Effect of critical crop weed-competition in cotton (*Gossypium hirsutum* L.)

Abstract

The field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2020-21 and 2021-22. To Study of critical crop-weed competition in cotton (*Gossypium hirsutum* L.) under south Gujarat condition. The treatment W_6 (Weed free up to harvest) was recorded significantly higher plant height at harvest, number of sympodial branches per plant, seed cotton weight (g/plant), stalk weight at harvest (g/plant) and seed cotton yield (kg/ha) during 2020-21, 2021-22 and in pooled results. But treatment (W_6) was statistically at par with the treatments W_5 (Weed free up to 75 DAS), W_4 (Weed free up to 60 DAS) and W_7 (Weedy up to 15 DAS) in both the years and in pooled results. The magnitude of increase in seed cotton yield with weed free up to harvest treatment (W_6) over weedy up to harvest treatment (W_{12}) were to the tune of 67.82, 75.90 and 71.87% higher during 2020-21, 2021-22 and in pooled results. Number of monopodial branches per plant was found non-significant results in both the individual years and in pooled results. Significantly minimum total least nutrient depletion (Nitrogen, phosphorus and potassium) by weed was recorded under the treatment W_6 (Weed free up to harvest), value were nitrogen 0.27, 0.23 and 0.25 per cent, phosphorus 0.07, 0.06 and 0.06 per cent, potassium 0.38, 0.32 and 0.35 per cent during both individual years and in pooled results, respectively. But it remained at with the treatments W_5, W_4 and W_7. Whereas, total highest nutrient depletion was recorded under the treatment W_{12} (Weedy up to harvest), value were nitrogen 13.34, 11.35 and 12.34 per cent, phosphorus 3.01, 2.73 and 2.87 per cent, potassium 14.37, 12.19 and 13.28 per cent during 2020-21, 2021-22 and in pooled results, respectively.

Key word: Seed cotton yield, stalk yield, monopodial, sympodial and nutrient depletion

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Introduction

Weeds are the major hurdle in agriculture. The productivity of cotton crop is complex phenomenon which is governed by numerous endogenous and exogenous factors. Among the various agronomic factors weed management is of vital importance for harvesting potential production under different agro-climatic conditions. In modern agriculture, the costly inputs applied for raising the crop are absorbed by the weeds. A major barrier for increased productivity is the severe crop-weed competition. High infestation of weeds, especially at the early stage of crop growth, poses considerable threat in achieving the desired yield of cotton

crop. Therefore, for a good crop, initial checking of the weeds is most important. The limited research works are available on crop-weed competition in cotton (*Gossypium hirsutum* L.) under south Gujarat condition.

Cotton crop occupies 13.0 m ha area with production 337 lakh bales and productivity 439 kg/ha in India. Among them Gujarat, Maharashtra and Telangana were the leading cotton growing states covering around 67 per cent (88.02 lakh ha) in area under cotton cultivation and 66 per cent (223 lakh bales) of cotton production in India. It is major *kharif* cash crop of Gujarat grown in area of 25.49 lakh ha with production 87.12 lakh bales and productivity 581 kg/ha. Cotton is essentially produced for its high quality fibre, which is commonly used in textile industry. It is the back bone of textile industry contributing nearly 80 per cent of raw material. Hence, cotton is an important commodity in the world economy. In India, cotton is cultivated under rainfed (65 per cent) as well as irrigated conditions in the states of Maharashtra, Gujarat, Karnataka, Madya Pradesh, Punjab, Rajasthan, Haryana, Tamil Nadu and Uttar Pradesh. Gujarat is the largest producer of cotton in India followed by Punjab and Maharashtra. Introduction of *Bt.* cotton took place in 2002, *Gossypium hirsutum* L. represents more than 90 per cent of the hybrid cotton production in India.

The critical period of crop weed competition is between early growth during which weeds can grow without affecting crop yield and the point after which weed growth does not affect yield. The time of weed removal has an important effect on the growth and yield of the crop. Removing weeds at any time during growing season may not be beneficial. For getting higher and profitable yield of *Bt.* cotton crop, the crop should be kept weed free from 60 to 75 days after sowing under south Gujarat condition reported by Vasave (2025). Stage of weed removal is as important as removal perse. Therefore, it is necessary to identify the critical period of weed control to render the weed control practices more effective and economical for improving the yield of cotton crop. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to more than 40 per cent reported by Vasave (2025).

Determination of the period when weeds after maximum competition to the crop is of great importance for planning weed control programmes. How sown competition from weeds starts is of great concern to the farmer who wants to do weeding at the proper time and thus, to avoid extra vagant expenses, time of weed removal is more important rather than removal perse. Crops are grown from ancient times, weeds are controlled through mechanical and manual practices without damage to environment but the use of herbicides during the short span of last 50 years have raised serious doubts about their continuous use. But continuous use of synthetic herbicides in heavy doses creates environment pollution and increases the number

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of herbicide resistant weeds. Hence, researchers should find out some natural way for minimizing the environment hazard. In recent years, allelopathic suppression of weeds is receiving greater attention in weed management.

Materials and methods

The field experiment entitled "Study of critical crop-weed competition in cotton (*Gossypium hirsutum* L.) under south Gujarat condition" was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2020-21 and 2021-22. The different critical crop weed competition treatments were imposed in cotton crop along with the other recommended package of practices. The soil of the experimental field was clayey in texture, medium in organic carbon and low, medium and high in available nitrogen, phosphorus and potassium, respectively and slightly alkaline in reaction during both the years of investigation. The experiment on critical crop weed competition in cotton was under taken during *kharif-rabi* seasons of two consecutive years 2020-21 and 2021-22. There were twelve different critical crop weed competition treatments *viz.*, W_1: Weed free up to 15 DAS, W_2: Weed free up to 30 DAS, W_3: Weed free up to 45 DAS, W_4: Weed free up to 60 DAS, W_5: Weed free up to 75 DAS, W_6: Weed free up to harvest, W_7: Weedy up to 15 DAS, W_8: Weedy up to 30 DAS, W_9: Weedy up to 45 DAS, W_{10}: Weedy up to 60 DAS, W_{11}: Weedy up to 75 DAS and W_{12}: Weedy up to harvest. The experiment was laid out in randomized block design with three replications. Gujarat Cotton Hybrid-12 was used for cultivation.

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Weed flora in cotton experiment

The total 19 dominant species in field experiment, monocot weeds, *Echinochloa crusgalli*, *Echinochloa colonum*, *Digitaria sanguinalis*, *Eleusine indica*, *Cynadon dactylon*, *Eragrostis major* L, *Dinebra retroflexa*, *Commelina bengalensis*, dicot weeds, *Physalis minima* L., *Phyllanthus niruri*, *Chenopodim album*, *Digera arvensis* Forsk, *Euphorbia hirta* L., *Cyanthillium cinereum*, *Portulaca oleracea*, *Amaranthus viridis*, *Eclipta alba*, *Tridax procumbens* and sedges weed, *Cyperus rotundus* L. were observed in the experimental field of cotton during both the years (2020-21 and 2021-22).

Results and discussion

Effect on growth parameters

Significantly higher plant height at harvest was recorded under the treatment W_6 (Weed free up to harvest), but it was statistically at par with the treatments W_5 (Weed free up to 75 DAS), W_4 (Weed free up to 60 DAS) and W_7 (Weedy up to 15 DAS) during first year, second year and in pooled results. Significantly lower plant height at harvest was recorded under the

treatment W_{12} (Weedy up to harvest) during both the years an-d in pooled results. It might be due to efficient utilization of moisture, nutrients and light by cotton crop with proper aeration in the root zone, which enabled crop plants to explore their maximum potential in the presence of very less competition offered by weeds. Plant height was adversely affected in the treatment of weedy up to harvest plot due to competition of weeds with crop to the germination to harvest stage for major factor (Light, moisture, space and nutrient). These findings are also in accordance with the results of those reported by Hiremath *et al.* (2014), Hargilas *et al.* (2015), Pandagale *et al.* (2018) and Vasave (2025). The non-significant results for monopodial branches per plant in both the individual years and in pooled results could be due to the minimal influence of weed-free and weedy treatments on this field experiment in cotton. Monopodial branch development is primarily governed by genetic factors and may not be highly responsive to external competition from weeds. Similar results were also obtained by Bharati *et al.* (2011), Basha *et al.* (2016) and Vasave (2025). The treatment W_6 (Weed free up to harvest) was recorded significantly higher sympodial branches per plant, but it remained at par with the treatments W_5, W_4 and W_7 in both the years and in pooled results. However, significantly lower sympodial branches per plant was recorded under the treatment W_{12} (Weedy up to harvest) during both the years and in pooled results. The weed control within 60 to 75 days after germination of cotton crop had less competition for nutrients, moisture, space and light, which was ultimately increased sympodial branch formation, resulting in a greater number of branches. During the initial stage of cotton crop, weed free environment had also played a role in shaping branching patterns under various treatments. These results of this investigation were in conformity with findings of Pachamuthu *et al.* (2014), Singh and Rathore (2014), Basha *et al.* (2016), Singh *et al.* (2016), Kamble *et al.* (2020), Shekara *et al.* (2020) and Panchal *et al.* (2022).

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Table 1: Effect of different treatment on growth parameters of cotton

Treatments	Plant height at harvest			Number of monopodial branches/plant			Number of sympodial branches/plant		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
W_1: Weed free up to 15 DAS	125.75	118.18	121.97	1.16	1.13	1.15	21.45	21.85	21.65
W_2: Weed free up to 30 DAS	126.62	124.17	125.40	1.21	1.17	1.19	22.41	23.10	22.76
W_3: Weed free up to 45 DAS	128.22	126.58	127.40	1.22	1.20	1.21	22.21	22.25	22.23
W_4: Weed free up to 60 DAS	141.73	143.31	142.52	1.28	1.31	1.29	25.85	26.76	26.31
W_5: Weed free up to 75 DAS	145.64	149.50	147.57	1.31	1.32	1.31	26.02	26.80	26.41
W_6: Weed free up to harvest	147.55	150.19	148.87	1.32	1.33	1.33	26.07	26.95	26.51
W_7: Weedy up to 15 DAS	142.66	145.82	144.24	1.29	1.31	1.30	23.60	25.66	24.63
W_8: Weedy up to 30 DAS	128.86	131.08	129.97	1.25	1.21	1.23	23.06	23.54	23.30
W_9: Weedy up to 45 DAS	128.33	129.65	128.99	1.23	1.20	1.22	19.04	22.15	20.59
W_{10}: Weedy up to 60 DAS	126.25	120.98	123.62	1.20	1.14	1.17	19.78	19.87	19.82
W_{11}: Weedy up to 75 DAS	120.04	113.28	116.66	1.12	1.13	1.13	18.51	19.00	18.75
W_{12}: Weedy up to harvest	119.45	109.09	114.27	1.10	1.10	1.10	18.33	18.49	18.41
S. Em. ±	6.27	5.53	4.19	0.07	0.09	0.06	0.90	1.03	0.69
CD (P= 0.05)	18.39	16.23	11.94	NS	NS	NS	2.63	3.03	1.97
C.V. %	8.24	7.37	7.83	10.28	12.21	11.28	6.99	7.78	7.48
Interaction Y x T									
S. Em. ±	5.98			0.08			0.98		
CD (P= 0.05)	NS			NS			NS		

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Effect on yield attributes and yield

Significantly higher seed cotton weight per boll (g) was recorded under the treatment W_6 (Weed free up to harvest) in both the years and in pooled results. The treatment (W_6) also statistically at par with the treatments W_5, W_4 and W_7 in both the years and in pooled results. Significantly lower seed cotton weight per boll was recorded under the treatment W_{12} (Weedy up to harvest) in both the years and in pooled results. It might be due to weed free treatments reduce stress on cotton plants, promoting more efficient photosynthesis and nutrient uptake, which are crucial for seed development and weight gain of seed cotton weight per boll. Weed free treatments (At 60, 75 DAS, at harvest and weedy up to 15 DAS) create optimal conditions for cotton plants to thrive, resulting in higher seed cotton weight per plant through enhanced resource utilization. The results are in agreement with the findings of Honnappa *et al.* (2018), Mathukia *et al.* (2018), Rai *et al.* (2021) and Vasave (2025).

The treatment W_6 (Weed free up to harvest) was recorded significantly higher seed cotton yield per plant during 2020-21, 2021-22 and in pooled results. But this treatment (W_6) also remained at par with the treatments W_5, W_4 and W_7 in both the years and in pooled results. Significantly lower seed cotton yield per plant was recorded under the treatment W_{12} (Weedy up to harvest) in both the years and in pooled results. Weed free treatment (At 60, 75 DAS, at harvest and weedy up to 15 DAS) faced the least weed competition from germination till maturity that also relates to best use of resources as reflected in terms of seed cotton yield per plant. Further promoting healthy plant growth and more number of boll formation, which contributing to higher seed cotton yield per plants. The results are in close agreement with those of Pandagale *et al.* (2018), Shekara *et al.* (2020), Rathod *et al.* (2023) and Vasave (2025). Significantly higher stalk weight per plant at harvest was recorded under the treatment W_6 (Weed free up to harvest), but this treatments was also statistically at par with the treatments W_5, W_4 and W_7 in both the years and in pooled results. Significantly lower stalk weight per plant at harvest was recorded under the treatments W_{12} (Weedy up to harvest) in both the years and in pooled results. Under weed free treatments (At 60, 75 DAS and at harvest), these were less weed competition which resulted in better crop growth and enhanced source capacity which resulted in increased stalk weight per plant. Similar findings were reported by Rai *et al.* (2021), Panchal *et al.* (2022) and Vasave (2025).

Significantly higher seed cotton yield (kg/ha) was achieving through W_6 (Weed free up to harvest) treatment, but this treatments also at par with W_5 (Weed free up to 75 DAS), W_4 (Weed free up to 60 DAS) and W_7 (Weedy up to 15 DAS) in both the years and in pooled

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Table 2: Effect of different treatment on yield attributes and yields of cotton

Treatments	Seed cotton weight (g/boll)			Seed cotton yield (g/plant)			Stalk weight (g/plant)			Seed cotton yield (kg/ha)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
W_1: Weed free up to 15 DAS	1.24	1.23	1.24	114	112	113	163	159	161	1828	1824	1826
W_2: Weed free up to 30 DAS	1.31	1.29	1.30	124	122	123	178	177	177	2157	2144	2150
W_3: Weed free up to 45 DAS	1.32	1.32	1.32	126	123	124	184	190	187	2190	2627	2408
W_4: Weed free up to 60 DAS	1.48	1.51	1.50	137	135	136	213	218	215	2608	2808	2708
W_5: Weed free up to 75 DAS	1.53	1.59	1.56	140	143	141	222	228	225	2795	2843	2819
W_6: Weed free up to harvest	1.55	1.62	1.58	141	145	143	228	231	229	2811	2957	2884
W_7: Weedy up to 15 DAS	1.49	1.55	1.52	137	138	138	218	220	219	2750	2701	2726
W_8: Weedy up to 30 DAS	1.38	1.35	1.37	126	130	128	204	209	206	2414	2329	2371
W_9: Weedy up to 45 DAS	1.36	1.34	1.35	127	125	126	197	197	197	2320	2013	2167
W_{10}: Weedy up to 60 DAS	1.28	1.28	1.28	119	120	120	170	160	165	2047	1963	2005
W_{11}: Weedy up to 75 DAS	1.19	1.21	1.20	109	112	111	152	155	153	1745	1784	1765
W_{12}: Weedy up to harvest	1.16	1.12	1.14	107	111	109	143	147	145	1675	1681	1678
S. Em. ±	0.05	0.08	0.05	4.60	4.57	3.36	7.19	6.89	5.04	129.36	109.20	87.26
CD (P= 0.05)	0.14	0.24	0.14	13.49	13.40	9.59	21.10	20.20	14.39	379.41	320.27	248.89
C.V. %	6.03	10.59	8.97	6.35	6.26	6.54	6.58	6.25	6.50	9.83	8.20	9.32
Interaction Y x T												
S. Em. ±	0.07			4.75			7.13			123.41		
CD (P= 0.05)	NS			NS			NS			NS		

results. The magnitude of increase in seed cotton yield with weed free up to harvest treatment (W_6) over weedy up to harvest treatment (W_{12}) were to the tune of 67.82, 75.90 and 71.87% higher during 2020-21, 2021-22 and in pooled results reported by Vasave (2025). Seed cotton yield is the function of yield attributing characters. The enhancement in seed cotton yield was positively and significantly correlated with yield attributing characters like number of sympodia branches/plant, number of bolls/plant and boll weight which found positively contribute to the seed cotton yield. These results are in accordance with those obtained by Mathukia *et al.* (2018), Devi *at al.* (2022), Raj *et al.* (2022), Rathod *et al.* (2023) and Vasave (2025).

Effect on total nutrient uptake by weed

Significantly lower total nutrient uptake (Nitrogen, phosphorus and potassium) by weed was recorded under W_6 (Weed free up to harvest) treatment, which remained at par with W_5, W_4 and W_7 in both the years and in pooled results. Significantly higher total nutrient uptake (Nitrogen, phosphorus and potassium) by weed was recorded under the treatment weedy up to harvest treatment (W_{12}), value were nitrogen (13.34, 11.35 and 12.35 per cent), phosphorus (3.01, 2.73 and 2.87 per cent) and potassium (14.37, 12.19 and 13.28 per cent) during 2020-21, 2021-22 and in pooled results, respectively. The total uptake of nitrogen, phosphorus and potassium by weeds showed significant differences between weed-free and weedy treatments, likely due to variations in the dry weight of weeds. In weedy treatments, the higher dry weight of weeds resulted in greater nutrient uptake as weeds aggressively competed for available nutrients in the soil. Nitrogen uptake, in particular, was prominent due to its mobility and key role in promoting vegetative growth, while phosphorus and potassium uptake were also influenced by the increased dry weight of weeds. In weed-free treatments, the absence of weeds or minimal weed growth significantly reduced the dry weight of weeds, leading to lower nutrient uptake by them, which was ultimately reflect in maximum weed control efficiency. This difference highlights the relationship between dry weight of weeds and nutrient uptake, where the greater weed dry weight in weedy treatments directly correlates with higher nutrient removal from the soil. These findings are in consonance with the report by Vasave (2025).

Conclusion

On the basis of experimental results of two years, it can be concluded that the treatments W_6 (Weed free up to harvest), W_5 (Weed free up to 75 DAS), W_4 (Weed free up to 60 DAS) and W_7 (Weedy up to 15 DAS) proved most effective treatments for managing weeds with significantly improved growth parameters *viz.*, plant height, sympodial branches per plant and

yield attributes and yield parameters *viz.*, seed cotton weight per boll (g), seed cotton yield (g/plant), stalk yield per plant at harvest (g/plant), seed cotton yield (kg/ha) and also significantly total lower nutrient depletion by weed recorded under the treatments W_6,W_5, W_4 and W_7. Whereas, Whereas, total highest nutrient depletion was recorded under the treatments W_{12} (Weedy up to harvest) during both the individual years and in pooled results.

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Table 3: Total nitrogen, phosphorus and potassium uptake by weed as influenced by various treatments

Treatments	Total uptake nutrient by weed (kg/ha)								
	Nitrogen			Phosphorus			Potassium		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
W_1: Weed free up to 15 DAS	7.09	6.04	6.57	1.60	1.50	1.55	7.88	6.80	7.34
W_2: Weed free up to 30 DAS	3.35	3.19	3.27	0.82	0.81	0.82	4.06	3.72	3.89
W_3: Weed free up to 45 DAS	1.68	1.60	1.64	0.42	0.41	0.41	2.05	1.92	1.98
W_4: Weed free up to 60 DAS	0.60	0.48	0.54	0.16	0.14	0.15	0.78	0.64	0.71
W_5: Weed free up to 75 DAS	0.46	0.36	0.41	0.13	0.10	0.11	0.63	0.48	0.55
W_6: Weed free up to harvest	0.27	0.23	0.25	0.07	0.06	0.07	0.38	0.32	0.35
W_7: Weedy up to 15 DAS	0.72	0.52	0.62	0.19	0.14	0.17	0.95	0.68	0.81
W_8: Weedy up to 30 DAS	1.43	1.32	1.37	0.36	0.35	0.35	1.78	1.67	1.72
W_9: Weedy up to 45 DAS	2.07	1.89	1.98	0.52	0.49	0.50	2.57	2.31	2.44
W_{10}: Weedy up to 60 DAS	2.73	2.42	2.58	0.63	0.61	0.62	3.16	2.79	2.98
W_{11}: Weedy up to 75 DAS	9.05	8.74	8.89	2.01	2.08	2.04	9.98	9.46	9.72
W_{12}: Weedy up to harvest	13.34	11.35	12.34	3.01	2.73	2.87	14.37	12.19	13.28
S. Em. ±	0.24	0.18	0.16	0.05	0.05	0.04	0.19	0.33	0.19
CD (P= 0.05)	0.71	0.54	0.44	0.14	0.16	0.10	0.57	0.96	0.54
C.V. %	11.73	10.00	11.32	9.71	11.95	11.05	8.27	15.75	12.22
Interaction Y x T									
S. Em. ±	0.22			0.05			0.77		
CD (P= 0.05)	NS			NS			NS		

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