Effect of environment as influenced by mulches on yield attributes and yield of seed cotton on MCU 5 (*Gossypium hirsutum*)[1] /

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Compendio

*En la Universidad Agrícola Tamil Nado, Coimbatore, India, se realizó un experimento para estudiar el efecto del hule negro, hule blanco y la paja de mijo perla (*Pennisetum thyphoides*) empleados como cobertura inerte, o "mulches", en la variedad MCU 5 de algodonero durante el periodo 1974–1975. Se encontró que la caída de las flores aumentó debido a las lluvias y al incremento repentino de temperaturas matinales microclimáticas. El rendimiento de la semilla de algodón fue significativamente mayor en los tratamientos que contaron con la cobertura inerte que en el tratamiento testigo. El porcentaje de incremento fue de 44.5, 42.2 y 14.2 para las coberturas inertes formadas por hule blanco, mijo perla y hule negro, respectivamente.*

Introduction

Among the several factors governing cultivation of cotton, climate and soil play a vital role as in the case of other crops. Sikka and Dastur (4) observed that rainfall and temperature are the most important among the climatic factors that influence the cultivation of cotton and that the quantity of distribution of rainfall alone accounts for 60 to 70 per cent in the annual fluctuation in the Indian cotton production. They have identified adequate moisture, minimum temperature above 60°F during germination, day temperature of 70 to 80°F during vegative period and a day temperature ranging from 80 to 90°F and cool nights during the fruiting period as optima for the best results. The crop can stand day temperatures even as high as 110 to 115°F, but irrigation is required under such conditions. Mulches were applied to crops from the dawn of agriculture, mainly with a view to conserve the soil and moisture. The effect of mulches changing the environment of microclimate on cotton have not been studied so far except by Geiger (2) on forest litter. The potentiality of the mulches in effecting a change in the environment depends on the colour, texture and nature of the mulches. The black and white rubber wastes and the easily available pearl millet (*Pennisetum typhoides*) straw by virtue of their different colour and physical properties could produce a different environment. These have been taken into consideration to study the response of cotton plant to such modifications of the environment as manifest in flower production, flower shedding, boll number and yield on MCU 5 cotton under irrigation at the Tamil Nadu Agricultural University, Coimbatore, India.

Materials and methods

Coimbatore is situated at 11°N and 77°E at an altitude of 498 m above mean sea level with an annual average rainfall of 644 mm. The experiment was conducted in the fields of the Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore campus. The soil is clay loam type with low availability of N and P_2O_5 and high K_2O content.

The treatments adopted were (i) control (no mulch), (ii) black rubber waste, (iii) white rubber waste and (iv) pearl millet (*Pennisetum typhoides*) straw. The rubber wastes are factory rejects of the tyre industry. The black material was in the form of 5 mm x 5 mm x 30 cm long strands. The white rubber waste was in the form of flats of 5 mm thickness, 30 cm long and 15 to 30 cm broad. The pearl millet straw was made into small bundles of 5 to 6 plants so that they could not be disturbed by wind. The experiment was laid out during the winter

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season of 1974-1975 in a randomised block design with seven replications.

The variety MCU 5 having a duration of 165 days was chosen for the study. The seeds were sown on 13, VIII, 1974 at the rate of two seeds per hole adopting a spacing of 75 x 22.5 cm. The thinning was done on the 15th day of sowing thus leaving one seedling per hill. The recommended fertilizer dose of 60 kg N, 30 kg P_2O_5 and 30 kg K_2O/ha was applied as per recommendation. The mulches were applied on 22, IX, 1974, i,e. 41 days after sowing. White and black rubber wastes were spread at the rate of 31.0 ton/ha, while 7.1 ton/ha alone was used in the case of pearl millet straw. Irrigation and plant protection were carried out at the recommended levels. Soil temperature at 5 cm depth, temperature of the mulch and above mulch and air temperature were recorded daily at 06.30 and 14.30 hours Indian Standard Time. The following characters were studied:

i) **No. of flowers per plant:** The fully opened flowers in plot were counted daily for a period of 49 days from 13, X, 1974 to 30, XI, 1974 and expressed as flowers per plant per week.

ii) **No. of dropped floral parts:** The number of flowers, squares and bolls dropped were counted from 11th to 17th week and expressed as total floral drops per plant.

iii) **No. of bolls per plant:** This was counted at each harvest from 121st day at weekly intervals and expressed as total number of bolls per plant.

iv) **Yield of seed cotton:** The picking of cotton seed commenced on 11, XII, 1974 and ended on 15, I, 1975 with six weekly pickings and expressed in kg/ha.

Results and discussion

Number of flowers per plant: The effect of mulch treatment from the first day of commencement 13, X, 1974 (9th week) to 30, XI, 1974 (15th week) is presented in Table 2. It was seen that flowering commenced under all treatments on the 62nd day (13, X, 1974) after sowing. The total number of flowers produced per plant in all the treatments were equal indicating that this character is controlled by genetic factors rather than environmental factors. The rate of production is altered to some extent by the environmental changes produced by the treatments. In black rubber, the number of flowers produced during the 9th week was maximum, followed by white rubber mulch and remained high in black rubber up to 14th week and a sudden decline at 15th week. Similar trend was noticed in the control plot with a slow pace. In the case of white rubber and pearl millet straw the flower production continued unabated even during the 15th week. It appeared that the higher temperature in the afternoon in black rubber and control was conducive for earlier production of flowers and the lower temperature in white rubber and pearl millet straw prolonged the duration of flower production (Table 1).

Number of dropped flowers per plant: The effect of treatments on this character are presented in Table 2. In all the weeks, the total drop of flowers was highest in the control plot and the least in pearl millet straw mulch. Dunlap (1) attributed the cause for flower drop to the physiological, environmental, and physical damage due to the injury caused by insects and diseases, more than to other factors. In all the treatments the drop of flowers was maximum during the 15th week. Mason (3) has observed that dark rainy days during the later stage of plant growth were the invariable precursors of the augmented rates of shedding of flowers and bolls. Among the treatments the maximum drop (7.04) was in control. The temperature above the surface in the mornings were 17.9, 18.7, 19.0 and 19.4°C in control, white rubber, black rubber and pearl millet straw respectively. It is seen clearly that the flower drop has decreased with

Table 1. Range of soil temperature in centigrade from 7th to 17th week.

Treatments	Morning soil temperature range in °C			Afternoon soil temperature range in °C		
Mulches	From	To	Mean	From	To	Mean
Control – No mulch	21.4	25.9	23.7	30.0	42.5	36.3
Black rubber	23.1	26.5	24.4	28.3	33.5	30.9
White rubber	22.7	26.4	24.6	28.0	32.8	30.4
Pear millet straw	27.7	26.4	24.4	27.5	32.7	30.2

Table 2. Effect of treatments on number of flowers and dropped floral parts per plant in different weeks.

Treatments	Weeks									
	9	10	11	12	13	14	15	16	17	Total
					Number of flowers per plant					
Control – No mulch	0.87	3.53	3.94	3.89	3.99	4.30	3.65			24.17
Black rubber	1.27	3.61	4.21	4.03	4.49	4.70	2.11			27.42
White rubber	1.01	3.43	3.67	3.84	4.19	4.05	4.31			24.50
Pearl millet straw	0.87	3.49	3.53	3.91	4.03	4.13	4.46			24.42
Mean	1.01	3.52	3.84	3.92	4.18	4.30	3.63			24.42
					Number of dropped floral parts per plant					
Control – No mulch			0.06	0.20	1.28	2.94	7.04	3.39	0.64	15.55
Black rubber			0.04	0.23	1.11	1.85	5.05	2.28	0.42	10.98
White rubber			0.03	0.15	0.93	1.87	5.08	2.03	0.38	10.47
Pearl millet straw			0.02	0.18	0.79	1.49	4.12	1.55	0.25	8.40
Mean			0.04	0.19	1.03	2.04	5.32	2.31	0.42	

	No. of Flowers		No. of dropped floral parts	
	S.E.	C.D. (5%)	S.E.	C.D. (5%)
Treatments	0.04	N.S.	0.05	0.13
Weeks	0.06	0.18	0.06	0.17
Interaction	0.12	0.35	0.12	0.34

N. S. Not significant

increase in microclimatic temperature in the morning. Thus microclimate appears to hold the key in the physiology of flower drop though soil temperature and associate factors may have some effect. Further, the afternoon soil temperature from 7th to 17th week (Table 1) also clearly showed that an increase in temperature increased the flower drop. Dunlap (1) found high shedding rate for the plants exposed to high temperature in six varieties in Texas.

Number of bolls per plant: The effect of treatments on the boll number per plant are furnished in Table 3. It was found that the boll number was highest under black rubber mulch without differing with pearl millet straw. The least number of bolls were obtained in control. It was seen that the absolute variation of soil temperatures, namely the difference between the highest and the lower temperatures experienced by the crop during the 7th to 23 rd week may have an effect on the number of bolls. The absolute variations were 21.3, 11.6, 11.3 and 11.8°C in control, black rubber, white rubber and pearl millet straw respectively. The differences of soil temperature variation between black and white rubber mulch is only small but the differences in the number of productive bolls is statistically significant. The higher number of bolls in white rubber may be due to the higher light reflectivity of white in contrast to black. The reflection of incident sunlight by white rubber would have increased the light intensity in the under surface of the leaves of cotton and this might have contributed to the increase in number of productive bolls when compared to black. Dunlap (1) has observed that the fruiting processes are considerably inhibited by the reduced amount of light.

Yield of seed cotton: The yield of seed cotton, picking wise and the total seed cotton yield due to the treatments are presented in Table 3. It may be seen that the mulched plots gave higher yield than control. The highest yield of 2 133 kg/ha was obtained in white rubber mulch followed by pearl millet straw, black rubber and control. The per cent increase over control being 44.5, 42.1 and 14.2 in the case of white rubber, pearl millet straw and black rubber respectively. Considering the yield of seed cotton at each picking, it is seen that the control plot gave a slightly higher yield than white rubber in the first picking, while maximum yield was recorded in pearl millet straw. In the subsequent pickings the control plot gave the least yield. The yield progres-

Table 3. Effect of treatments of seed cotton yield and number of bolls per plant.

Treatments	Seed cotton yield at different pickings (kg/ha)						Total seed cotton yield kg/ha	Number of bolls per plant
Mulches	I	II	III	IV	V	VI		
Control – No mulch	215	350	392	326	114	79	1 476	10.8
Black rubber	220	360	452	411	149	94	1 686	12.3
White rubber	207	395	610	567	223	131	2 133	14.8
Pearl millet straw	264	463	552	488	204	126	2 097	14.2
Total	906	1 568	2 006	1 792	690	430		
	Treatment		Picking		Interaction			
S. E.	6		8		16		39	0.6
C. D. (5%)	17		21		45		115	1.9

sively increased up to the third picking and decreased thereafter in all treatments. This may be due to the inherent character of this variety.

It is seen that the mean soil temperature for the whole period from 7th to 23rd week viz., the mean of the temperature recorded in the minimum and maximum epochs in the early morning and afternoon in the respective treatments were 28.9, 17.3, 26.9 and 26.5°C in control, black rubber, white rubber and pearl millet straw respectively. The yield has increased with a decrease in temperature, except in pearl millet straw, which gave a slightly lower yield. This may be due to the nature of the absolute variation of temperatures during the entire period. The higher variation of 21.5°C was noted in control, ranging from 20.8 to 42.5°C and the yield was the lowest. On the other hand in the mulched plots this absolute range of variation was 11.6°C in black rubber, 11.3°C in white rubber and 11.8°C in pearl millet straw. Under these lower ranges, higher yields have been obtained. However, the yield in black rubber was not as high as in the other mulches. This may be attributed to higher temperature in the afternoon ranging from 28.3 to 33.5°C than in either white rubber (28.0 to 32.8°C) or in pearl millet straw (27.5 to 32.9°C). A slightly lower yield in pearl millet straw than in white rubber may be due to a slightly wider variation in the absolute range of temperature by 11.8°C from 21.1 to 32.9°C than in white rubber in which the range was 11.3°C from 21.5 to 32.8°C. The morning temperature was slightly higher and afternoon temperature was slightly lower in white rubber, than in pearl millet straw. This might have contributed for higher yield.

In addition to soil temperature the temperature prevailing near the hypocotyl region of the plants may also affect the yield. Within the mulches, the highest temperature in the afternoon during the period from the 10th to 18th weeks i.e. from the commencement flowering to the first picking was 44.2, 36.8 and 38.2°C in black rubber, white rubber and pearl millet straw respectively. The yield in the mulched plot was found to decrease with increase in the afternoon temperature within mulch. Therefore the lower yield in pearl millet straw when compared to white rubber may be due to the higher temperature.

Summary

The effect of mulches on the modification of the environment in the vicinity of the cotton plant and its response to flower production, flower shedding, number of bolls and yield of seed cotton was studied by the application of black rubber, white rubber and pearl millet straw as mulches on MCU 5 cotton under irrigation during 1974-1975 winter season at the Tamil Nadu Agricultural University, Coimbatore campus, India. The rate of flower production up to 13th week was high and declined rapidly thereafter in black rubber mulch and control due to the higher temperature in the soil and plant than other mulches. The shedding of flowers increased due to rainfall and sudden decrease in morning microclimatic temperature. The reduction in fluctuation of soil temperature appeared to increase the number of bolls in the mulched plots. The yield of seed cotton increased significantly in all the mulches over control. The increase over control was 44.5, 42.1 and 14.2 per cent in white rubber, pearl millet straw and black rubber respectively. The yield was found to increase with a decrease in mean soil temperature, as well as the range of variations of temperature.

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