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GROWTH AND PRODUCTIVITY OF IRRIGATED COTTON A S INFLUENCED BY SEASON, INTERCROPPING SYSTEM AND WEED MANAGEMENT PRACTICES

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ABSTRACT

Field experiments were conducted at Agricultural College and Research Institute, Madurai during summer 2016 and winter 2016-17 to evaluate the different intercropping systems and weed management practices on growth and yield of irrigated cotton. Results of the study revealed that, sole cotton recorded taller plants (97.3 and 106.2 cm), higher, leaf area index (2.86 and 3.02), dry matter production (3829 and 4128 kg ha^{-1}), crop growth rate (4.37 and 4.85 g m^{-2} day^{-1}), relative growth rate (0.0157 and 0.0151 g g^{-1} day^{-1}) during both the seasons. With regard to weed management practices, hand weeding twice at 20 and 40 DAS recorded taller plants (105.0 and 116.5 cm), higher, leaf area index (3.34and 3.59), dry matter production (4409 and 4666 kg ha^{-1}), crop growth rate (4.95 and 5.48 g m^{-2} day^{-1}), relative growth rate (0.0169 and 0.0131 g g^{-1} day^{-1}) during Summer 2016 and Winter 2016-17.Higher mean seed cotton yield of 1520 kg ha^{-1} was recorded in sole cotton and it was on par with cotton + sesame intercropping system. Among the weed management practices, hand weeding twice at 20 and 40 DAS recorded higher seed cotton yield (1709 kg ha^{-1}). This was comparable with pre-emergence (PE) application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS. Cotton + sunflower intercropping system with PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS and cotton + sesame intercropping system with PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS was found to be beneficial for better in weed control, higher yield and economic returns.

(Key words: Crop growth rate, intercropping, seed cotton yield, weed management)

INTRODUCTION

Cotton is the most remunerative and important cash crop of India. Among the various factors responsible for deplorably low yield of irrigated cotton, severe weed infestation is important particularly in India. Initial slow growth, wide row spacing, high dose of chemical fertilizers combined with prostate nature of its growth permit early and severe crop-weed competition resulting in loss of yield to the tune of 45 to 85% (Das, 2008). At present, manual weeding has become costly due to scarcity of labourers and hence it has become extremely difficult to keep the crop weed free. Effective and economical weed control in irrigated cotton is possible through integrating different weed management methods (Patel *et al*., 2014).Intercropping is the growing of two or more crops simultaneously in the alternative rows on the same piece of land in order to utilize available resources efficiently and obtaining more production unit-1 (Lithourgidis *et al*., 2011).The importance of highly intensive crop sequence is well recognized to meet the growing demands of ever increasing population (Ezung *et al*., 2020). Two crops differing in rooting ability, nutrient requirements, height and canopy grow simultaneously with least competition (Lithourgidis *et al*., 2006). Weed density and biomass may substantially be reduced through intercropping(Poggio, 2005).Conversion of modern chemically intensive agriculture to a sustainable form of agriculture like organic farming appears to be a viable option for maintaining the desirable agricultural production in future (Ezung *et al.*, 2021). Hence, the present investigation was undertaken to evaluate the different intercropping system and weed management practices on growth and yield of irrigated cotton.

MATERIALS AND METHODS

Field experiments were conducted at Agricultural College and Research Institute, Madurai during summer 2016 and winter 2016-17. The main plot comprised of four intercropping systems, I1- cotton + sorghum (1:1), I2 - cotton + sunflower (1:1), I3 - cotton + sesame (1:1), I4- sole cotton, and six weed management practices as sub plots, W1 - *Prosopis juliflora* leaf extract 30% pre-emergence application + one hand weeding on 40 days after seeding (DAS), W2 - *Annona squamosa* leaf extract 30% PE + one hand weeding on 40 DAS, W3 - *Mangifera indica* leaf extract 30% PE + one hand weeding on 40 DAS, W4 - pendimethalin 1.0 kg ha^{-1} PE + one hand weeding on 40 DAS, W5 - two hand weedings at 20 and 40 DAS, W6 - control (no weeding or

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spray). The experiments were laid out in a split plot design with three replications. Healthy and viable seeds of cotton variety 'SVPR 4' were sown as base crop at the rate of 15 kg ha^{-1}. Main cotton crop was sown with row to row spacing of 75 cm and plant to plant spacing of 30 cm, on the same day intercrops were sown in between two rows of cotton crop following 1:1 ratio for main and intercrops. Pre-emergence application of pendimethalin at 1.0 kg ha^{-1} was done at 3 DAS. The plant to plant spacing adopted for intercrop was 30 cm. Leaves of *Prosopis juliflora*, *Annona squamosa* and *Mangifera indica* at vegetative stage were collected and washed gently with tap water for a few seconds to remove contaminants like dust etc. The fresh leaves of above species were cut into small species, soaked in alcohol and water 1:1 proportion and kept for overnight. After 12 hours, soaked leaves were ground with the help of mixer grinder. From the paste, the leaf extract of each botanical species was prepared by filtration which represented 100% stock solution (Sripunitha, 2009). From the stock solution, 30% concentration was prepared and sprayed on 3 DAS by using knapsack sprayer as per the treatment schedule. The plant height, leaf area index, dry matter production, crop growth rate and relative growth rate were measured at 120 DAS. Seed cotton obtained from net plot area was shade dried, weighed at each picking and yields of all pickings were added and expressed as kg ha^{-1}. The leaf area index, crop growth rate and relative growth rate were calculated using the following formula.

Leaf area index (Ashley *et al.,* 1963)

$$LAI = \frac{L \times W \times N \times 0.775}{\text{Land area } (cm^2) \text{ occupied by one plant}}$$

Where,

L = Length of the leaf in cm

W = Width of the leaf in cm

N = Number of leaves $plant^{-1}$

0.775 = Constant factor

Crop growth rate (Watson, 1958)

$$CGR = \frac{W2 - W1}{P\,(t2-t1)}$$

Where,

W1 and W2 - Whole plant dry weight at time t1 and t2

P - Land occupied by the plant

t1 and t2 - Time interval in days

Relative growth rate (Enyi, 1962)

$$RGR = \frac{\text{Loge } W2 - \text{Loge } W1}{t2 - t1}$$

Where,

W1 - Whole plant dry weight at t1

W2- Whole plant dry weight at t2

t1 and t2 - Time interval in days

RESULTS AND DISCUSSION

Plant height

The plant height of cotton was significantly influenced by intercropping system and weed management practices (Table 1). The Taller plant of cotton (97.3 and 106.2 cm during Summer 2016 and Winter 2016-17) was recorded in sole cotton and it was comparable with cotton + sesame intercropping system. The taller plant was attributed to penetration of light and circulation of air in the canopy of cotton and comparatively more area available to sole cotton to forage for nutrients and to harness solar radiation. Shorter plant of cotton was noticed under cotton + sorghum intercropping system. Growing of intercrops significantly reduced the plant height of cotton. The maximum reduction (19.7 and 17.1% during summer 2016 and Winter 2016-17) was observed under cotton + sorghum intercropping system. The reduced plant height of cotton under sorghum and sunflower intercropping systems may be attributed to increased plant population $unit^{-1}$ area and interference by allelopathic crops. Similar trend of reduction in plant height due to intercropping of sorghum and sunflower was reported by Aladakatti *et al.* (2011).Among the different weed management practices, hand weeding twice at 20 and 40 DAS (W5) registered the taller plant of cotton (105.0 and 116.5 cm during both the years respectively) which was followed by PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS. This might be due to better weed control in the above treatments which resulted in efficient utilization of light, water and nutrients than other treatments. Besides, proper aeration in the root zone might have enabled roots to explore their maximum potential in the presence of very less competition offered by weeds. Favourable influence of hand weeding on plant height of cotton was observed by Malarkodi (2013). Shorter plant was recorded under control.

Leaf area index

Measurement of leaf area is a basic tool for growth analysis and it is directly related to both biological and economical yield (Table 1).Among the cropping systems, maximum leaf area index was registered under sole cotton with 2.86 and 3.02 during the Summer 2016 and Winter 2016-17 which was followed by cotton + sesame intercropping system. Cotton + sorghum intercropping system registered lesser LAI of 1.81 and 2.00 during both the years. The increase might have been brought by the taller plants producing more foliage leading to greater leaf area index. Cotton intercropped with sorghum recorded lower LAI (36.7 and 33.8% during Summer 2016 and Winter 2016-17) during both the years of investigation and such reduction in leaf area index of cotton might be due to competitive and suppressive effect of intercrops resulting in lean and lanky plants with lesser leaf area and foliage. Similar finding of reduced LAI under cotton intercropped with cluster bean was reported by Harisudan (2007).Among the weed management practices, hand weeding twice at 20 and 40 DAS exerted a significant influence on LAI by recording

3.34 and 3.59 during both the seasons. It was followed by PE application of pendimethalin at 1.0 kg ha^{-1} + hand weeding at 40 DAS. Increase in LAI of cotton crop was due to the better weed control that promoted the cotton plant to utilize the resources in a better way and solar radiation without any interference. This is in accordance with the findings of Malarkodi (2013).The minimum leaf area index (1.34 and 1.43 during both the years) was recorded under control.

Dry matter production

Different intercropping system and weed management techniques significantly influenced the dry matter production (DMP) of cotton (Table 2).Higher DMP was noticed under sole cotton which registered 3829 and 4128 kg ha^{-1}during both the seasons and it was comparable with intercropping of cotton during both the years. Lower DMP was registered under intercropping of cotton + sorghum. Increase in DMP with sole cotton is attributed to increase in plant height and LAI and thus in total biomass. This might be also due to its influence on photosynthesis, which could have led to accumulation of more dry matter as reported by Angrej and Thakar (2015). Dry matter production was decreased in cotton intercropped with sorghum, sunflower and sesame than sole cropping during both the years. Maximum reduction of dry matter production was registered with cotton + sorghum intercropping system (36.7 and 37.5% during Summer 2016 and Winter 2016-17) than sole cropping during both the years. This might be due to competition for utilization of available resources *viz.*, nutrient, moisture and solar radiation to a greater extent and accumulation of photosynthates, as the dry matter production was mainly influenced by assimilatory surface area and its photosynthetic ability (Sankaranarayanan *et al*., 2012).Among the weed management practices, hand weeding twice at 20 and 40 DAS recorded higher DMP of 4409 and 4666 kg ha^{-1}during Summer 2016 and Winter 2016-17and it was followed by PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS.This might be due to effective control of all the weeds at critical stages and suppression of late emerged weeds by second hand weeding at 40 DAS with greater nutrient uptake and vigorous growth of cotton crop. This might be also due to the fact that cotton crop without weeds could intercept more light. This resulted in more photosynthates favouring higher DMP. Similar observation of greater increase in DMP of cotton with two hand weeding was noticed by Malarkodi (2013). Lower DMP was registered by the control. Unweeded control registered lower dry matter production of cotton due to the competition by excessive weed growth. Similar finding of decrease in dry matter production of cotton by increased weed density with ineffective weed management practice was reported by Bhoi *et al.* (2007).

Crop growth rate and Relative growth rate

Crop growth rate is a function of light interception by the leaf area of crop which was used to determine the crop production (Table 2 and 3). Sole cotton recorded higher crop growth rate of 4.37 and 4.85 g m^{-2} day^{-1}during both the seasons and it was comparable with intercropping of cotton + sesame. Crop growth rate was lesser to the extent of 3.11 and 3.26g m^{-2} day^{-1} was recorded in cotton + sorghum intercropping system. Among the weed management practices, hand weeding twice at 20 and 40 DAS recorded higher CGR in cotton (4.95 and 5.48 g m^{-2} day^{-1} during both the seasons). Minimum crop growth rate of 2.86 and 2.68 g m^{-2} day^{-1} was noticed under control. The relative growth rate expresses the dry weight increase in a time interval in relation to the initial dry weight. Among the cropping systems, maximum relative growth rate (0.0157 and 0.0151 g g^{-1} day^{-1} during Summer 2016 and Winter 2016-17) was recorded by sole cotton This was comparable with intercropping of cotton + sesame and intercropping of cotton + sunflower. Lower relative growth rate (0.0134and 0.0141g g^{-1} day^{-1}) was noticed in cotton + sorghum intercropping system. In weed management practices, hand weeding twice at 20 and 40 DAS recorded significantly higher relative growth rate (0.0169 and 0.0131 g g^{-1} day^{-1} during both the years). Minimum relative growth rate (0.0131 and 0.0134 g g^{-1} day^{-1}) was recorded under control. Higher value of physiological growth parameters under sole cotton was due to the lesser competition for growth factors *viz.,* light, nutrients and space as compared to the sorghum, sunflower and sesame intercropping system. This could be also due to the accumulation of more dry matter with the enhancement of photosynthetic efficiency due to more leaf area and translocation of photo assimilates. Similar findings of increase in CGR and RGR of sole soybean were reported by Ghosh *et al.* (2006) under soybean + redgram intercropping system. Among the weed management practices, maximum CGR and RGR were recorded under hand weeding twice at 20 and 40 DAS. This might be due to effective utilization of moisture and nutrients by cotton which enabled crop plants to explore their maximum potential in with minimum pressure offered by weeds (Nalayini and Kandasamy, 2003).

Seed cotton yield

The mean data revealed that, different intercropping system and weed management practices significantly influenced the seed cotton yield (Table 3). Higher seed cotton yield of 1520 kg ha^{-1} was recorded in sole cotton and it was on par with cotton + sesame intercropping system. This might be due to vigorous and quick growth of intercrops during early vegetative stage and slow growth of cotton which caused severe competition for the available resources leading to reduced plant height, leaf area index, dry matter production and all the yield components in cotton as evidenced in this study as reported by Ravindra kumar *et al.* (2017).Intercropping of cotton + sorghum registered lower seed cotton yield of 883 kg ha^{-1}. The reduction in seed cotton yield was also attributed to significant reduction in $plant^{-1}$ growth, sympodia plant-1,number of bolls $plant^{-1}$ and boll weight. Reduction in seed cotton yield of cotton under intercropped plots may be reflective of competition and allelopathic effects of sorghum and sunflower (Aladakatti *et al*., 2011). Weed

Table1. Effect of intercropping system and weed management practices on plant height(cm) and leaf area index (LAI) of cotton during Summer 2016 and Winter 2016-17

Treatments	Plant height (cm)										Leaf area index (LAI)									
	2016					2016-17					2016					2016-17				
	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean
W_1	83.1	95.6	96.6	97.3	**93.2**	88.8	99.1	99.2	101.9	**97.3**	1.87	2.54	2.55	2.72	**2.42**	2.06	2.61	2.77	2.84	**2.57**
W_2	79.3	94.3	94.5	95.4	**90.9**	87.4	97.0	97.1	97.9	**94.9**	1.69	2.18	2.22	2.53	**2.16**	1.83	2.45	2.48	2.59	**2.34**
W_3	83.3	97.8	98.4	100.4	**95.0**	90.0	106.7	110.0	112.9	**104.9**	1.95	2.73	2.79	2.83	**2.58**	2.18	2.90	2.92	3.07	**2.77**
W_4	85.3	101.8	103.9	107.1	**99.5**	95.3	113.0	114.1	117.0	**109.9**	2.00	2.96	3.16	3.17	**2.82**	2.21	3.17	3.29	3.32	**3.00**
W_5	86.6	107.7	111.1	114.4	**105.0**	96.1	117.7	123.9	128.2	**116.5**	2.17	3.23	3.62	4.35	**3.34**	2.44	3.43	3.84	4.63	**3.59**
W_6	50.9	52.3	64.3	69.3	**59.2**	70.2	77.0	77.7	79.0	**76.0**	1.20	1.22	1.37	1.57	**1.34**	1.25	1.35	1.48	1.64	**1.43**
Mean	**78.1**	**91.6**	**94.8**	**97.3**		**88.0**	**101.8**	**103.7**	**106.2**		**1.81**	**2.48**	**2.62**	**2.86**		**2.00**	**2.65**	**2.80**	**3.02**	
	I	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**	
S.Ed	1.3	1.6	3.2	3.2		1.7	2.0	4.1	4.1		0.04	0.07	0.14	0.15		0.04	0.07	0.15	0.15	
CD(p=0.05)	3.3	3.3	6.8	6.6		4.3	4.1	8.7	8.3		0.10	0.15	0.29	0.30		0.11	0.16	0.31	0.32	

I_1- Cotton + Sorghum (1:1), I_2 - Cotton + Sunflower (1:1), I_3 - Cotton + Sesame (1:1), I_4- Sole cotton, W_1 - PE *Prosopis juliflora* leaf extract @ 30% + one HW on 40 DAS, W_2 - PE *Annona squamosa* leaf extract @ 30% + one HW on 40 DAS, W_3 - PE *Mangifera indica* leaf extract @ 30% + one HW on 40 DAS, W_4 - PE Pendimethalin @ 1.0 kg a.i. ha^{-1} + one HW on 40 DAS, W_5 - Two HW at 20 and 40 DAS and W_6 - Control (No weeding or spray)

Table 2. Effect of intercropping system and weed management practices on dry matter production(kg ha^{-1}) and crop growth rate (g m^{-2} day^{-1}) of cotton during Summer 2016 and Winter 2016-17

Treatments	Dry matter production (kg ha^{-1})										Crop growth rate (g m^{-2} day^{-1})									
	2016					2016-17					2016					2016-17				
	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean
W_1	2467	3396	3587	3684	**3284**	2622	3444	3907	4133	**3527**	3.19	3.91	4.24	4.33	**3.92**	3.38	3.70	4.58	4.89	**4.14**
W_2	2333	3027	3124	3302	**2947**	2520	3067	3244	3311	**3036**	3.04	3.64	3.73	3.84	**3.56**	3.17	3.39	3.79	3.84	**3.55**
W_3	2529	3862	3956	4071	**3605**	2671	4378	4431	4498	**3995**	3.10	4.39	4.40	4.49	**4.10**	3.35	5.27	5.44	5.45	**4.88**
W_4	2582	4226	4382	4449	**3910**	2756	4533	4733	4849	**4218**	3.20	4.67	4.76	4.80	**4.36**	3.50	5.35	5.47	5.39	**4.93**
W_5	2658	4738	5004	5236	**4409**	2800	5027	5218	5618	**4666**	3.42	5.17	5.42	5.79	**4.95**	3.50	5.79	5.90	6.71	**5.48**
W_6	1969	2005	2120	2231	**2081**	2111	2178	2240	2360	**2222**	2.73	2.79	2.92	2.99	**2.86**	2.67	2.59	2.65	2.80	**2.68**
Mean	**2423**	**3542**	**3696**	**3829**		**2580**	**3771**	**3962**	**4128**		**3.11**	**4.10**	**4.25**	**4.37**		**3.26**	**4.35**	**4.64**	**4.85**	
	I	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**	
	60	103	198	206		74	113	220	226		0.07	0.12	0.23	0.24		0.09	0.14	0.28	0.29	
CD(p=0.05)	147	208	408	417		183	228	455	457		0.17	0.24	0.48	0.49		0.23	0.30	0.59	0.60	

I_1- Cotton + Sorghum (1:1), I_2 - Cotton + Sunflower (1:1), I_3 - Cotton + Sesame (1:1), I_4- Sole cotton, W_1 - PE *Prosopis juliflora* leaf extract @ 30% + one HW on 40 DAS, W_2 - PE *Annona squamosa* leaf extract @ 30% + one HW on 40 DAS, W_3 - PE *Mangifera indica* leaf extract @ 30% + one HW on 40 DAS, W_4 - PE Pendimethalin @ 1.0 kg a.i. ha^{-1} + one HW on 40 DAS, W_5 - Two HW at 20 and 40 DAS and W_6 - Control (No weeding or spray)

Table 3. Effect of intercropping system and weed management practices on relative growth rate (g g^{-1} day^{-1}) of cotton during Summer 2016 and Winter 2016-17and mean seed cotton yield (kg ha^{-1}) of cotton during Summer 2016 and Winter 2016-17

Treatments	Relative growth rate (g g^{-1} day^{-1})										Mean seed cotton yield (Kg ha^{-1})				
	2016					2016-17					2016 and 2016-17				
	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean	I_1	I_2	I_3	I_4	Mean
W_1	0.0134	0.0146	0.0148	0.0149	**0.0144**	0.0142	0.0147	0.0147	0.0148	**0.0146**	793	1474	1517	1553	**1334**
W_2	0.0134	0.0141	0.0143	0.0145	**0.0141**	0.0141	0.0146	0.0146	0.0146	**0.0145**	739	1336	1403	1465	**1236**
W_3	0.0134	0.0153	0.0155	0.0163	**0.0151**	0.0142	0.0150	0.0151	0.0153	**0.0149**	928	1576	1607	1715	**1457**
W_4	0.0135	0.0163	0.0165	0.0172	**0.0159**	0.0144	0.0156	0.0157	0.0158	**0.0154**	1152	1814	1827	1844	**1659**
W_5	0.0139	0.0178	0.0179	0.0180	**0.0169**	0.0144	0.0159	0.0160	0.0163	**0.0157**	1184	1853	1880	1918	**1709**
W_6	0.0130	0.0131	0.0131	0.0132	**0.0131**	0.0130	0.0134	0.0135	0.0138	**0.0134**	502	531	590	623	**562**
Mean	**0.0134**	**0.0152**	**0.0154**	**0.0157**							**883**	**1431**	**1471**	**1520**	
	I	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**		**I**	**W**	**I at W**	**W at I**	
	0.0002	0.0002	0.0005	0.0005		0.0001	0.0001	0.0002	0.0002		24	41	78	82	
CD (p=0.05)	0.0005	0.0005	0.0011	0.0010		0.0002	0.0002	0.0004	0.0004		60	83	162	165	

I_1- Cotton + Sorghum (1:1), I_2 - Cotton + Sunflower (1:1), I_3 - Cotton + Sesame (1:1), I_4- Sole cotton, W_1 - PE *Prosopis juliflora* leaf extract @ 30% + one HW on 40 DAS, W_2 - PE *Annona squamosa* leaf extract @ 30% + one HW on 40 DAS, W_3 - PE *Mangifera indica* leaf extract @ 30% + one HW on 40 DAS, W_4 - PE Pendimethalin @ 1.0 kg a.i. ha^{-1} + one HW on 40 DAS, W_5 - Two HW at 20 and 40 DAS and W_6 - Control (No weeding or spray)

management practices on cotton had significant impact on seed cotton yield. Hand weeding twice at 20 and 40 DAS recorded higher seed cotton yield (1709 kg ha^{-1}). This was on par with PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS. Effective control of weeds by manual weeding or herbicide under the above superior treatments could be attributed to reduced crop-weed competition for moisture, nutrients and sunlight and eventually enhanced photosynthetic and metabolic activities in the crop, which reflected in improved growth and development of the crop and finally increased seed cotton yield as reported by Mathukia *et al*., 2019.The control registered lower seed cotton yield of562 kg ha^{-1}.

Interaction effect of intercropping system and weed management practices had significant effect on seed cotton yield during both Summer and Winter seasons. Sole cotton + hand weeding twice at 20 and 40 DAS recorded the highest seed cotton yield of 1918 kg ha^{-1}. It was on par with cotton + sesame intercropping system and hand weeding twice at 20 and 40 DAS, cotton + sunflower inter cropping system and hand weeding at 20 and 40 DAS, sole cotton with PE application pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS, cotton + sesame intercropping system with PE application pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS and cotton + sunflower intercropping system with PE application pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS. The lowest seed cotton yield (502 kg ha^{-1}) was recorded under cotton intercropping with sorghum and control.

Efficient control of weeds along with higher growth attributes and productivity of cotton could be achieved by cotton + sunflower intercropping system with PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS and cotton + sesame intercropping system with PE application of pendimethalin 1.0 kg ha^{-1} + hand weeding at 40 DAS.

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