

Effect of Plastic Mulches and Botanicals on Growth and Physiological Attributes of Okra

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ABSTRACT: Plastic mulches can play an important role in pest control by light reflection repels and additionally the high temperature generated reduces the incidence of diseases. The cultivation of okra by the use of synthetic chemicals which affects the human health as well as the environment. Plant extracts (botanicals) have potentiality to manage the plant pests and diseases which is more efficient, eco-friendly and cost effective as compared to chemicals. A field experiment was conducted at Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, India during summer season of 2021 and 2022 to find out the effect of plastic mulches and botanicals on growth and physiological attributes of okra. The experiment was laid out in Factorial Randomized Complete Block Design (FRCBD) with three replications. There were two factors, in which first factor with four levels of coloured plastic mulches and second factor with five levels of botanicals spray. From the present study, it was found that the treatment comprising of silver plastic mulch along with foliar spray of *Azadirachta indica* leaf extract (5 %) were found most effective in increasing plant height (117.81 cm) at final harvest, number of branches per plant (4.57), total leaf chlorophyll content (37.99 mg/ 100g) and leaf area index (3.03) over other treatments. It might be recommended for the terai region of West Bengal.

Keywords: *Azadirachta indica*, Botanicals, Growth, Plastic mulch, Okra.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an important fruit vegetable crop cultivated in tropical, subtropical, and mild temperate parts of the world and belongs to the family Malvaceae. It is rich source of protein, calcium, potassium, and iodine (Agbo *et al.*, 2008). It is rich in fibre and an excellent source of mineral iodine which helps in control of goitre (Yawalkar, 1965). Tender pods of okra are used as delicious vegetable. To a limited extent, it is used in canned, dehydrated, and frozen form. Okra is grown during summer and rainy seasons. During summer season, the temperature is high and soil moisture is important during this time. Plastic mulches alter the plant's growing environment by generating warmer soil temperatures, holding soil moisture, reducing weed growth thus making more availability of nutrients to the plant, which ultimately induces better growth of plants (Lamont, 1993; Dodds *et al.*, 2003; Hanna *et al.*, 2003). Plant extracts have antimicrobial activity and feeding deterrents. Neem (*Azadirachta indica*) is a promising agent for the control of plant virus such as "Yellow vein mosaic of okra". It contains azadirachtin and these have antimicrobial activities, also used as abortifacient, an antiseptic, a purgative, a diuretic, an insect repellent.

Neem and garlic gave a good degree of suppression of yellow vein mosaic virus symptoms on okra sprayed under field conditions (Bhyan *et al.*, 2007). Researchers are trying to evaluate different plant extracts (botanicals) to control plant diseases, which do not affect the human health. An eco-friendly management such as plant extracts are now used to manage the plant diseases which is more efficient and cost effective as compared to chemicals (Yadav *et al.*, 2023; Sarabani *et al.*, 2002). Therefore, keeping in view the above facts, the present investigation was carried out with the objective to evaluate the effect of plastic mulches and botanicals on growth and physiological attributes of okra.

MATERIALS AND METHODS

The experiment was carried out at Uttar Banga Krishi Viswavidyalaya, West Bengal, India (26°19' N latitude and 89°23' E longitude at an elevation of 43 meters above MSL) during summer season of 2021 and 2022. The climatic condition of the region was subtropical with high rainfall and high humidity. The field experiment comprised of two factors, in which first factor with four levels of coloured plastic mulches and second factor with five levels of botanicals spray. First factor (coloured plastic mulches): M₀ – No mulch; M₁ –

Black plastic mulch; M₂ – Silver plastic mulch; M₃ – Blue plastic mulch, and second factor (only foliar application): B₀ – No botanical spray; B₁– *Azadirachta indica* leaf extract (5%); B₂– *Allium cepa* extract (5%); B₃– *Allium sativum* extract (5%); B₄ – *Zingiber officinale* extract (5%). The plot size was 3 m x 3 m with a spacing of 60 cm x 60 cm. The land was brought to a fine tilth through tillage and ploughing. Bunds and irrigation channels were prepared and different coloured plastic mulches were installed based on the treatments. The okra seeds were sown directly to the field and light irrigation was provided after sowing. All other recommended cultural practices were followed to raise healthy crop.

A. Method of preparation of plant extracts (botanicals)

Fresh neem leaves, onion bulbs, garlic cloves and ginger were thoroughly washed with tap water followed by washing with sterilized water. Stock solution from the freshly collected plant materials were prepared by crushing 5 gram each in mortar and pestle and soaked in 100 ml water at 25°C for about 3 days. After 3 days, the extracts were filtered through muslin cloth followed by Whatman filter paper no. 1. From this, 5 ml of the concentrated solution was taken and 95 ml distilled water was added into it to prepare 5 % concentration (Khan *et al.*, 2000; Vasava and Patel 2020).

B. Statistical analysis

Two years data were collected from various treatments which were subjected to statistical analysis by adopting the randomized block design (RBD) as recommended by Panse and Sukhatme (2000) with the help of OPSTAT statistical package. The data for individual year was used for pooled analysis over two years and the mean were compared at 0.05 levels for statistical significance (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

A. Effect of plastic mulches and botanicals on growth of okra

There was a significant enhancement in plant height due to the application of plastic mulches and botanicals. Pooled data (Table 1) clearly indicated that, the application of silver plastic mulch + foliar spray of *Azadirachta indica* leaf extract (5%) (M₂B₁) recorded maximum plant height (117.81 cm) at final harvest followed by the application of silver plastic mulch + foliar spray of *Allium sativum* extract (5%) (M₂B₃) having plant height of 110.67 cm. The lowest plant height (82.48 cm) was recorded with No mulch + No botanical spray (M₀B₀). The data pertaining on number of branches per plant of okra has been presented in Table 1. The application of silver plastic mulch + foliar spray of *Azadirachta indica* leaf extract (5%) (M₂B₁) recorded maximum number of branches per plant (4.57) followed by the application of silver plastic mulch +

foliar spray of *Allium sativum* extract (5%) (M₂B₃) having number of branches per plant of 4.45. The minimum number of branches per plant (3.24) was recorded with No mulch + No botanical spray (M₀B₀). The improvement in growth characters as a result of using silver plastic mulch might be due to improved moisture conservation during entire growth period of okra. The enhancement in photosynthesis and other metabolic activities, and enhanced soil microorganism activity resulting in more availability of nutrients which ultimately lead to improved plant growth. The improvement of growth parameters due to the application of botanicals might be due to the presence of possible growth hormones present in them. Similar findings were reported by Ogunlana (1995); Bhatt *et al.* (2011); Parmar *et al.* (2013).

B. Effect of plastic mulches and botanicals on physiological attributes of okra

Pooled data (Table 2) revealed that, the application of silver plastic mulch + foliar spray of *Azadirachta indica* leaf extract (5%) (M₂B₁) recorded maximum total leaf chlorophyll content (37.99 mg/ 100g) followed by the application of silver plastic mulch + foliar spray of *Allium sativum* extract (5%) (M₂B₃) having total leaf chlorophyll content of 37.07 mg/ 100g. The lowest total leaf chlorophyll content (27.12 mg/ 100g) was recorded with No mulch + No botanical spray (M₀B₀). Similar results were also reported by Panchal *et al.* (2001) who found that mulch had significant effect on total chlorophyll contents. The observations recorded on leaf area index of okra has been presented in Table 2. The application of silver plastic mulch + foliar spray of *Azadirachta indica* leaf extract (5%) (M₂B₁) recorded maximum leaf area index (3.03) followed by the application of silver plastic mulch + foliar spray of *Allium sativum* extract (5%) (M₂B₃) having leaf area index of 2.92. The lowest leaf area index (2.23) was recorded with No mulch + No botanical spray (M₀B₀). Mulching modifies soil temperatures (reducing the gap between maximum and minimum soil temperatures), which affects soil microbial activities. The enhancement in soil microbial activities might be due to the increasing soil organic carbon content due to mulching which is considered as one of the major constituents of food supply for micro-organisms. The increased microbial population which in turn enhanced the plant growth parameters viz., leaf chlorophyll content, leaf area index, plant height and number of branches. The application of plastic mulches and botanicals enhanced the plant growth which ultimately improved the photosynthetic capacity in the leaves leading to more leaf area index as compared to the control. Comparable results were observed by Sharma *et al.* (2023); Kayum *et al.* (2008); Bhatt *et al.* (2011); Ogunlana (1995).

Table 1: Effect of plastic mulches and botanicals on growth attributes of okra (pooled data of two years).

Treatments	Treatment details	Plant height (cm) at final harvest			Number of branches per plant		
		Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
First Factor - Mulch (M)							
M ₀	No mulch	83.25	93.20	88.22	3.05	3.69	3.37
M ₁	Black plastic mulch	99.46	105.68	102.57	3.83	4.02	3.92
M ₂	Silver plastic mulch	105.72	112.45	109.09	4.05	4.57	4.31
M ₃	Blue plastic mulch	95.00	99.83	97.41	3.76	3.59	3.67
S.Em.(±)		0.91	0.99	0.95	0.11	0.08	0.07
CD (0.05)		2.60	2.83	2.71	0.31	0.23	0.19
Second Factor – Botanicals (B)							
B ₀	No botanical spray	89.86	98.89	94.37	3.37	3.90	3.63
B ₁	<i>Azadirachta indica</i> leaf extract (5%)	102.64	106.81	104.73	3.78	4.19	3.98
B ₂	<i>Allium cepa</i> extract (5%)	93.15	100.97	97.06	3.76	3.70	3.73
B ₃	<i>Allium sativum</i> extract (5%)	97.74	104.76	101.25	3.88	3.94	3.91
B ₄	<i>Zingiber officinale</i> extract (5%)	95.90	102.53	99.21	3.59	4.10	3.84
S.Em.(±)		1.02	1.10	1.06	0.12	0.09	0.07
CD (0.05)		2.91	3.16	3.04	NS	NS	NS
Interaction (M x B)							
M ₀ B ₀	No mulch + No botanical spray	77.25	87.70	82.48	3.10	3.37	3.24
M ₀ B ₁	No mulch + <i>Azadirachta indica</i> leaf extract (5%)	88.34	97.26	92.80	3.07	3.83	3.45
M ₀ B ₂	No mulch + <i>Allium cepa</i> extract (5%)	82.37	91.79	87.08	2.97	3.70	3.34
M ₀ B ₃	No mulch + <i>Allium sativum</i> extract (5%)	84.76	96.27	90.52	3.13	3.73	3.43
M ₀ B ₄	No mulch + <i>Zingiber officinale</i> extract (5%)	83.53	92.97	88.25	2.97	3.83	3.40
M ₁ B ₀	Black plastic mulch + No botanical spray	94.81	102.13	98.47	3.43	4.07	3.75
M ₁ B ₁	Black plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	106.63	109.43	108.03	3.90	4.20	4.05
M ₁ B ₂	Black plastic mulch + <i>Allium cepa</i> extract (5%)	96.53	103.60	100.07	4.13	3.63	3.88
M ₁ B ₃	Black plastic mulch + <i>Allium sativum</i> extract (5%)	100.76	107.47	104.12	4.20	3.83	4.02
M ₁ B ₄	Black plastic mulch + <i>Zingiber officinale</i> extract (5%)	98.59	105.78	102.19	3.47	4.37	3.92
M ₂ B ₀	Silver plastic mulch + No botanical spray	97.61	107.17	102.39	3.60	4.47	4.04
M ₂ B ₁	Silver plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	116.48	119.14	117.81	4.30	4.83	4.57
M ₂ B ₂	Silver plastic mulch + <i>Allium cepa</i> extract (5%)	101.18	109.55	105.37	3.97	4.23	4.10
M ₂ B ₃	Silver plastic mulch + <i>Allium sativum</i> extract (5%)	107.00	114.33	110.67	4.27	4.63	4.45
M ₂ B ₄	Silver plastic mulch + <i>Zingiber officinale</i> extract (5%)	106.31	112.08	109.20	4.13	4.67	4.40
M ₃ B ₀	Blue plastic mulch + No botanical spray	89.75	98.57	94.16	3.33	3.70	3.52
M ₃ B ₁	Blue plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	99.11	101.42	100.27	3.83	3.90	3.87
M ₃ B ₂	Blue plastic mulch + <i>Allium cepa</i> extract (5%)	92.52	98.92	95.72	3.97	3.23	3.60
M ₃ B ₃	Blue plastic mulch + <i>Allium sativum</i> extract (5%)	98.44	100.97	99.71	3.90	3.57	3.74
M ₃ B ₄	Blue plastic mulch + <i>Zingiber officinale</i> extract (5%)	95.17	99.27	97.22	3.77	3.53	3.65
S.Em.(±)		2.03	2.21	2.12	0.24	0.18	0.15
CD (0.05)		5.82	6.32	6.07	NS	NS	NS

Table 2: Effect of plastic mulches and botanicals on physiological attributes of okra (pooled data of two years).

Treatments		Total leaf chlorophyll content (mg/ 100g)			Leaf area index		
		Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
First Factor - Mulch (M)							
M ₀	No mulch	27.78	29.23	28.51	2.23	2.62	2.43
M ₁	Black plastic mulch	34.16	34.89	34.52	2.37	2.73	2.55
M ₂	Silver plastic mulch	35.85	36.21	36.03	2.69	2.93	2.81
M ₃	Blue plastic mulch	31.97	32.52	32.24	2.62	2.83	2.72
S.Em.(±)		0.37	0.43	0.37	0.04	0.04	0.04
CD (0.05)		1.07	1.24	1.05	0.11	0.12	0.12
Second Factor – Botanicals (B)							
B ₀	No botanical spray	30.71	31.38	31.04	2.22	2.54	2.38
B ₁	<i>Azadirachta indica</i> leaf extract (5%)	33.83	34.89	34.36	2.68	3.04	2.86
B ₂	<i>Allium cepa</i> extract (5%)	31.62	32.32	31.97	2.36	2.70	2.53
B ₃	<i>Allium sativum</i> extract (5%)	33.35	34.27	33.81	2.62	2.85	2.73
B ₄	<i>Zingiber officinale</i> extract (5%)	32.69	33.21	32.95	2.51	2.77	2.64
S.Em.(±)		0.42	0.48	0.41	0.04	0.05	0.05
CD (0.05)		NS	NS	NS	NS	NS	NS
Interaction (M x B)							
M ₀ B ₀	No mulch + No botanical spray	26.11	28.12	27.12	2.03	2.44	2.23
M ₀ B ₁	No mulch + <i>Azadirachta indica</i> leaf extract (5%)	28.95	30.13	29.54	2.42	2.79	2.60
M ₀ B ₂	No mulch + <i>Allium cepa</i> extract (5%)	27.32	29.04	28.18	2.07	2.52	2.29
M ₀ B ₃	No mulch + <i>Allium sativum</i> extract (5%)	28.48	29.88	29.18	2.35	2.73	2.54
M ₀ B ₄	No mulch + <i>Zingiber officinale</i> extract (5%)	28.06	28.99	28.53	2.30	2.65	2.47
M ₁ B ₀	Black plastic mulch + No botanical spray	32.39	32.34	32.37	2.11	2.47	2.29
M ₁ B ₁	Black plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	35.39	37.08	36.24	2.54	3.27	2.90
M ₁ B ₂	Black plastic mulch + <i>Allium cepa</i> extract (5%)	33.28	33.64	33.46	2.26	2.53	2.39
M ₁ B ₃	Black plastic mulch + <i>Allium sativum</i> extract (5%)	35.00	36.23	35.62	2.54	2.75	2.64
M ₁ B ₄	Black plastic mulch + <i>Zingiber officinale</i> extract (5%)	34.72	35.15	34.93	2.44	2.63	2.53
M ₂ B ₀	Silver plastic mulch + No botanical spray	34.10	33.65	33.88	2.36	2.64	2.50
M ₂ B ₁	Silver plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	37.63	38.34	37.99	2.92	3.15	3.03
M ₂ B ₂	Silver plastic mulch + <i>Allium cepa</i> extract (5%)	34.94	35.07	35.01	2.60	2.97	2.78
M ₂ B ₃	Silver plastic mulch + <i>Allium sativum</i> extract (5%)	36.76	37.38	37.07	2.87	2.98	2.92
M ₂ B ₄	Silver plastic mulch + <i>Zingiber officinale</i> extract (5%)	35.82	36.61	36.22	2.70	2.95	2.82
M ₃ B ₀	Blue plastic mulch + No botanical spray	30.23	31.40	30.81	2.38	2.61	2.49
M ₃ B ₁	Blue plastic mulch + <i>Azadirachta indica</i> leaf extract (5%)	33.34	34.02	33.68	2.84	2.96	2.90
M ₃ B ₂	Blue plastic mulch + <i>Allium cepa</i> extract (5%)	30.96	31.52	31.24	2.52	2.81	2.66
M ₃ B ₃	Blue plastic mulch + <i>Allium sativum</i> extract (5%)	33.15	33.57	33.36	2.73	2.94	2.83
M ₃ B ₄	Blue plastic mulch + <i>Zingiber officinale</i> extract (5%)	32.17	32.09	32.13	2.63	2.85	2.74
S.Em.(±)		0.84	0.97	0.82	0.09	0.10	0.09
CD (0.05)		NS	NS	NS	NS	NS	NS

CONCLUSIONS

From the above findings, it is concluded that the treatment comprising of silver plastic mulch along with foliar spray of *Azadirachta indica* leaf extract (M₂B₁) found most effective in increasing plant height, number of branches per plant, total leaf chlorophyll content and leaf area index of okra over other treatments. Therefore, the cultivation of okra using silver plastic mulch along with foliar spray of *Azadirachta indica* leaf extract might be recommended for the terai region of West Bengal.

FUTURE SCOPE

The studies can be conducted using some more different coloured plastic mulches. Other mulching materials like uprooted and dried weeds, straw of previous crops, etc. can also be studied for their effect on okra crop cultivation. Further research study on the use of neem seeds compared with the leaf extracts and rate of application is needed.

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Conflict of Interest. None.

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