EFFECT OF CROP-WEED COMPETITION IN COTTON (GOSSYPIUM HIRSUTUM L.) - REVIEW

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ABSTRACT
Cotton being a long duration, wide spaced and relatively slow growing crop in early stages, is subjected to a severe weed infestation. Weeds have always been a bottleneck for crop production. Inadequate weed control at appropriate stage is considered as a major constraint for high yield. Cotton was very sensitive to weed competition in the first 60 days of crop growth. The period of weed interference, crop damage and the critical period of crop-weed competition were 30 to 60 days which occupied 50 per cent of the whole cotton growing period. Seed cotton yield loss increased with the increase in the duration of competition and maximum loss was observed due to full season competition. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to an extent of 40 to 85 per cent. Due to their high competitive ability, weeds compete for resources thereby affecting productivity of cotton. Hence, a brief review is presented on the nature of weed spectrum in cotton, competition between crops and weeds, their effect on growth and yield, quality of cotton.

Key words: Cotton, crop-weed competition, Gysspium hirsutum, Light, Moisture, Nutrients, Weed spectrum.

INTRODUCTION
Cotton (Gossypium hirsutum L.), the ‘white gold’ or ‘money spinner’ enjoys a predominant position amongst all cash crops in India and cultivated since Indus civilization. Cotton occupies the prime position in India constituting more than 70 per cent of the total fibre consumption in the textile sector. In India, cotton cultivation provides livelihood for over 4 million farming families. It produces only 3.95 million bales of lint every year with a productivity of 567 kg ha⁻¹ (Anonymous, 2008). The key role that cotton plays in our country can be gauged from the fact that nearly 15 million farmers spread out in more than 10 states are dependent on cotton cultivation (Prasad and Prasad, 2009). Besides the actual cotton growing farmers, nearly 60 million people are employed along the cotton value chain, from weaving to textile and exports of garments. Directly and indirectly, it accounts for about 33 per cent of our export earning and the cotton farming contributes around 29.8 per cent of Indian Agricultural GDP. In textile industry, cotton plays a vital role in supplying raw materials to the tune of 85 per cent of total requirement in India. It has immense potentiality to share foreign exchange of 38 per cent to total export of Indian economy.

Weed spectrum in cotton
Weed species in cotton field differ widely due to soil and environmental types. To evolve a successful weed management practice, identification of weeds associated with cotton crop is important. Rout and Satapathy (1998) stated that the cotton fields in Orissa were infestd with grasses like Cynodon dactylon (Pers.), Digitaria setigera, Digitaria ciliaris (Nees.), Eleusine indica (Gaertn.) and Paspalum scrobiculatum (L.), sedges viz., Cyperus rotundus (L.) and Cyperus iria (L.) and broad leaved weeds viz., Celosia argentea (L.), Commelina benghalensis (L.), Sida acuta (Burn.), Aeschynomene indica (L.) and Mimosa pudica (L.). Kakade et al.(1999) opined that the dominant weed flora in the cotton field comprised of Digera arvensis (Forsk.), Commelina benghalensis (L.), Lagasca

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Corchorus trilocularis, Bermudagrass in cotton was proved to be 4 to 7 weeks (Vencil et al., 1993). Rong et al. (1999) found that the period of weed interference, crop damage and the critical period of crop-weed competition were 30 to 90 days which occupied 50 per cent of the whole cotton growing period. Seed yield loss increased with the increase in the duration of competition and maximum loss was observed due to full season competition. Papamichail et al. (2002) reported that presence of weeds for more than 3 weeks after crop emergence caused significant reduction in crop growth and lint yields. Cotton was very sensitive to weed competition in the first 60 days of crop growth (Sivakumar and Subbian, 2002). According to Ayyadurai and Poonguzhalan (2010) stated that the critical period of weed-competition in rice-fallow cotton works out to be between 20.25 and 59.50 (say 20 and 60) days after sowing in rice-fallow cotton.

Critical period of cotton - weed competition

Panwar and Malik (1991) reported that the competition of Trianthema portulacastrum was higher up to 50 DAS whereas, competition of Echinocloa was up to 100 DAS and hence, first 60 DAS was the most critical period for crop-weed competition. The critical crop-weed competition for Bermuda grass in cotton was proved to be 4 to 7 weeks (Vencil et al., 1993). Rong et al. (1999) found that the period of weed interference, crop damage and the critical period of crop-weed competition were 30 to 90 days which occupied 50 per cent of the whole cotton growing period. Seed yield loss increased with the increase in the duration of competition and maximum loss was observed due to full season competition. Papamichail et al. (2002) reported that presence of weeds for more than 3 weeks after crop emergence caused significant reduction in crop growth and lint yields. Cotton was very sensitive to weed competition in the first 60 days of crop growth (Sivakumar and Subbian, 2002). According to Ayyadurai and Poonguzhalan (2010) stated that the critical period of weed-competition in rice-fallow cotton works out to be between 20.25 and 59.50 (say 20 and 60) days after sowing in rice-fallow cotton.

Competition for moisture

According to Schwerzel and Thomas (1971) soil moisture removed by weeds was 3 to 5 times more than that of cotton. If weeds were allowed to compete with cotton after first and second irrigation the yield loss were 16 and 12 percent, respectively (Smith et al., 1971). Coble et al. (1981) described that water stress or moisture availability also might influence the duration of critical weed free period for crops. Patterson (1995) reported that the weeds competed with the crops for water, reduced the amounts of soil water available to support crop growth and there by resulting in crop water stress.

Competition for light

Schwerzel and Thomas (1971) found that cotton crop took 16 weeks for canopy development to cover 95 percent whereas, weeds took only 8 weeks and the weeds were able to produce more growth and competed efficiently for light. According to Patterson (1982) both purple and yellow nut sedge (Cyperus rotundus and Cyperus esculentus) shading to 60 and 30 percent of full sunlight resulted in reduced dry matter production, leaf area production, rhizome and tuber formation. Aldrish (1984) reported that the proportion of total canopy LAI contributed by crop and weed and their relative height or vertical disposition of the crop and weed components of the total canopy were the most critical factors affecting competition for light. Plant height and vertical leaf distribution were defined as effective components of the competitive struggle for light (Graf and Hill, 1992).

Gupta (1998) suggested that the competition for light commenced very early in the crop season if a dense
weed growth smothered the crop seedlings. Cotton was prone to heavy weed growth at its seedling stage and consequently suffered badly at the shading effect of weeds.

**Competition for nutrients:** Competition for nutrients is an important aspect for crop-weed competition and yield loss. According to Singh et al. (1971) weed control within 15 days after germination of cotton crop had less competition for nutrients. Schwerzel and Thomas (1971) suggested that weeds presenting during 4 to 6 weeks in summer and 6 to 8 weeks in winter competed for more nutrients. Balasubramanian (1985) found that weeds removed 40.9 kg N ha\(^{-1}\) in unweeded plot, whereas, it was reduced to 14.4 kg N ha\(^{-1}\) due to herbicide application. Balasubramanian and Sankaran (1978) reported that N, P and K uptake of crop was increased by three times, if proper weed control measures were taken up. According to Jain et al. (1981) weeds removed 5-6 times N, 5-12 times P and 2-5 times K under upland condition. At low weed densities, high N rates could markedly increase crop yields and minimize weed competition (Moody, 1981). Paterson and Nalewaja (1992) concluded that increased uptake of minerals by weeds often resulted in a competitive advantage over crop species. Tomasco (1995) found that weeds accumulated higher concentrations of mineral nutrients than crops, thus depleting soil nutrient levels more quickly and reducing crop yield. Gupta (1998) reported that weeds usually absorbed mineral nutrients faster than many crop plants and accumulated in their tissues in relatively large amounts.

**Effect of weed competition on cotton growth parameters:** Plant height was unaffected even when the crop was left unweeded (Schwerzel and Thomas, 1971 and Sankaran and Rethinam, 1974). The dry matter production of cotton per unit area was the lowest under unweeded condition (Sankaran and Rethinam, 1974; Tripathi and Singh, 1978 and Singh, 1983). Decrease in plant height due to weed competition was observed by several workers (Balasubramanian and Sankaran, 1976; Rangiah et al., 1976; Singh, 1983 and Rushing et al., 1984). Holt and Orcutt (1991) observed that yellow (Cyperus esculentus L.) and purple nutsedge (Cyperus rotundus) compete with cotton for resources and can assimilate biomass faster than cotton. Reduced plant height by prolonged delays in weed removal was reported by Bukun (2004).

Ayyadurai (2008) found that the lowest values for the growth components like plant height, LAI, DMP and monopodia plant\(^{-1}\) throughout the crop growth period. The longer the duration of weed infestation the greater was the reduction in the values of growth components. It was observed that the DMP of cotton was reduced by 16.266 kg ha\(^{-1}\) for every kg of dry matter produced by weeds. Maintaining the field weeds free for first 60 DAS or beyond resulted in higher values for cotton growth components which were on par with those in weed free up to harvest.

**Effect of weed competition on cotton yield parameters:** Panwar et al. (1999) registered the maximum number of bolls and weight of seed cotton plant\(^{-1}\) with the farmer's practice of weeding thrice at 20, 40 and 60 DAS due to efficient control of monocot and dicot weeds. Sreenivas (2000) observed that higher number of bolls plant\(^{-1}\) was recorded with farmer's practice. Velayutham et al. (2002) reported that unweeded check reduced the boll number plant\(^{-1}\) and boll weight of cotton. Nadanassabady and Kandasamy (2002) observed that maintaining the field weed free up to harvest resulted in maximum (17.6) number of bolls plant\(^{-1}\) and minimum (7.6) number of bolls plant\(^{-1}\) was recorded in unweeded plot. Significantly reduction in boll number plant\(^{-1}\) and boll weight in unweeded check was observed by Srinivasan, (2003). Kalaisundarson and Sundari (2004) reported that the highest boll number plant\(^{-1}\) (17.4) was recorded in hand weeding twice. Unweeded control produced less no of osypodial branches, boll number plant\(^{-1}\) and boll weight in cotton (Sadangi et al., 2006). Ayyadurai (2008) found that the yield components were severely affected by weed competition. The yield components like number of sympodia plant\(^{-1}\), number of bolls plant\(^{-1}\) and boll weight could be enhanced by 7.2 to 7.4, 14.3 to 18.1 and 4.8 to 5.2 times, respectively by maintaining the field weed free for first 60 DAS or more. However, weeding beyond 80 DAS significantly reduced the boll setting percentage.

**Effect of weed competition on cotton yield**
Cotton being a wide spaced relatively slow growing crop during its initial stages suffers from severe weed
competition and causing substantial reduction in seed cotton yields up to an extent of 69 per cent (Srinivasalu and Rao, 2000). Vivek et al. (2002) opined that the yield loss due to weeds ranged from 30 to 70 per cent. Bryson et al. (2003) reported that the purple nut sedge caused seed cotton yield reductions of 62 - 85 per cent. Khan and Khan (2003) reported that grassy weeds cause 15 to 40 per cent and broad leaf weeds 15 to 30 per cent yield losses in cotton crop. Wallia et al. (2007) concluded that if left uncontrolled the weeds not only reduced crop yield but also increased the weed seed bank in soil which created problems for succeeding crop. Weeds play a significant role in reducing the seed cotton yield on an average by 30 per cent as observed by Mushtaq and Cheema, (2008). Ayyadurai (2008) concluded that, weeds, when left unchecked until harvest, reduced the seed cotton yield by 96.5 per cent. The loss in yield was proportional to the duration of weed infestation. The yield was found to decline at the rate of 6.019 kg ha$^{-1}$ for every kg of weed dry matter produced.

Effect of weed competition on cotton quality parameters: The quality of cotton was unaffected by weed infestation (Klingman, 1973; Buendia et al., 1976 and Rushing et al., 1984). Seed weight and fibre per cent were also unaffected by weed infestation (Nobrega et al., 1977). Buchanan and Burns (1970) on the contrary reported that the quality characters of cotton was adversely affected as compared to vegetative growth and stand of the crop due to severe weed competition in the initial stages of the crop growth. Cia et al. (1978) also found that the weeds adversely affected the quality characters of cotton like fibre percentage, seed weight, fibre uniformity, Micronaire and Pressely indices. However, ginning percentage was not found to be affected by weed competition (Sayed et al., 1979; Singh and Nagwekar, 1989). In cotton, competition with weeds resulted in fewer and less mature bolls plant$^{-1}$ and lowered lint quality (Abernathy and McWhorter, 1992).

Effect of weed competition of nutrient uptake on cotton: Nadanasababady and Kandasamy (2002) observed that nutrient depletion by weeds was higher as compared to cotton in unweeded plot. Maximum nutrients depletion of 61.8 kg N, 5.6 kg P and 57.6 kg K ha$^{-1}$ by weeds were recorded under unweeded plots at 60 days after sowing as reported by Baldev et al. (2004). Latha (2005) found that the nutrient depletion by weeds were higher than the nutrient uptake by cotton in unweeded plot under rice-fallow situation. Kumar et al. (2007) reported that unweeded check registered higher nutrient removal of weeds when compared to herbicide applied plots. Ayyadurai (2008) stated that nutrient uptake by cotton increased progressively with increase in the duration of weed free period. When left unchecked, weeds reduced the nutrient uptake by cotton to the tune of 94 to 96 per cent. The maximum depletion of nutrients by weeds occurred between 20 and 60 DAS which coincided with the critical period of cotton-weed competition.

CONCLUSION

From the above review it can be concluded that the critical period of weed-competition in cotton works out to be between 20.25 and 59.50 (say 20 and 60) days after sowing in cotton. It is clear that weeds when allowed to compete with cotton severely affected the growth and yield attributes, seed cotton yield and resource use efficiency. Also, the quality of cotton fibre was lowered. The critical period of crop-weed competition has been reported to be first 60-70 days after seeding.

REFERENCES


