



Effect of Different Mulches on the Biometric Performance of Cucumber Crop under Polyhouse

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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 present study entitled "Effect of different mulches on the biometric performance of cucumber crop under polyhouse" was conducted during summer, 2019 at polyhouse, College of Agricultural Engineering, Kandi. Sangareddy, Telangana. Treatments consisted of five different mulches (White transparent, Black and silver, Black, Organic (paddy straw) and without mulch). The experiment was laid out in a randomized block with four replications. Growth parameters visually vine length and the number of leaves plant⁻¹ differed significantly with different mulches and cucumber without mulch gave significantly higher growth parameters, followed by black and silver, black, white transparent whereas significantly lower growth parameters were recorded with organic mulch. The yield attributes visually the number of fruits plant⁻¹, fruit length and fruit circumferences were significantly superior with cucumber without mulch whereas significantly lower yield attributes were observed in organic mulch. Fruit yield ha⁻¹ was significantly higher with cucumber without mulch. Organic mulch recorded significantly lower fruit yield ha⁻¹. Gross and net returns were higher with cucumber without mulch whereas significantly lower gross and net returns were observed in

organic mulch. The highest benefit-cost ratio was observed with cucumber without mulch whereas the lowest benefit-cost ratio was observed with white transparent mulch. The study has shown that cucumber can be grown without any mulch during the summer season under polyhouse at Central Telangana Zone of Telangana.

Keywords: *Cucumber; polyhouse; mulches; summer; Telangana.*

1. INTRODUCTION

The environment is the most determinantal factor in horticultural crops [1]. The open-field production of vegetables encounters many production constraints like heavy rain, thunderstorms, excessive solar radiation, temperature and humidity levels above plant growth optima [2], high insect pest infestation pressure [3] and fungal diseases [4]. Protected cultivation is a suitable approach towards vegetable production under adverse climate. Polyhouse farming is a new and widely accepted method of farming in the present day. The invention of the polyhouse is a solution for the lack of agricultural lands. Throughout the year four to five crops can be grown in a polyhouse due to the availability of required plant environmental conditions. Compared to the cultivation in open field poly houses are an alternative for protected cultivation that allows the plants to escape from stress full factors that significantly affect the production and quality of vegetables. There will be an increase in the production of vegetables, fruits, or flowers in polyhouse farming without losing their color and quality. Export quality products of international standards can be produced in a polyhouse.

Cucumber (*Cucumis sativus* L.) is one of the most important highly nutritional and popular members of the Cucurbitaceae family cultivated for its fresh fruits and pickling [5,6]. In India, it is mainly grown as a summer warm-season vegetable crop. The demand for quality products is increasing day by day. Cucumber grown under polyhouse showed superior quality than grown under open conditions. Also, off-season production of the crop can be possible under polyhouse. To be competitive in today's marketplace, plasticulture using mulches is a management tool that enables vegetable growers to realize greater returns per unit of land [7]. Mulching reduces the number of days to flowering and first harvest. Different mulches may improve the soil temperature, as they absorb solar radiation and thereby heat the soil (Anderson et al., 1995). Plastic mulches have been used commercially on vegetables since the

early 1960s to modulate the micro-climate around the plant by modifying the radiation budget (absorptivity vs. reflectivity) of the surface and decreasing the soil water loss, especially black and clear plastic films [8] on soil and air temperature, moisture retention and vegetable yields. A notable snag of these technologies is the non-biodegradable nature of the film sheets in current use until biodegradable films become available. On the other hand, organic mulch materials such as grain straw, fresh or old hay, freshly cut forage or cover crops, chipped brush, wood shavings, tree leaves, cotton gin waste, rice or buckwheat hulls, and other crop residues used as mulch are biodegradable and if properly utilized perform all the benefits of any mulch viz, soil and water conservation, enhanced soil biological activity and improved chemical and physical properties of the soil [9] except for early season soil warming. However, its snag includes unavailability in adequate quantities at the place of use, hence must be transported to the place of need and requires considerable manual labor spreading them, its decomposition may temporarily reduce mineral nitrogen and also the natural phytotoxins released during decomposition may inhibit weed and crop growth [10]. All these may hamper the yield of the crop to some extent, except some cautionary measures are taken. As no systematic research has been conducted in the Central Zone of Telangana to define the combined effect of different mulches and the cultivation of cucumber grown under polyhouse conditions, there is a need to establish the relationship between mulches and cucumber growth. To evaluate the effect of different mulches on cucumber crop under polyhouse, to monitor the biometric growth of cucumber crop under polyhouse and assess the economic feasibility of different mulches in polyhouse, the present study on "Effect of different mulches on the biometric performance of cucumber crop under polyhouse" was undertaken.

2. MATERIALS AND METHODS

The experiment entitled "Effect of different mulches on the biometric performance of

cucumber crop under polyhouse" was conducted at the polyhouse, during summer, 2019 at College of Agricultural Engineering, Kandi, Sangareddy Telangana. The farm is geographically situated at an altitude of 516 m above mean sea level (MSL) and 170 37' N-latitude and 0780 6' E-longitude and falls under the Central zone of Telangana state. The experiment was laid out in a randomized block design replicated four times with five treatments. The treatments were T1. White transparent mulch, T2 Black and silver mulch, T3 Black plastic mulch, T4 Organic (Paddy straw) and T5 Without mulch. The variety taken is Kasturi which is a commonly cultivated hybrid in Telangana and Andhra Pradesh with maximum production. It is a short duration hybrid of 45 to 50 days which is recommended for the cultivation under agro-climatic conditions of Kharif and summer seasons. The experimental beds were cleaned properly without any stubble, subsequently leveling was done and plots were laid out as per the layout plan. The bed size is 8 m X 1.0 m. Two seeds were dibbled per hill at a depth of 1.5 cm on mulched sheets on March 15th, 2019 to get desired plant population, followed by irrigation to ensure proper and uniform germination. The thinning operation was done 10 days after sowing by retaining one healthy and vigorous seedling per hill. The common fertilizer schedule adopted for all the treatments was 100:100:100 kg ha⁻¹ of Nitrogen, Phosphorus and Potassium respectively. Entire phosphorus and potassium were applied as basal in the form of SSP and MOP respectively. Half of the Nitrogen was applied as basal and the remaining half of nitrogen in two splits at 30 and 45 DAS. Hand weeding was done only without mulch once at 25 days after sowing. All the plots were uniformly irrigated through drip as and when required based on crop growth. Recommended plant protection measures were adopted as and when needed. The cucumber fruits were harvested in two pickings. Harvesting started after 45 DAS and finished in 2 pickings. Biometric observations like vine length, number of leaves per plant, number of fruits per plant, fruit length, fruit circumference, fruit weight and fruit yields were recorded. Economics was worked out based on the current market price.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Significantly higher vine length at harvest was recorded in cucumber without mulch (118.6cm) followed by black and silver (108.5cm), black

mulch (102.8cm) and white transparent (95.2cm) whereas significantly lower vine length was recorded in organic mulch (89.2cm). A similar trend was observed at all other growth stages also (Table-1). The enhancement of vegetative growth due to mulches in winter has been reported manutention [11], Saleh et al., [12] and Aniekwe et al., [13]. But the experiment being conducted in summer, without mulch has recorded more vine length because of the accumulation of optimum heat compared to mulched treatments where heat accumulation might be more than optimum. Organic mulch might have utilized the mineral nitrogen for its decomposition and also the natural phytotoxins released during decomposition might have inhibited the crop growth [10]. The significantly higher number of leaves plant⁻¹ at harvest was recorded in cucumber without mulch (35.5) followed by black and silver (31.8), black plastic mulch (29.2) and white transparent (26.2) whereas the significantly lower number of leaves plant⁻¹ was recorded in organic mulch (23.0). A similar trend was observed at all other growth stages also (Table-2). More vine length might have contributed to a greater number of leaves plant⁻¹ in cucumber without mulch. Manutention [11], Saleh et al., [12] and Aniekwe et al., [13] reported a greater number of leaves plant⁻¹ in mulched plots during winter.

3.2 Yield Attributes

The significantly higher number of fruits plant⁻¹ was recorded in cucumber without mulch (15.6) followed by black and silver (13.3), black plastic mulch (11.1) and white transparent (9.1) whereas the significantly lower number of leaves plant⁻¹ was recorded in organic mulch (7.5) (Table-3). Because the accumulation of more photosynthesis due to a greater number of leaves in cucumber without mulch might have contributed to a greater number of fruits plant⁻¹. A higher number of fruits plant⁻¹ was observed in biodegradable mulch with paper during summer in the temperate zone of Finland [1]. Significantly higher fruit length was observed in cucumber without mulch (9.8cm) followed by black and silver (9.4cm), black mulch (9.1cm), white transparent mulch (8.7cm) whereas significantly lower fruit length was recorded with organic mulch (8.4cm) (Table-3). Maximum exploitation of photosynthesis towards the sink-in without mulch resulted in significantly higher fruit length. Higher cucumber fruit length with mulches during winter was reported by Aniekwe et al., [13], Dygima and Demkouma, [14] and Thakur et al.,

[15]. Significantly higher fruit circumference was reported in cucumber without mulch (74.6mm) followed by black & silver (71.4mm), black mulch (68.8mm) and white transparent mulch (66.2mm), whereas fruit circumference was significantly lower with organic (63.2mm) (Table-3). Significantly higher growth attributes like vine

length and number of leaves plant⁻¹ in cucumber without mulch resulted in significantly higher fruit circumference. Higher fruit circumference with mulches during winter was reported by Aniekwe et al., [13], Dygima and Demkouma, [14] and Thakur et al., [15].



Fig. 1. Layout of experiment



Fig. 2. Sowing of seeds



Fig. 3. Germination of seed after 5 days of sowing

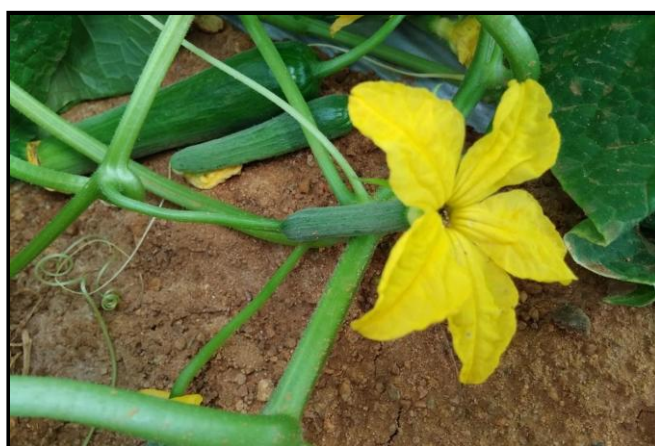


Fig. 4. Flowering stage of cucumber

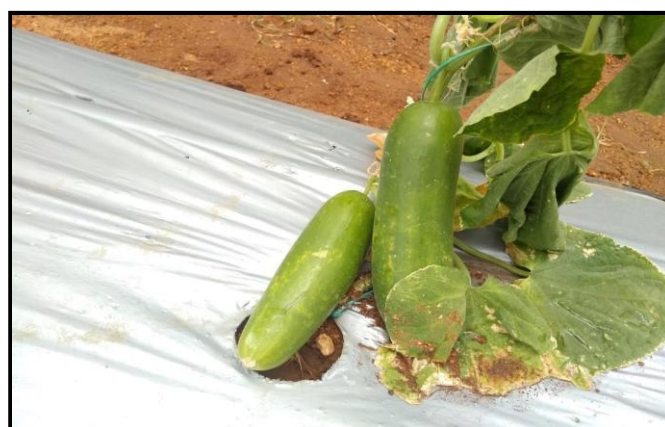


Fig. 5. Cucumber in black and silver mulch

Table 1. Vine length (cm) of cucumber at 15, 30, 45 days after sowing and at harvest as influenced by different mulches under polyhouse

Treatments	15 DAS	30 DAS	45 DAS	At harvest
White transparent	18.4	59.1	93.8	95.2
Black and silver	21.3	64.9	105.7	108.5
Black	19.3	63.5	99.9	102.8
Organic	17.8	53.9	87.8	89.2
Without mulch	24.3	73.2	116.2	118.6
S.E. (m)	0.5	1.4	1.8	1.8
C.D.	1.5	4.3	5.4	5.2

Table 2. Number of leaves plant⁻¹ of cucumber at 15, 30, 45 days after sowing and at harvest as influenced by different mulches under polyhouse

Treatments	15 DAS	30 DAS	45 DAS	At harvest
White transparent	3.3	14.5	24.5	26.2
Black and silver	3.8	16.5	29.5	31.8
Black	3.6	15.7	27.0	29.2
Organic	3.0	11.5	21.9	23.0
Without mulch	5.2	18.0	33.0	35.5
S.E. (m)	0.04	0.3	0.8	0.9
C.D.	0.1	1.0	2.3	2.5

Table 3. Number of fruits plant⁻¹, fruit length (cm) and fruit circumference (mm), fruit weight (g) and fruit yield (tonnes ha⁻¹) of cucumber as influenced by different mulches under polyhouse

Treatments	No. of fruits plant ⁻¹	Fruit length (cm)	Fruit circumference (mm)	Fruit weight (g)	Fruit yield (tonnes ha ⁻¹)
White transparent	9.1	8.7	66.2	180	22.9
Black and silver	13.3	9.4	71.4	242	45.4
Black	11.1	9.1	68.8	223	34.7
Organic	7.5	8.4	63.2	160	16.0
Without mulch	15.6	9.8	74.6	270	59.9
S.E. (m)	0.03	0.07	0.8	4.9	0.4
C.D.	1.2	0.2	2.4	15.0	1.3

Table 4. Economics (₹ ha⁻¹) of cucumber as influenced by different mulches under polyhouse

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross returns (₹ ha ⁻¹)	Net returns (₹ ha ⁻¹)	B:C ratio
White transparent	2,92,366	4,58,000	1,65,634	1.6
Black and silver	2,68,200	9,08,000	6,39,800	3.4
Black	2,83,700	6,94,000	4,10,300	2.5
Organic	1,65,700	3,20,000	1,54,300	1.9
Without mulch	1,55,700	11,98,000	10,42,300	7.7

Cost of cucumber (kg): ₹ 20/-

3.3 Yield

Fruit weight was significantly higher in cucumber without mulch (270g) followed by black and silver mulch (242g), black mulch (223g) and white transparent mulch (180g), whereas significantly lower fruit weight was obtained with the organic (160g) (Table-3). Significantly higher fruit length and fruit circumference in cucumber without mulch might have contributed to significantly higher fruit weight without mulch. Higher fruit weight with mulches was reported by Aniekwe et al., [13], Dygima and Demkouma, [14] and Thakur et al., [15]. Fruit yield tonnes ha⁻¹ was significantly higher in cucumber without mulch (59.9) followed by black and silver mulch (45.4) black mulch (34.7) and white transparent (22.9) whereas significantly lower fruit yield ha⁻¹ was obtained with the organic mulch (16.0) (Table-3). Significantly higher fruit length, fruit circumference and fruit weight in cucumber without mulch might have contributed to significantly higher fruit yield ha⁻¹ in cucumber without mulch. Being summer, optimum heat accumulation without mulch might be the reason for higher fruit yield ha⁻¹. In the black plastic film, the heat was dispatched by conduction, half going into the soil and half into the air space; the soil was therefore heated up quite slowly. While with transparent film, the film transmitted practically the whole of the solar radiation that

became absorbed by the soil, the soil was therefore heated up more quickly [16] whereas organic mulch might have utilized the mineral nitrogen for its decomposition and also the natural phytotoxins released during decomposition might have inhibited the crop growth [10]. Higher fruit yield of cucumber with mulches during winter was reported by Maged, [16], Trivedi and Singh, [1], Aniekwe et al., [13], Dygima and Demkouma, [14] and Thakur et al., [15].

3.4 Economics

Cost of cultivation was highest for white transparent mulch (₹. 2,92,366/-) followed by black mulch (₹. 2,83,700/-), black and silver mulch (₹. 2,68,200/-) and organic (₹. 1,65,700/-) whereas it was lowest for without mulch (₹. 1,55,700/-). Gross returns were highest for without mulch (₹. 11,98,000/-) followed by black and silver mulch (₹.9,08,000 /-), black mulch (₹. 6,94,000/-) and white transparent mulch (₹.4,58,000/-), whereas it was lowest for organic, (₹. 3,20,000/-). Net returns were significantly higher in without mulch (₹. 10, 42,300/-) followed by black and silver mulch (₹. 6, 39,800/-), black mulch (₹. 4, 10,300/-) and white transparent mulch (₹. 1, 6 5,634/-) whereas it was lowest for organic mulch (₹. 1, 54,300/-). The benefit cost ratio was highest for without mulch (7.7) followed

by black and silver mulch (3.4), black mulch (2.5) and organic (1.9) whereas it was lowest for white transparent mulch (1.6) (Table-4). Even though gross and net returns were higher with white transparent mulch, but because of more mulch cost, benefit-cost ratio was lower in white transparent mulch compared to organic mulch. The results conformed with Praveen Kumar, R.S. Chauhan, R.K. Grover et al., [17].

4. CONCLUSIONS

Mulching has shown a negative impact on the performance of cucumber during summer under polyhouse at Central Telangana Zone of Telangana. Cucumber without any mulch has recorded significantly higher growth parameters, yield attributes, yield, gross and net returns whereas cucumber with organic mulch has recorded significantly lower growth parameters, yield attributes, yield, gross and net returns during summer under polyhouse at Central Telangana Zone of Telangana. The highest benefit-cost ratio was observed with cucumber without mulch whereas the lowest benefit-cost ratio was observed with white transparent mulch during summer under polyhouse at Central Telangana Zone of Telangana.

5. FUTURE LINE OF WORK

Based on the literature cited, mulches have shown a positive effect on cucumber either in the winter season or in temperate zones by increasing the soil temperature. But, as the experiment is conducted in summer results obtained are conflicting with the literature cited, where mulching has shown a negative impact on the performance of cucumber. However, to confirm the results, the trial has to be evaluated at least for two more years under a similar situation by taking the climatic factors also into consideration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Trivedi and Singh. Cucumber seed multiplication and characterization. Thailand. 2015;52.
2. Max YS. Effects of mulch on soil physical properties and NPK concentration in maize (Zea mays) shoots under two tillage systems. International Journal of Agriculture and Biology. 2009;11: 120-124.
3. Nguyen. Cucumber yield under regular deficit irrigation and mulching treatments. Acta Horticulturae. 2009;731:189-194.
4. Sringarm. Plastic house microclimate as affected by low tunnels and plastic mulches. Egyptian Journal of Horticulture. Publ. 1993. 2013;19(2):111-119.
5. Lower RL, Edwards MD. Cucumber breeding in breeding vegetable crops, Westport, Connecticut, USA: AVI Publishing Co. 1986;173-203.
6. Thoa DK. Cucumber seed multiplication and characterization, AVRDC/ARC training. Thailand. 1998;51.
7. Lamont WJ, Poling EB. A fresh way of looking for profits: Double-cropping strawberries, muskmelons, fruit South. 1999;7(4):8-11.
8. Liakatas AJ, Clark A, Monteith JL. Measurements of the heat balance under plastic mulches. Part1. Radiation balance and soil heat flux. Agriculture for Meteorology. 1986;36:227-239.
9. Murugan M, Gapinath G. Effect of organic and inorganic mulches on growth and flowering of Cassandra (Crossandra undulaefolia Salisb) cv. "Saundarya." Research on Crops. 2001;2:346-350.
10. Wallace RW, Bellinder RR. Alternative tillage and herbicide options for successful weed control in vegetables. Hort. Science. 1992;27:745-749.
11. Manutention A. Plastic mulch. The choice of film. Plasticulture. 1984;62: 37-45.
12. Saleh SM, Medany MA, El-Behiry UA, Abu-Hadid AF. Effect of polyethylene color on the growth and production of cucumber in greenhouse during autumn. Proceedings of the international symposium on the horizons of using organic matter and substrates in Horticulture, Cairo, Egypt, 6-9 April, 2002. Acta- Horticulturae. 2003;608:259-265.
13. Anderson DF, Garisto MA, Bourrut JC, Schonbeck MW, Jaye R, Wurberger A, Aniekwe M, Abdel-Razzak H, Ibrahim A, Wahb-Aaah M, Alsadon A. Response of muskmelon cultivars to plastic mulch and irrigation regimes under greenhouse conditions. J. Anim. Plant Science. 2015;25(5):1398-1410.
14. Dygima A, Demkouma D. Plastic mulch in dry tropical zones. Trials on vegetable

- crops in Burkina Faso. *Plasticulture*. 1986;69(1):19-24.
15. Thakur PS, Thakur A, Kanaujia SP, Thakur A. Reversal of water stress effects in mulching impact on the performance of *Capsicum annum* under water deficit. *Indian Journal of Horticulture*. 2000 ;57:250-254.
 16. Maged A, El-Nemr. Department of vegetable research, National Research Centre, Dokki, Cairo, Egypt; 2006.
 17. Praveen Kumar RS, Chauhan RK, Grover. Comparative economics of cucumber cultivation under polyhouse and open field conditions in Haryana. *Indian Journal of Economics and Development*. 2015;3(7).

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