were highest in rice hull mulched plots. Non – pruning treatment produced a higher total number of fruits, length, diameter and weight of fruits, number of marketable and non- marketable fruits. Black plastic mulch which took the longest time to bud break also produced the least value in all the yield parameters assessed except in the length of fruits. In Abakaliki, rice hull mulch and non-pruning produced an optimum marketable yield of cucumber.

Keywords: Cucumber, mulching materials, pruning and performance

Introduction

Cucumber is an annual trailing vine which belongs to the family Cucurbitaceae. It grows in warm temperate and cool tropical regions of the world. Than (1995) reported that the worldwide production of cucumber is more than ten million tonnes per hectare per year. It is a primary source of vitamins and minerals and it can be pickled, canned or frozen. The response of crops to mulch includes earlier production (Call and Courter, 1989, Decoteau *et al*, 1989), greater total yield (Jensen, 1990) and reduced insect and disease problems (Greenough *et al*, 1990). Rice straw, grass, polyethylene and sawdust are some of the mulching materials which tomato growers used for their crops (Paterson and Eirhart, 1974; Locasio and Meyers, 1975; Famoso and Bautista, 1983). Organic mulches such as hay, straw, grass clippings and compost, add nutrients to the soil through decomposition (Dickerson, 2007). Lamont (1999) reported that black plastic absorbs most incident solar radiation. Black plastic absorbs 96% of the short wave radiation while it transmits and reflects very little. The absorbed radiation is held by the upper layer of the soil causing it to heat. (Teadale and Abdul - Baki, 1995). Two varieties of cucumber (Ded - bai and Pol - lek) were grown using plastic and rice straw mulches. Thi Ba (1993) reported that the black polyethylene plastic mulch significantly increased yield. Plastic mulch increased temperature and soil moisture, reduced evaporation, increased nutrient uptake, controlled weeds, protected plants from pests and reduced fruit rotting. Goyal and Allison (1983) observed that the use of plastic mulch on the cucumber increased cucumber production by 4.6t/ha in Puerto Rico. Reported beneficial responses of tomatoes to polyethylene mulch include earlier production (Schalk *et al.*, 1980; Bhella, 1988; West and Pierce, 1988), better fruit quality (Wien and Minotti, 1987) and greater total yield (Jones *et al.*, 1977; Wien and Minotti, 1987). An experiment on the use of plastic mulch for okra production showed that plastic mulches increased soil temperature, seedling emergence, conserved soil

moisture, improved plant growth, resulted in early flowering and increased total yield of okra. Chiazor (2008) reported that the number and length of roots of okra under mulch was higher than that of the non – mulching treatment. In a trial on the effect of pruning on the yield of cucumber, Duong (1999) reported that pruning had no effect on the length of the fruits and mean fruit weight. Pruned cucumber had higher weight of fruits than the unpruned ones. A similar result was obtained in a pruning study on cucumber (Than, 1995). Studies on apical bud and leaf removal in okra showed that the treatments enhanced the vegetative growth and development (Olasantan, 1988). Parr and Hussey (1962) reported similar effects of apical bud and leaf removal on cucumber. Than (1996) observed that unpruned cucumber flowered three days earlier than the pruned ones. The effect of pruning and spacing on cucumber showed that the highest total yield was obtained from the non – pruning treatment. Pruning all the branches on the main stem or pruning the branches up to node ten decreased the number of non- marketable yield (Hong, 2000). Palada and Chang (2003) found that the removal of the lateral shoot had a positive effect on total yield of bitter gourd. The total number of marketable and non-marketable fruits was higher in the unpruned treatment and least on the one stem pruning (Okafor, 2007). The objective of this study was to determine the effect of various mulching materials and pruning on growth and yield of cucumber in Abakaliki, Southeastern Nigeria.

Materials and Methods

The experiment was conducted at the experimental field of the Faculty of Agriculture and Natural Resources Management of Ebonyi State University, Abakaliki, in the Southeastern Nigeria from 30^{th} of May to 30^{th} of August, 2009. Ebonyi State is in the derived savanna zone of Nigeria located at latitude 06^0 4^1N and longitude 08^0 65^1E, at an altitude of 447.2 meters above mean sea level (Ebonyi State University metrology station).The soil in the experimental area is classified as ferallitic well drained sandy loam. The experimental field measured 24.5m long by11m wide, giving a total of 264.5m^2. Raised beds were manually cultivated. The experimental field was divided into four equal blocks and each block consisted of eight (8) plots, giving a total of thirty - two (32) subplots. Each plot measured 2m x 2m with 0.5 between adjacent plots. The experiment was conducted as a 4 x 2 factorial laid out in Randomized Complete Block Design (RCBD). Each treatment was replicated four times and the treatments comprised four mulching materials (no mulching, rice hull mulch, black plastic mulch and white plastic mulch) and two pruning (non – pruning and main stem pruning). The mulching materials were applied two days before sowing of the seeds commenced and two seeds of the cucumber variety "Market More" was sown per hole by direct seeding at a spacing of 50cm x 30cm. NPK fertilizer was applied at the rate of 150kg/ha. The plots were weeded about three times using hoes and a total of three sprays of Endocot 35 Emulsifiable concentrate was applied on the 3^{rd}, 5^{th} and 6^{th} week after planting to protect the crop against insects such as aphids, ladybird, *Zonoceros variegates* and thrips. Harvesting of the matured fruits commenced nine weeks after planting and the following parameters were measured: vine length, number of leaves, number of days to 50% anthesis (flowering), number of flowers, number of fruits, length, weight and diameter of fruits, number of marketable and non - marketable fruits, number of roots and length of roots.

Statistical Analysis

The data collected was statistically analyzed for differences between mulching materials and pruning using analysis of variance (ANOVA) techniques and where the F-values showed statistically significant differences, the means of such treatments was compared using LSD at the 5% level of probability (Steel and Torrie, 1980; Obi, 1986).

Results and Discussion

The result showed that the effect of mulching materials on vine length was significant (P = 0.05) (Table 1). The vine length of the plants grown with the rice hull mulch was the longest while that of the non – mulching treatment was the shortest and they differed significantly. Ricehull mulch produced vine length that was significantly longer than all other treatments. However, the vine length of plants grown with the white plastic mulch was significantly longer than that of the black plastic mulch and the non – mulching treatment, while the black plastic mulch and the non – mulching treatment produced plants whose vine length were statistically similar. Pruning had no significant effect on vine length. Although, pruning the main stem produced longer vines than the non-pruning treatment. Mulching materials x pruning interaction was non-significant. However, the longest vines was recorded under the rice hull mulch on plants whose main stem was not pruned while the shortest was in the black plastic mulch and non-pruning.

Table 1: Effect of mulching materials and pruning on vine length (cm)

	Mulching materials				
Pruning	Black plastic	White plastic	Ricehull	Non- mulching	Mean
Main stem pruning	44.80	50.48	66.18	33.95	48.85
Non- pruning	28.47	43.56	74.39	31.38	44.45
Mean	36.64	47.02	70.29	32.67	
F-LSD (P =0.05)					
Mulching material			= 8.50		
Pruning			= NS		
Mulching material x pruning			= NS		

Mulching materials had significant (P = 0.05) effect on the number of leaves produced (Table 2). The highest number of leaves was recorded on the rice hull mulch while the lowest was on the non-mulching treatment and they differed significantly. The number of leaves obtained on the rice hull mulch was significantly higher than all other treatments while number of leaves recorded on the black and white plastic mulches did not differ among themselves. The effect of pruning, mulching material x pruning interaction was non – significant at P = 0.05. Pruning the main stem produced plants with a higher number of leaves than the non-pruning treatment. The highest number of leaves was recorded on the rice hull mulch and the main stem pruning while the least was on the non-mulching and non-pruning treatment.

Table 2: Effect of mulching materials and pruning on number of leaves produced

	Mulching materials				
Pruning	Black plastic	White plastic	Ricehull	Non- mulching	Mean
Main stem pruning	25.80	29.49	41.89	20.62	29.45
Non- pruning	24.77	24.22	41.63	19.65	27.57
Mean	25.29	26.86	41.76	20.14	
F-LSD (P =0.05)					
Mulching material			= 5.69		
Pruning			= NS		
Mulching material x pruning			= NS		

Rice hull mulch produced the highest number of flowers while the least number of flowers was obtained on the non- mulching treatment and they differed significantly (P = 0.05) (Table 3). The number of flowers produced on the rice hull mulch was significantly higher than all other treatments while number of flowers produced on plants mulched with the black plastic mulch, white plastic mulch and non – mulching treatments were statistically similar. The effect of pruning on the number of flowers produced was non – significant at P = 0.05. However, main stem pruning produced a higher number of flowers than the non – pruning treatment. Mulching materials x

pruning interaction was non – significant. The highest number of flowers was produced on plants grown with the ricehull mulch and non – pruning treatment while the least was on the white plastic mulch and non – pruning.

Table 3: Effect of mulching materials and pruning on number of flowers

	Mulching materials				
Pruning	Black plastic	White plastic	Ricehull	Non- mulching	Mean
Main stem pruning	9.12	11.37	14.97	7.77	10.81
Non- pruning	8.03	7.24	16.33	8.45	10.01
Mean	8.58	9.31	15.65	8.11	
F-LSD (P =0.05)					
Mulching material			= 2.29		
Pruning			= NS		
Mulching material x pruning			= NS		

Mulching materials had significant (P= 0.05) effect on the number of days to 50% flowering (anthesis) (Table 4). The earliest bud - break was recorded on plants grown with the rice hull mulch while the longest number of days to 50% anthesis was obtained on plants mulched with the black plastic mulch and they differed significantly. Number of days to 50% anthesis obtained on the plants grown with the black plastic mulch, white plastic mulch and non –mulching treatment were statistically similar. Pruning had no significant effect on the number of days to 50% anthesis. However. Plants whose main stem was pruned had an earlier bud - break than those that were not pruned. Mulching materials x pruning interaction was non – significant. Although, days to 50% anthesis was longest on non – mulching and non – pruning treatments while the shortest number of days to 50% anthesis was recorded on plants grown with the rice hull mulch and the main stem pruning treatments.

Table 4: Effect of mulching materials and pruning on the number of days to 50% anthesis (flowering)

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	46.40	46.30	42.40	42.95	44.51
Non- pruning	47.50	46.70	42.95	49.30	46.30
Mean	46.95	46.50	42.68	46.13	
F-LSD (P =0.05)					
Mulching material			= 1.76		
Pruning			= NS		
Mulching material x pruning			= NS		

Mulching materials and pruning had significant (P = 0.05) effect on the total number of fruits produced (Table 5). The highest number of fruits was produced on the rice hull mulch while the least was on the black plastic mulch and they differed significantly. The number of fruits recorded on the rice hull mulch was significantly (P = 0.05) higher than all other treatments. Non – pruning treatment produced a significantly higher total number of fruits than the main stem pruning. Mulching materials x pruning interaction was not significant. However, the highest total number of fruits was recorded on the rice hull mulch and non – pruning while the lowest number of fruits was obtained on the black plastic mulch and main stem pruning and on the non – mulching and main stem pruning.

Table 5: Effect of mulching materials and pruning on the total number of fruits

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	3.51	3.70	6.00	3.51	4.18
Non- pruning	4.64	4.95	8.30	5.06	5.74
Mean	4.08	4.33	7.15	4.29	
F-LSD (P =0.05)					
Mulching material			= 1.12		
Pruning			= 1.20		
Mulching material x pruning			= NS		

The effect of mulching materials and pruning on the length of fruits was significant (P = 0.05) (Table 6). The longest fruits were recorded on plants grown with the rice hull mulch while the shortest was on the non – mulching treatment and they differed significantly. Rice hull mulch produced significantly (P = 0.05) longer fruits than the black and the white plastic mulches. Non – pruning treatment produced significantly longer fruits than the main stem pruning treatment. The interaction between mulching materials and pruning was non – significant. Although, the longest fruits was obtained on plants grown with the rice hull mulch and non – pruning treatments while the shortest was on the black plastic mulch and main stem pruning.

Table 6: Effect of mulching materials and pruning on the length of fruits produced (cm).

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	66.69	98.20	126.71	79.38	92.75
Non- pruning	104.40	115.70	195.24	88.01	125.84
Mean	85. 55	106.95	160.98	83.70	
F-LSD (P =0.05)					
Mulching material			= 18.90		
Pruning			= 26.77		
Mulching material x pruning			= NS		

Mulching materials had significant (P = 0.05) effect on the diameter of fruits produced (Table 7). Diameter of fruits recorded on the rice hull mulch was significantly higher than the white plastic mulch and the non – mulching treatment. Plants that were not pruned produced fruits that were significantly wider than those whose main stems were pruned. Mulching materials x pruning interaction was not significant. However, diameter of fruits was highest on rice hull mulch and non – pruning treatments while black plastic mulch and main stem pruning produced the least diameter of fruits.

Table 7: Effect of mulching materials and pruning on the diameter of fruits (cm)

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	60.48	78.79	10.69	66.03	77.99
Non- pruning	82.93	89.02	149.87	97.86	104.92
Mean	71.71	83.91	128.28	81.95	
F-LSD (P =0.05)					
Mulching material			= 16.30		
Pruning			= 23.12		
Mulching material x pruning			= NS		

The result showed that mulching materials and pruning had significant (P = 0.05) effect on the weight of fruits produced (Table 8). Weight of fruits was highest on plants mulched with rice hull mulch and lowest on those mulched with black plastic mulch and they differed significantly. Weight of fruits recorded on plants grown with the white plastic mulch and non – mulching treatment were statistically similar. Non – pruning treatment produced a significantly higher weight of fruits than the main stem pruning. The interaction between mulching material and pruning was not significant at P = 0.05 (Table 8). Although, the highest weight of fruits was on plants mulched with rice hull and non – pruning treatment while the lowest was recorded on plants grown with the black plastic mulch and main stem pruning.

Table 8: Effect of mulching materials and pruning on the weight of fruits (kg)

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	1.20	1.57	2.17	1.29	1.56
Non- pruning	1.62	1.98	3.18	1.68	2.12
Mean	1.41	1.78	2.68	1.49	
F-LSD (P =0.05)					
Mulching material			= 0.40		
Pruning			= 0.44		
Mulching material x pruning			= NS		

The effect of mulching materials on the number of marketable fruits produced was significant (P = 0.05) (Table 9). Number of marketable fruits was highest on plants grown with rice hull mulch and least on the black plastic mulch and they differed significantly. Number of marketable fruits recorded on plants mulched with rice hull mulch was significantly higher than those grown with the white plastic mulch and the non – mulching treatment. Non – pruning produced a significantly (P = 0.05) higher number of marketable fruits than the main stem pruning treatment. Mulching materials x pruning interaction was non – significant. The highest number of marketable fruits was recorded on plants mulched with rice hull mulch and non – pruning treatment while the lowest was on plants grown with the black plastic mulch and main stem pruning treatment. Mulching materials had significant (P = 0.05) effect on the number of non- marketable fruits produced (Table 10). The highest number of non – marketable fruits was recorded on rice hull mulched plots while the lowest was on plots mulched with black plastic mulch and they differed significantly. The number of marketable fruits obtained from the rice hull mulched plots was significantly (P = 0.05) higher than that from the white plastic mulch and non – mulching treatments. Pruning, mulching material x pruning interaction was non – significant (Table10). However, non- pruning treatments produced a higher number of non – marketable fruits than the main stem pruning treatment. The highest number of non – marketable fruits was obtained on rice hull mulched plots and non – pruning treatment while the lowest was on the black plastic mulch and main stem pruning treatments.

Table 9: Effect of mulching materials and pruning on number of marketable fruits

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	2.20	2.80	3.90	2.70	2.90
Non- pruning	3.60	4.20	6.05	4.58	4.59
Mean	2.90	3.50	4.98	3.60	
F-LSD (P =0.05)					
Mulching material			= 1.10		
Pruning			= 1.69		
Mulching material x pruning			= NS		

Table 10: Effect of mulching materials on the number of non – marketable fruits

	Mulching materials				
Pruning	Black plastic	White plastic	Rice hull	Non- mulching	Mean
Main stem pruning	0.75	1.15	2.00	1.00	1.23
Non- pruning	0.95	1.15	2.25	1.25	1.40
Mean	0.85	1.15	2.13	1.13	
F-LSD (P =0.05)					
Mulching material			= 0.45		
Pruning			= NS		
Mulching material x pruning			= NS		

The longest vines, the highest number of leaves and number of flowers was obtained on plants that were mulched with rice hull mulch. This may suggest that rice hull mulch added some nutrients to the soil and these were available for plant growth. Dickerson (2007) reported that unlike synthetic mulches, organic mulches like hay, straw, grass clipping and compost tend to return nutrients to the soil through decomposition. The shortest number of days to 59% anthesis (flowering) was recorded on plants grown with rice hull mulch while plants mulched with white plastic mulch took the longest number of days to bud break. Decoteau *et al* (1989) and Jensen (1990) observed that the response of plants to mulching was earlier production of fruits and greater total yield. Non – mulching treatment consistently gave least value in all the vegetative parameters measured except on the number of days to 50% anthesis where plants mulched with rice hull mulch had the earliest bud break. Non –mulching may have exposed the soil to high temperature, rapid evaporation of moisture and leaching of mineral nutrients leading to poor vegetative growth. Plants whose main stem were pruned produced the longest vines, highest number of leaves and flowers while days to 50% anthesis was higher on the non –pruning treatment. A similar observation was made by Olasatan (1988) who reported that studies on apical bud and leaf removal in okra showed that the treatments enhanced okra vegetative growth and development. This is not in conformity with the report by Than (1996) who observed that unpruned cucumber flowered three days earlier than the pruned plants. The highest total number of fruits, length, weight, diameter of fruits and number of marketable fruits was recorded on plants that were mulched with rice hull mulch. This may suggest rice hull mulch decomposed and added some nutrients to the soil, which enhanced the production of longer vines for the attachment of more flowers and subsequent fruit production. Rice hull mulch may have suppressed weed growth on the plots where they were applied. Dickerson (2007) found that unlike synthetic mulches, organic mulches like hay, straw, grass clipping and compost tend to return nutrients to the soil through decomposition. Locasio and Myers (1975) as well as Famoso and Bautista (1983) reported that the application of mulch can suppress weed growth and induce early maturity of fruits. Black plastic mulch consistently produced least value in all the yield parameters measured except in the length of fruits where non – mulching treatment produced the shortest fruits. This may be attributed to the high temperature that prevails under plastic mulches, especially black plastic mulch. Lamont (1999) observed that black plastic absorbs most incident solar radiation. A similar observation was made by Teadale and Abdul – Baki (1995) who reported that black plastic mulch absorbs 96% of short wave radiation while it transmits and reflects very little. Also, they noted that the absorbed radiation was held by the upper layer of the soil, causing it to heat. The non – pruning treatment produced the highest total number of fruits, number of marketable and non - marketable fruits, length, weight and diameter of fruits. This may suggest that the non –pruned plants had more lateral shoots for the attachment of more fruits. This is in conformity with the observation made by Okafor (2007) who reported that the total number of fruits, marketable and non –marketable fruits was highest in the non – pruned treatment and least on the one stem pruning. A similar observation was made by Than (1996) who noted that non – pruning treatment produced the highest total yield of cucumber. Main stem pruning consistently

gave lower values in all the yield parameters measured. This result agrees with the report by Parr and Hussey (1962) who observed that the removal of the apical buds and leaves delayed fruiting and decreased pod yield. A contrary observation was made by Duong (1999) who reported that pruned cucumber had higher weight of fruits than the unpruned ones. Palada and Chang (2003) also found that the removal of the lateral shoots had a positive effect on the total yield of bitter gourd.

Conclusion

This field trial revealed that the longest vines, highest number of leaves, number of flowers, total number of fruits, length, weight and diameter of fruits, number of marketable and non – marketable fruits was produced on the rice hull mulched plots. Non – pruning treatment produced a higher total number of fruits, length, weight and diameter of fruits, number of marketable and non – marketable fruits. In Abakaliki, rice hull mulch and non – pruning produced optimum marketable yield of cucumber.

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