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RESEARCH ARTICLE :

Integrated weed management in cotton

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SUMMARY : Field experiments were conducted during 2013 and 2014, at Agricultural College and Research Institute, Madurai to study the effect of integrated weed management in rainfed cotton. The weed management practices consisted of pendimethalin (1.0 kg.ha^{-1}) and (*Calotropisgigantea* leaf extract spray at three concentrations (10%, 20%, and 30%) in combination with power weeder operation twice and manual weeding twice. From the results of the experiments, it could be recommended that the integrated weed management practices like, application of PE pendimethalin at 1.0 kg ha^{-1} + power weeding on 40 DAS (T_{11}) recorded higher seed cotton yield and economic return.

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KEY WORDS :
Weed density, Weed dry weight, Yield, Economic return

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BACKGROUND AND OBJECTIVES

Cotton varieties are cultivated at wider spacing, which in turn invites multiple weed species infestation. Weed competition is severe during its initial growth stages. The increasing cost and unavailability of labour in time has forced to use herbicides for weed control in cotton. So to attain a season long weed control, integration of chemical, mechanical and cultural methods holds a great promise in crop production. Hence, integrated weed management in cotton play important role in increasing crop production.

Brar *et al*. (1995) stated that pre emergence application of pendimethalin @ 1.5 kg ha^{-1} followed by one hoeing at 30 DAS was effective for the control of annual broad leaved and grassy weeds. The total weed density was reduced by 60-70 per cent with application of pendimethalin at 1.0 kg ha^{-1} + hand weeding on 30 DAS (Vivek *et al*., 2002). Velayutham (1996) reported that pre-emergence application of pendimethalin at 0.75 kg ha^{-1} followed by one hand weeding resulted in the enhanced kapas yield which was comparable with hand weeding twice. Rajavel *et al*. (2002) obtained higher seed cotton yield of 1217 kg ha^{-1} under integrated method of herbicide with manual weeding which was comparable with manual weeding twice (1205 kg ha^{-1}). The higher seed cotton yield and benefit: cost ratio were recorded with three hand weedings and three hoeings followed by pre and post-emergence application of pendimethalin and glyphosate

with two hand weedings and two hoeings (Deshpande *et al.*, 2006). So to attain a season long weed control, integration of chemical, mechanical and cultural methods holds a great promise in cotton production. Hence, integrated weed management in cotton play important role in increasing crop production.

RESOURCES AND METHODS

Field experiments were conducted at Agricultural College and Research Institute, Madurai during 2013 and 2014. Field trials were laid out in Randomized Block Design with fourteen treatments replicated thrice. The weed management practices evaluated in the present study consisted of *Calotropis gigantea* leaf extract spray at three concentrations (10%, 20%, and 30%) chemical weed control (Pendimethlin @ 1.0 kg ha^{-1}) power weeder weeding (PWW at twice) and manual weeding (hand weeding twice) in combination. Leaf extracts of 10, 20 and 30 per cent concentrations were sprayed on 3 DAS as pre emergence (PE) and 10 DAS as early post emergence (EPoE) by using hand sprayer. Weed management practices (hand and power weeding) were done on 40 DAS.

OBSERVATIONS AND ANALYSIS

Weed flora of the experimental field consisted of fourteen weeds and among these weeds, *Cyanodon dactylon* and *Echinochloa colonum* were the dominant grass, *Cyperus rotundus* was the only sedge, *Trianthema portulacastrum*, *Corchorus trilocularis* and *Cleome viscose* were the predominantbroad leaved weeds.The results of the experiment revealed that the broad leaved weeds dominated over grasses and sedges in cotton during the initial growth stage. Among broad leaved weeds, *Trianthema portulacastrum* was the dominant weed flora during both the years. Dominance of broad leaved weeds in early stages was due to their faster growth and deep root system and thus promoted the absorption of soil moisture.

Effect ontotal weed density, total weed dry weight and weed control efficiency :

At 20 DAS, lesser and comparable level of total weed density and weed dry weight were recorded in the application of PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and application of PE pendimethalin at 1.0 kg ha^{-1} + PW(T_{11})during 2012 and 2013, respectively. At 40 DAS, during 2012 and 2013, lesser density and dry weight of total weed were observedwith two hand weeding (T_{12}), two power weeding (T_{13}), application of PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) which were comparable with each other. At 60 DAS, lesser total weed density (Fig.1) and dry weight (Fig. 2) were found in two hand weeding (T_{12}), PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}), PE pendimethalin at 1.0 kg ha^{-1}+ PW (T_{11})

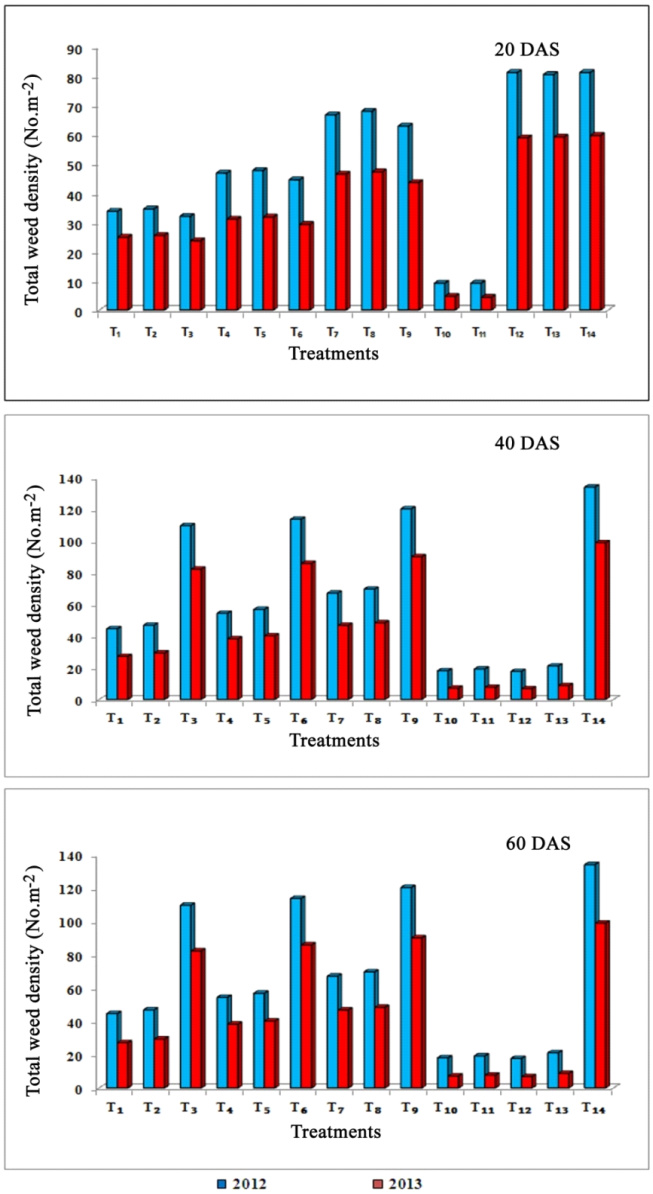

Fig. 1 : Effect of weed management practices on total weed density at 20, 40 and 60 DAS during 2012 and 2013

and two power weeding (T_{13}) which were comparable with each other during 2012 and 2013, respectively. Unweeded check observed with higher density and dry weight of total weed at all the stages of observation during both the years. During 2012 and 2013, application of PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) registered higher WCE at 20 DAS. At 40 DAS, two hand weeding (T_{12}), two power weeding(T_{13}), PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) recorded highest WCE. At 60 DAS, two hand weeding(T_{12}), PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}), PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) and two power weeding(T_{13}) were recorded with higher WCE (Fig. 3).

Effect on yield attributes, seed cotton yield and economics :

Weed management practices did not significantly influence the number of monopodial branches $plant^{-1}$ in both the years. The data on number of sympodial branches $plant^{-1}$, number of bolls $plant^{-1}$ and boll weight were recorded and presented under yield characters. Significant variation among the treatments was noticed for all the yield attributes. During 2012, the maximum seed cotton yield of 2185 kg ha^{-1} was registered with two hand weeding (T_{12}) and the yield under this treatment was comparable with PE pendimethalin at 1.0 kg ha^{-1}+ HW (T_{10}), PE pendimethalinat 1.0 kg ha^{-1} + PW (T_{11}) and two power weeding (T_{13}) with the yield of 2123, 2087, 2045 kg ha^{-1}.During 2013, two hand weeding (T_{12}) was comparable with PE pendimethalin at 1.0 kg ha^{-1}+ HW (T_{10}), PE pendimethalin at 1.0 kg ha^{-1}+ PW (T_{11}) and two power weeding (T_{13}) which registered higher seed cotton yield of 2293, 2232,2196 and 2174 kg $ha^{-1,}$ respectively (Fig. 4). Unweeded control recorded lesser seed cotton yield of 1356 and 1517 kg ha^{-1} in both the years, respectively.Highest benefit cost ratio (B: C ratio) was obtained with the application of PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) with 1.82 and 1.69 during 2012 and 2013. It was followed by PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) with 1.80 and 1.66 during the two years of study (Table 1).

Effect of weed control treatments on weed density, weed dry weight, weed control efficiency, seed cotton yield and economics :

Among the broad leaved weeds, *Trianthema portulacastrum* was the dominant weed flora during both the years of study. This might be due to the smothering effect of broad leaved weeds on monocots. The leaf area of the weed was more favourable for interception of brighter solar radiation. Nazar *et al*. (2008) reported that dominance of broad leaved weeds during the early stages of cotton was due to their fast growth and deep root system.

In the early stage of the crop growth (20 DAS), total weed density (Fig.1), total weed dry weight (Fig.2), were reduced greatly by the application of PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and PE

Table 1 : Economics of different weed management practices in cotton during 2012 and 2013

Treatments	2012		2013	
	Net income (Rs. ha^{-1})	B:C ratio	Net income (Rs. ha^{-1})	B:C ratio
T_1 - PE Calotropis @ 30 % + HW on 40 DAS	24549	1.48	23065	1.40
T_2 - PE Calotropis @ 30 % + PW on 40 DAS	24534	1.50	24290	1.44
T_3 - PE Calotropis @ 30 % +EPoECalotropis @ 30 %	8932	1.19	9872	1.18
T_4 - PE Calotropis @ 20 % + HW on 40 DAS	14709	1.29	15585	1.27
T_5 - PE Calotropis @ 20 % + PW on 40 DAS	14654	1.30	16810	1.30
T_6 - PE Calotropis @ 20 % +EPoECalotropis @ 20 %	8012	1.17	8992	1.17
T_7 - PE Calotropis @ 10 % + HW on 40 DAS	12749	1.25	13945	1.24
T_8 - PE Calotropis @ 10 % + PW on 40 DAS	13414	1.27	14730	1.26
T_9 - PE Calotropis @ 10 % +EPoECalotropis @ 10 %	7572	1.16	8232	1.15
T_{10} -Pendi. @ 1.0 kg ha^{-1} + HW on 40 DAS	37624	1.80	35630	1.66
T_{11} -Pendi. @ 1.0 kg ha^{-1} + PW on 40 DAS	37529	1.82	35895	1.69
T_{12} -HW on 20 and 40 DAS	37351	1.75	35023	1.62
T_{13} -PW on 20 and 40 DAS	35256	1.76	34608	1.66
T_{14} -Unweeded control	13156	1.32	14268	1.31

pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}). Prabhu (2010) pointed out that broad spectrum action of pendimethalin recorded lesser density of grasses at 25 DAS due to the translocative nature of the herbicide. At 20 DAS, the sedge weeds were not satisfactorily controlled by pendimethalin 30 per cent EC formulation. It was supported by Nair *et al*. (1983) stating the failure of pendimethalin to control nutsedge. Pre emergence application of pendimethalin effectively reduced *Trianthema portulacastrum* which was the predominant weed in the experimental site. This might be possibly due to the effective prevention of seed germination of broad leaved weeds. Nalini (2010) reported that pendimethalin effectively controlled annual weeds than perennial weeds. Das and Duary (1998) reported that the herbicidal effect of pendimethalin might be due to the inhibition of cell division and thus curtailed the density of weeds. The reduced weed dry weight could be due to the reduction in weed density at all the stages of crop growth. This might be attributed to rapid depletion of carbohydrate reserve of the weeds through rapid respiration as pointed out by Prakash *et al*. (1999). At 20 DAS, application of PE pendimethalin at 1.0 kg ha^{-1} + HW and PE pendimethalin at 1.0 kg ha^{-1} + PW recorded the highest WCE of 74.7; 89.35 and 74.33; 89.37 per cent in 2012 and 2013, respectively (Fig. 3).

But at later stages of crop growth (40 DAS), total weed density, total weed dry weight, were reduced by manual weeding twice (T_{12}) and power weeding twice (T_{13}). The underground root portions like tubers and stolens were effectively removed by mechanical methods of weed control than the chemical application. This was

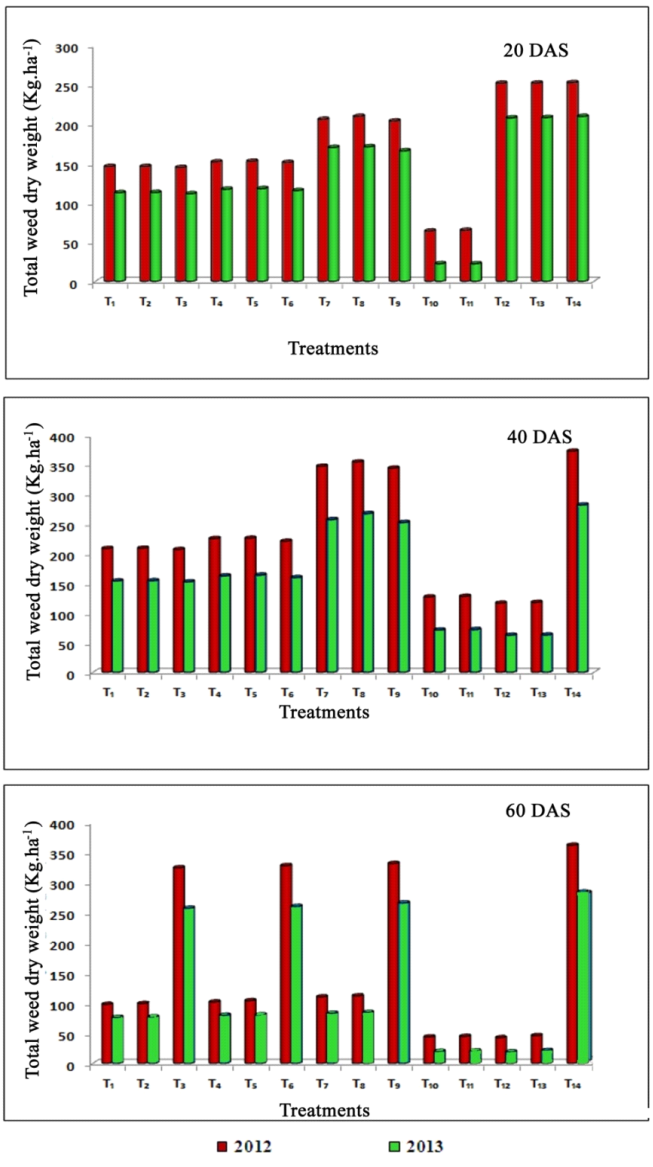

Fig. 2 : Effect of weed management practices on total weed dry weight at 20, 40 and 60 DAS during 2012 and 2013

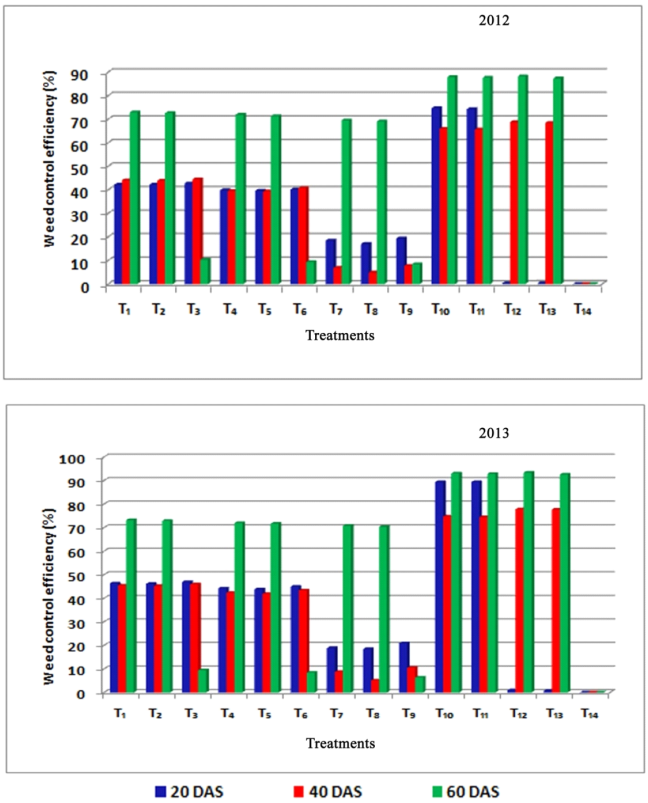

Fig. 3 : Effect of weed management practices on weed control efficiency at 20, 40 and 60 DAS during 2012 and 2013

due to the imposement of first manual weeding on 20 DAS which avoided the competition by weeds with crop for nutrient and moisture (Prabhu, 2010). Shobana (2002) reported that *Cynodon dactylon,* was perennial in nature which was not much controlled by pendimethalin application. At this stage, manual weeding twice controlled the grass and sedge weed efficiently and favoured the growth of cotton which influenced the crop and covered the field surface area much earlier than the weed.

At 60 DAS, both mechanical methods namely manual weeding twice (T_{12}) and power weeding twice (T_{13}) and integrated weed management *viz*., application of PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}) and PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) effectively controlled all the weeds and reduced the dry weight of weeds (Fig. 2) ultimately lead to better weed control efficiency in the above treatments. Balasubramanian (1992) who found that the weed control efficiency was comparatively higher with the application of pendimethalin at 1.0 kg ha^{-1} as compared with 0.5 and 0.75 kg ha^{-1}.

The yield attributing characters *viz*., number of sympodial branches $plant^{-1}$, number of bolls $plant^{-1}$ and boll weight ultimately decide the seed cotton yield. During both the years, the treatments had significant effect on yield attributes and seed cotton yield. The yield attributes andseed cotton yieldwere more with manual weeding twice (T_{12}), PE pendimethalin at 1.0 kg ha^{-1} + HW (T_{10}), PE pendimethalin at 1.0 kg ha^{-1} + PW (T_{11}) and power weeding twice (T_{13}). This might also be due to the season long weed control which was favourable for better growth and enhanced leaf area contributing for the activated photosynthesis and translocation of more photosynthates to sink which increased the boll weight (Nalini, 2010).In the above treatments the yield increasing percentage over control was 61, 57, 54 and 51 per cent during 2012 and 51, 47, 45 and 43 per cent during 2013, respectively (Fig. 4). Gnanavel and Babu (2008) also reported maximum seed cotton yield with pendimethalin combined with hand weeding as compared with control.

Weed management practices showed positive impact on benefit-cost ratio. By considering the cost of cultivation, pre emergence application of pendimethalin at 1.0 kg ha^{-1} + power weeding (T_{11}) resulted in higher net return of Rs. 37,529/- during 2012 and Rs. 35,895/- during 2013 and benefit cost ratio of 1.82 and 1.69 during both the years, respectively.

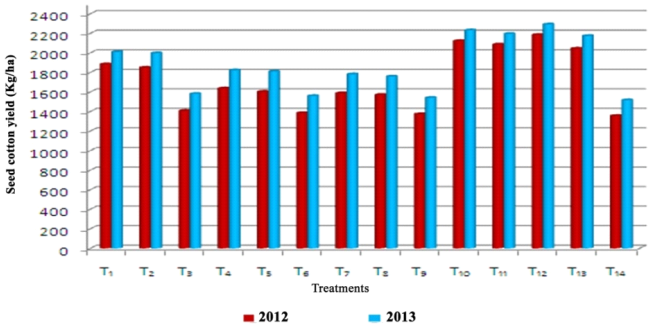

Fig. 4 : Effect of weed management practices on seed cotton yield during 2012 and 2013

Conclusion :

From the above study, it could be concluded,that the integrated weed management practices like, application of PE pendimethalin at 1.0 kg ha^{-1} + power weeding on 40 DAS (T_{11}) could keep the weed density and dry weight reasonably at a lower level and recorded higher seed cotton yield and economic net return. The integrated weed management practices also performed equally effective as that of mechanical methods because of good control of early emerging weeds by the pre emergence herbicide application and better removal of late emerging weeds by mechanical methods of weed control.

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