

Influence of organic manures and weed control methods on weed control efficiency in winter irrigated cotton

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ABSTRACT

Field experiment was conducted during winter irrigated season at Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore to find out the effect of organic manures and weed management practices on weed control efficiency in cotton. The experiment was laid out in a strip plot design. Treatments viz., farmyard manure, vermicompost, goat manure and composted poultry manure were assigned to main plot; while hand weeding, twin wheel hoe weeding, power weeding and weedy check were assigned to sub plot and replicated thrice. Weeding operations were done at 20 and 40 DAS. Results indicated that among the organic manures, composted poultry manure recorded significantly lower weed density (78.93 No. m²) and dry weight (25.08 g m²) which was comparable with goat manure. Among the weed management practices, hand weeding twice at 20 and 40 DAS recorded lower total weed density (55.24 No. m²), dry weight (26.57 g m²) and higher weed control efficiency (83.53%) followed by power weeding at 20 and 40 DAS. Based on the results, it can be concluded that application of composted poultry manure along with hand weeding or power weeding can be recommended as an effective weed management practice for better weed control in organic cotton cultivation system.

Keywords: Hand weeding, organic manure, power weeding, weed control efficiency

Cotton (*Gossypium hirsutum* L.) is one of the most important fiber crops and plays a pivotal role in agriculture, industrial development, employment generation and economic development of India. Cotton crop contributes 8.6 per cent value addition in agriculture and is a source of employment (40% of the rural community). It also fetches a substantial amount of foreign exchange (60%) through export of cotton fiber and fiber made products (CICR, 2012). However, in the modern days, when agriculture is motivated not only for production, but also takes into account the sustainability of all the resources including soil for the generations to come. The use of chemical fertilizers has been many-a-times reported for degrading soil and water resources. Moreover, organic farming is both a philosophy and a system of agriculture (Adhikari *et al.*, 2016). Organic manures apart from supplying all essential nutrients required by plants, improve soil structure, aeration, encourage good root growth, enhance nitrogen availability, water retention and increases soil organic matter (Udom *et al.*, 2007). The control of weeds in agroecosystems has likely troubled humans since the practice of agriculture began. The most negative aspects of weeds is that they compete with crops for water, light and nutrition and they can harbor diseases and pests that will further reduce the productivity of crops (Liebman, 2001). Crop-weed competition for the first few weeks (4-7) after planting has the greatest effect on cotton yield. Heavy weed infestations due to poor weed management practices are estimated to reduce cotton seed yields by about 30-40% (Ali *et al.*, 2013).

Regardless of farm size, region or varieties grown, the primary need voiced by organic cotton growers is an effective method of weed control. In wet regions (or years), early season weeds can choke out a burgeoning cotton crop. Later in the growing season, weeds can adversely impact yields and quality (Chandramohan and Chandaragiri, 2007). Ecological weed management is a holistic approach to weed control combining scientifically deduced information about weed biology and ecosystem dynamics with site specific knowledge from individual farms to produce long term weed management plans (Sumathi *et al.*, 2010). Direct and indirect weed control measures are utilized with tactical (single year) and strategic (multiyear) goals in mind (Kristiansen, 2003).

Hand weeding is a common weed control method used by organic growers and farmers in both developed and developing countries. Pulling weeds by hand, rouging them out with a hand-held hoe, or cutting them at the soil surface with a wheel hoe are all considered hand weeding. With hand weeding, selectively killing weeds in relation to the crop is easy, but the time and labour required is a limitation (Dubey, 2014). Mechanical weeding is standard practice for organic fields. However, a number of factors have severely reduced the availability of seasonal labour in cotton-growing regions (Mushtaq and Cheema, 2008). Several growers - particularly those new to farming organic cotton - expressed that the lack of available labour is a hindrance to expanding their production. In addition, the skill and experience of the operator is very important

when accurately judging the speed, depth, and timing that will make a cultivation event successful (Heinz, 2014). The utilization of numerous weed management methods that can be chosen based on site-specific qualities allows producers to be creative and their weed management plans to potentially develop synergistic effects that may be lacking in less complex systems. Keeping all the above in view, this experiment was carried out in order to study the effect of various sources of organic manures and weed control methods on weed control efficiency in winter irrigated cotton.

MATERIALS AND METHODS

The research was carried out in Field No. 37 E, Eastern Block, Department of Farm management, Tamil Nadu Agricultural University, Coimbatore during winter irrigated season (August) 2015-16 at 11°N latitude and 77° E longitude and an altitude of 426.7 m above mean sea level to investigate the performance of organic manures and weed management practices on weed control efficiency in cotton. The soil of the experimental field was sandy clay loam with low in available nitrogen (19.2 kg ha⁻¹), medium in available phosphorus (17.2 kg ha⁻¹) and high in available potassium (520 kg ha⁻¹). The experiment was conducted in strip plot design and replicated thrice. The treatments of organic manures viz., farmyard manure, vermicompost, goat manure and composted poultry manure were assigned to main plot and weed management practices viz., hand weeding, twin wheel hoe weeding, power weeder weeding and weedy check were fitted in the subplot. All the weeding operations were given on 20 and 40 DAS. The inter row weeds in machine or implements operated plots of inter row were removed manually. Organic manures on equal nitrogen basis were applied to respective plots as per treatment of organic manure viz. Farmyard manure (16 t ha⁻¹), vermicompost (5.23 t ha⁻¹), goat manure (6.15 t ha⁻¹) and composted poultry manure (3.63 t ha⁻¹). The cotton seeds (var. suraj) were treated with biocontrol agent of *Bacillus subtilis* @ 10 g kg⁻¹ and sown during August as winter irrigated crop with two seeds/hill at a spacing of 75 × 30 cm. Adequate care was taken to maintain optimum plant population. Gap filling was done ten days after sowing (DAS) and thinning done at 20 DAS by retaining one healthy seedling/ hill.

Observations on weeds

Weed density (No.m⁻²)

The weed count was recorded species wise using 0.5 × 0.5 m quadrat from four randomly fixed places in each plot and the weeds falling within the frames of the quadrat were counted and the weeds were classified as broadleaved weeds, grasses, sedges and the mean values were expressed in number m⁻².

Weed dry weight (g m⁻²)

The quadrat was placed at four places at random outside the net plot area but inside the border rows. The above ground portions of the enclosed weeds were removed from each plot. The weed samples were air dried and then oven dried in hot-air oven at 80±2°C for 72 hours and the dry weight of weeds was expressed as g m⁻².

Weed control efficiency (WCE)

Weed control efficiency was worked out on the basis of weed density recorded in each treatment at 40 DAS using the formula suggested by Mani *et al.* (1973).

$$\text{WCE (\%)} = \frac{\text{WD}_c - \text{WD}_t}{\text{WD}_c} \times 100$$

Where,

WCE (%) - Weed control efficiency in percentage

WD_c - Weed density (No. m⁻²) in control plot,

WD_t - Weed density (No. m⁻²) in treated plot

Data on weed density showed high variation and hence they were subjected to square root transformation ($\sqrt{X+0.5}$) and analyzed statistically. Wherever statistical significance was observed, critical difference (CD) at 0.05 per cent level of probability was worked out for comparison.

RESULTS AND DISCUSSION

The analysis of weed data obtained from the experiment showed varied response of the organic manures and weed control methods applied to the crop (Table 1).

Weed flora

A very rich weed flora infests cotton field. Weed species present in the experimental plot were identified at flowering stage of crop from un-weeded control plot. Weed flora of the experimental field consisted of four species of grass weeds, eight species of broad leaved weeds and one sedge weed. Grasses were more dominant (51.75%) than the broad leaved weeds (44.59%) and sedges (3.66%). The predominant among grass weeds were *Cynodon dactylon* and *Chloris barbata*. Among the broad leaved weeds, *Trianthema portulacastrum*, *Cleome viscosa*, *Digeria muricata* and *Boerhavia diffusa* were the dominant ones and *Cyperus difformis* was the only sedge present in the experimental site. The predominant occurrence of these weed species in cotton could probably be attributed to the ecological adaptation and dominance of the above listed weeds in sandy clay loam soils of Coimbatore region. Therefore, proper identification of weed species prevailing in the field is

essential for implementing weed control operation successfully. The similar weed flora were observed in winter irrigated cotton (Nalini *et al.*, 2015).

Density of total weeds

The total weed density was significantly altered by organic manures and weed management methods at 40 DAS (Table 1).

Among the various organic manures, lesser total weed density was observed at 40 DAS under composted poultry manure (78.93 No. m⁻²) followed by goat manure, while, farmyard manure received plot was showed higher weed density (118.5 No. m⁻²). Organic manure may affect crop–weed competitive interactions differently than chemical nitrogen fertilizer (Liebman and Davis. 2000), probably due to speed of N release or form of N. In a study, the gradual N release from manure and compost over years appeared to benefit weeds more than spring wheat.

With respect to weed management practices, hand weeding at 20 and 40 DAS recorded lower total weed density (55.24 No. m⁻²) followed by power weeder weeding at 20 and 40 DAS (59.36 No. m⁻²). Hand weeding twice and mechanical weeding twice with power weeder also found to be significantly superior over the unweeded control in reducing the density of the dominant weed species in cotton. Weed management either with manual or mechanical method reduced the weed stand in the earlier crop growth stages which might have lowered the weed seed return and ultimately the densities of weed species would have been reduced. Similar findings were made earlier by Leela (2002) who have reported that hand weeding or mechanical weeding could reduce the weed stand at early stages of crop growth.

The interaction between organic manures and weed control was significant at 40 DAS. During these stages, the treatment combination of composted poultry manure along with hand weeding at 20 and 40 DAS recorded lower weed density (41.26 No m⁻²) followed by composted poultry manure with power weeding at 20 and 40 DAS than the other treatment combinations.

Weed dry weight

Weed dry weight is the most important parameter to assess the weed competitiveness for the crop growth and productivity. Sparse weeds with high biomass might be more competitive for crops than dense weeds with lesser dry matter. The results showed that there was significant variation in dry weight of total weeds due to different organic manures and weed management practices (Table 1).

Among the organic manures, lower weed dry weight (25.08 g m⁻²) was observed with composted poultry

manure, but comparable with goat manure and vermicompost. This might be due to the reason that the poultry manure has high N content and good weed control efficacy due to its phytotoxic character (Baig *et al.*, 2001). Moreover, composted manure had the lowest seed bank of both grass and broadleaf species as compared with chemical fertilizer treatment.

Considerable reduction in weed dry weight (26.57 g m⁻²) was recorded with hand weeding on 20 and 40 DAS but were found to be the next best to power weeder weeding twice on 20 and 40 DAS. This might be attributed to the minimum number of total weeds with lesser biomass in the cropping period. In these treatments, nearly 75.37 per cent reduction of weed dry weight was noticed over unweeded control. Mechanical or manual weeding in controlling the weeds at critical crop-weed competition of cotton might be the reason for better crop growth.

These results are in line with the findings of Sumachandrika *et al.* (2002) who reported that mechanical weeding by stimulating the suppression of the targeted weeds by decreasing their competition and making their environment more favorable to cropping period. The treatment combination of composted poultry manure along with hand weeding at 20 and 40 DAS recorded lower weed dry weight (11.64 g m⁻²) which was statistically followed by composted poultry manure with power weeding at 20 and 40 DAS than the other treatment combinations. Two hand weeding at 25 and 45 DAS, for effective control of weeds during critical period of crop growth (Sarma and Gautam, 2006).

Weed control efficiency (%)

Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed control treatments over weedy check was worked out and depicted in figure 1.

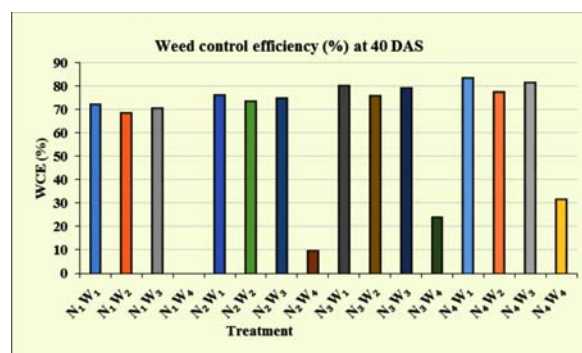


Fig. 1: Effect of organic manure and weed control methods on weed control efficiency (%) in cotton (var. suraj)

Table 1: Effect of organic manures and weed control methods on weed density and weed dry weight of cotton (40 DAS)

Treatment	Weed density (No. m ⁻²)					Weed dry weight (g m ⁻²)				
	W ₁	W ₂	W ₃	W ₄	Mean	W ₁	W ₂	W ₃	W ₄	Mean
N ₁	8.39 (69.83)	8.92 (79.02)	8.66 (74.52)	15.85 (250.6)	10.45 (118.5)	6.64 (43.57)	7.10 (49.94)	7.08 (49.63)	13.03 (169.3)	8.46 (78.10)
N ₂	7.77 (59.94)	8.20 (66.78)	8.00 (63.49)	15.08 (226.9)	9.76 (104.3)	5.58 (30.69)	5.99 (35.39)	5.81 (33.21)	11.05 (121.7)	7.11 (55.24)
N ₃	7.10 (49.93)	7.86 (61.20)	7.30 (52.73)	13.85 (191.2)	9.02 (88.76)	4.57 (20.37)	5.10 (25.52)	4.81 (22.62)	9.20 (84.12)	5.92 (38.16)
N ₄	6.46 (41.26)	7.54 (56.32)	6.87 (46.17)	13.11 (171.4)	8.50 (78.93)	3.48 (11.64)	4.23 (17.40)	3.90 (14.71)	7.55 (56.57)	4.79 (25.08)
Mean	7.43 (55.24)	8.13 (65.83)	7.71 (59.36)	14.47 (210.3)		5.07 (26.57)	5.61 (32.07)	5.40 (30.04)	10.21 (107.9)	
	N	W	N at W	W at N		N	W	N at W	W at N	
SEd	0.26	0.27	0.54	0.55		0.18	0.20	0.39	0.40	
LSD (0.05)	0.63	0.63	1.17	1.19		0.48	0.43	0.88	0.85	

Figures in parenthee are mean of original values; Data subjected to square root transformation

N₁ : 100 % RDN through Farmacyard manure

N₂ : 100 % RDN through vermicompost

N₃ : 100 % RDN through goat manure

N₄ : 100 % RDN through composted poultry manure

W₁ : Hand weeding at 20 & 40 DAS

W₂ : Twin wheel hoe weeding at 20 & 40 DAS

W₃ : Power operated weeding at 20 & 40 DAS

W₄ : Weedy check

Composted poultry manure along with hand weeding twice at 20 and 40 DAS recorded higher WCE of 83.53 per cent, followed by combination of composted poultry manure with power weeder weeding at 20 and 40 DAS (81.36 per cent). The maximum WCE obtained by the above promising weed management practices was due to greater reduction of grasses, sedges and broad leaved weeds in all the stages of crop growth itself which in turn increased the vigor and growth of cotton resulted in good crop establishment (Mynavathi, 2007). The lower weed control efficiency of 36.36 per cent was obtained in farmyard manure applied plot with weedy check treatment.

Several weeds infest the organic cotton cultivation system, compete with cotton plants for moisture, light and nutrients and decrease the cotton productivity. The results of the experiment showed that the use of composted poultry manure and two hand weedings or power weeding twice on 20 and 40 DAS might be the best option in cotton to combat weed menace. Use of these methods in integration with any other organic weed control methods may provide better weed control.

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