

Significance of Weed Flora Identification and its Management on *Bt* cotton (*Gossypium hirsutum* L.) growing tract of Tungabhadra Command Area

ABSTRACT

Aims: To identify the weed spectrum in *Bt* cotton under Tunga bhadra project command area and to study the effect of sequential application of pre and post emergent herbicides in weed growth and to know the control efficiency of different weed control practices on particular weed.

Study design: The design of the study was RBD (Randomized Block Design)

Place and duration of study: The experiment was conducted at ICAR- Krishi Vigyan Kendra farm, UAS, Raichur situated in TBP command area during *kharif* season of 2018-19.

Methodology: The design was RBD with 11 treatments and replicated thrice. Gross plot size of the field was 7.2 m × 4.8 m and net plot size was 5.4 m × 3.6 m with spacing of 90 x 30 cm. The certified seeds of Jadoo *Bt* II with an average weight of 6 to 6.5 g were used for sowing. The crop duration was around 6 month

Results: Weed flora present in the *Bt* cotton field were identified and classified based on their morphology. It was divulged that, dicotyledonous weeds were dominant in cotton field. The sequential applications of metolachlor 50 % EC @ 1000 g *a.i.* ha⁻¹ as PRE *fb* pyriithiobac sodium 10 EC @ 125 g *a.i.* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS reported lower weed count and weed dry matter and reported the highest weed control efficiency (90.22 %) at harvest than the single application of herbicides.

Conclusion: Application of pre-emergent followed by post emergent herbicides controls the early and later flush of weeds. It avoids the chance of flourishment of broad spectrum weeds and weed shift. Integrated herbicidal application along with intercultural operations had found better in keeping weed under a threshold than following a single method.

Keywords: Weed flora; weed control efficiency; sequential application; *Bt* cotton; pre-emergent.

1. INTRODUCTION

Bt cotton is the only GM Crop permitted for cultivation in the country by Govt. of India. All four of the cultivated species of cotton, *Gossypium arboretum*, *G. herbaceum*, *G. barbadense* and *G. hirsutum* are grown in Karnataka on an area of 5.75 lakh ha, producing 18 lakh bales and yielding 532.17 kg lint ha⁻¹ [1] *Gossypium hirsutum* accounts for the majority of the hybrid cotton grown. *Bt* cotton is widely grown on black soils in the state's north-eastern dry zone (Zones 2 and 3), which includes portions of the Tunga hhadra and Upper krishna irrigation project commands (TBP and UKP). In these commands, there has been a noticeable increase in the area planted with this crop in recent years.

The losses due to weeds are immense in *Bt* cotton and being a long duration crop, it is subjected to a severe weed menace. Weed infestation in cotton has been reported to offer severe competition and causing yield reduction to an extent of 50-85 per cent. The important monocotyledonous weeds

observed in TBP area were *Cyperus rotundus*, *Cynodon dactylon*, *Dinebra retroflexa*, *Echinochloa colonum* and *Echinochloa crusgalli*. While common dicotyledonous weeds observed were *Abutilon indicum*, *Commelina benghalensis*, *Digeria arvensis*, *Mimosa pudica*, *Parthenium hysterophorous*, *Phyllanthus fraternus*, and *Xanthium strumarium* [18]. With the the use of a suitable herbicide, weeds in the cotton field can be effectively killed or paralysed its germination itself. Hence, they are capable of giving the crop a relatively better weed free situation in the early stage of crop. Thus, the Weed flora identification is very much important in knowing the selectivity and susceptibility of weeds towards the particular herbicides. Recent studies on sequential use of herbicides were evident that, single treatment of herbicides failed to control weeds more effectively than the former method. Hence this study was conducted to prove the effect of sequential application of herbicides on weeds flora identified from *Bt* growing area [9].

2. MATERIAL AND METHODS

The experiment was conducted during kharif season of 2018-19 at ICAR- Krishi Vigyan Kendra farm, UAS, Raichur situated in TBP command area. It was laid out in medium black soil situated in North-eastern Dry zone (Zone 2) of Karnataka at 15°14' N latitude and 77°07' E longitude with an altitude of 389 meters above the mean sea level. The design was RBD with 11 treatments and three replications. Gross plot size was 7.2 m × 4.8 m and net plot size was 5.4 m × 3.6 m. The certified seeds of Jadoo *Bt* II with an average weight of of 6 to 6.5 g were used for sowing with a spacing of 90 cm × 30 cm. The sowing was done at August 16th 2018. The treatment consists of T₁-Metolachlor 50 % EC @ 800 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₂ - Metolachlor 50 % EC @ 1000 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₃- Metolachlor 50 % EC @ 1200 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₄- Metolachlor 50 % EC @ 2000 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₅- Diuron 80 % WP @ 1500 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₆- Pendimethalin 30 EC @ 1250 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS, T₇-Metolachlor 50 % EC @ 1000 g *a.i* ha⁻¹ as PRE *fb* Pyriithiobac sodium 10 EC @ 125 g *a.i* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS, T₈- Diuron 80 % WP @ 1500 g *a.i* ha⁻¹ as PRE *fb* Pyriithiobac sodium 10 EC @ 125 g *a.i* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS, T₉- Pendimethalin 30 EC @ 1250 g *a.i* ha⁻¹ as PRE *fb* Pyriithiobac sodium 10 EC @ 125 g *a.i* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS, T₁₀-Two hand weeding @ 15 and 30 DAS *fb* IC at 45, 60 and 75 DAS and T₁₁-Weedy check @ 15 and 30 DAS.

Metolachlor 50 EC, Diuron 80 WP and Pendimethalin 30 EC were applied on soil surface a day after sowing. Knapsack sprayers were utilized to apply these herbicides, and 1000 litres of water were used per hectare. Pyriithiobac sodium 10 EC was used in this experiment as post emergent. Intercultivation was carried out at 45 and 60 DAS for (T7 to T9) and at 45, 60 and 75 DAS for (T10). With the use of a blade hoe attached to bullocks, intercultivation was carried out. Only weed free checks at 15 and 30 DAS are conducted manually by hand. Three picking was done here during 6 MAP.

3. Results and Discussion

3.1 Observation on weeds

3.1.1 Weed flora

Table 1 indicating the weed flora observed in this experiment site of *Bt* cotton. The most found monocotyledonous weeds in this experiment were *Agropyren repens*, *Brachiaria euciformis*, *Cyanadon dactylon*, *Cyperus rotundus*, *Dinebra retroflexa*, *Digitaria ciliaris*, and *Dinebra retroflexa*. While common dicotyledonous weeds observed were *Aristolochia bracteata Retz*, *Amaranthus spinosus*, *Calatropis gigantean*, *Commelina bengalensis*, *Corchorus trilocularis*, *Euphorbia geniculata*, *Euphorbia hirta*, *Cassia occidentalis*, *Cleome viscosa*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Xanthium strumarium*, *Abutilon indicum* etc.

The poaceae was the most prevalent family identified here. Species composition was not uniform in the field still; the dicotyledonous weeds were more in number and competitive with the crop. These findings were also previously noted by [3, 12, 15, and 18]. It was also visible that, both *kharif* and *rabi* weeds were abundant in this area as because of the soil was vertisol, which had favourable physio-chemical properties. The [6] also reported that the soil characteristics particularly the amount of clay, play a major role in weed flora growth.

3.1.2 Total weed count (m⁻²)

The total weed count at different stages of crop growth influenced by different type of herbicidal applications is depicted in the Fig. 1. The lowest weed count (2.60 m⁻²) at 15 and (3.97 m⁻²) 30 DAS was recorded with the application of metolachlor 50 % EC @ 2000 g a.i ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS. The highest weed count (4.16 m⁻²) at 15 DAS and (5.16 m⁻²) at 30 DAS was identified in weedy check.

At 45 DAS, metolachlor 50 % EC @ 1000 g a.i. ha⁻¹ as PRE *fb* pyrithiobac sodium 10 EC @ 125 g a.i. ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS recorded the lower weed count after weed free treatment, two hand weeding @ 15 and 30 DAS *fb* IC at 45, 60 and 75 DAS. Other treatments were comparable and were significantly superior to weedy check.

At 75 DAS and at harvest metolachlor 50 % EC @ 1000 g a.i. ha⁻¹ as PRE *fb* pyrithiobac sodium 10 EC @ 125 g a.i. ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS (T₇) had significantly lower weed count (4.86 m⁻²) and (3.62 m⁻²) respectively, among all other treatments.

Table 1. Different weed flora belongs to monocot, dicot and sedges observed in the experimental site

Weed species	Family
Monocot	
<i>Cynodon dactylon</i> (L.) Pers	Poaceae
<i>Dinebra retroflexa</i> (Vahl.)	Poaceae
<i>Digitaria ciliaris</i>	Poaceae
<i>Brachiaria euciformis</i>	Poaceae
<i>Agropyron repens</i> L.	Poaceae
<i>Celosia argentea</i> L.	Poaceae

<i>Cyperus rotundus</i> L.	Cyperaceae
Dicot	
<i>Cyanotis cucullata</i> (Roth)	Commelinaceae
<i>Euphorbia hirta</i> L.	Euphorbiaceae
<i>Euphorbia geniculata</i> L.	Euphorbiaceae
<i>Legasca mollis</i> ,	Asteraceae
<i>Leucus aspera</i>	Laviatae
<i>Parthenium hysterophorus</i> L.	Asteraceae
<i>Phyllanthus niruri</i>	Euphorbiaceae
<i>Physalis minima</i>	Solanaceae
<i>Abutilon indicum</i> (L.) Sweet	Malvaceae
<i>Acalypha indica</i>	Euphobiaceae
<i>Acanthospermum hispidum</i>	Asteraceae
<i>Amaranthus spinosus</i>	Amaranthaceae
<i>Aristolochia bracteata</i> Retz.	Aristolochiaceae
<i>Calotropis gigantea</i> R. Br.	Asclepiadaceae
<i>Commelina benghalensis</i> L.	Commelinaceae
<i>Corchorus trilocularis</i>	Teliaceae
<i>Portulaca oleracea</i>	Portulacaceae
<i>Sida acuta</i> L.	Malvaceae
<i>Tridax procumbens</i>	Compositae
<i>Xanthium strumarium</i> L.	Asteraceae
Sedges	
<i>Cyperus rotundus</i>	Cyperaceae
<i>Cyperus esculentus</i>	Cyperaceae

It was followed by T₈ diuron 80 % WP @ 1500 g a.i. ha⁻¹ as PRE fb pyriithobac sodium 10 EC @ 125 g a.i. ha⁻¹ as POE @ 2-5 leaf stages of weeds fb IC @ 60 DAS (3.80 m⁻²), (T₉) pendimethalin 30 EC @ 1250 g a.i. ha⁻¹ as PRE fb pyriithobac sodium 10 EC @ 125 g a.i. ha⁻¹ as POE @ 2-5 leaf stages of weeds fb IC @ 60 DAS. At harvest the higher weed count (5.93 m⁻²) was recorded in (T₁) metolachlor 50 % EC @ 800 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS after weedy check (6.14 m⁻²) followed by T₅ diuron 80% WP @ 1500 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS (5.13 m⁻²), T₆ pendimethalin 30 EC @ 1250 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS (5.08 m⁻²), (T₂) metolachlor 50 % EC @ 1000 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS (5.02 m⁻²), (T₃) metolachlor 50 % EC @ 1200 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS (4.88 m⁻²), (T₄) metolachlor 50 % EC @ 2000 g a.i. ha⁻¹ as PRE fb IC @ 45 and 60 DAS (4.69 m⁻²).

The chemical treatment had reported higher weed control than the cultural weed control alone at earlier stages. As the herbicides were systemic in their function, it disrupts the cell division and cell elongation in shoot and root meristem of susceptible plants [2]. At 45 DAS, Application of POST emergent herbicides followed by PRE were significantly reduced the weed count compared to the sole application of Pre-emergent chemicals. Pyriithobac sodium, a newer type of acetolactase synthase inhibitor that affects the formation of amino acid in weeds, along with the aforementioned, tank mixing of pyriithobac and grassy herbicides may boost the phytotoxicity on weeds [19]. Further from 75 DAS to harvest, there was no significant effect of weeds on crop, as the cotton crop itself could smother the associated weeds due to its dense growth. Fully developed canopy reduced the

availability of nutrients and water towards weeds. The results are in conformity with the findings of [24].

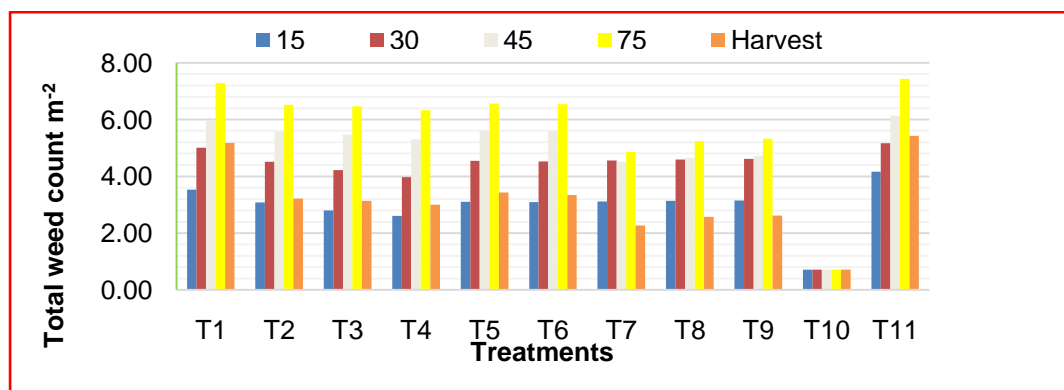


Fig. 1 Total weed count per m² in *Bt* cotton at different stages of crop growth as influenced by weed management treatments

3.1.3 Dry weight of weeds

3.1.3.1 Dry weight of monocot weeds (g m⁻²)

The effect of herbicidal application on dry weight of *Bt* cotton is presented in Table 2. There was noted a significant variation in dry matter production with different weed management practices. During initial period at 15 and 30 DAS, the highest weed dry matter production (5.73 g m⁻² and 12.76 g m⁻²) were found in weedy check followed by metolachlor 50% EC @ 800g *a.i ha*⁻¹ as PRE *fb IC* @ 45 and 60 DAS (T₁) and the least was found in two hand weeding @ 15 and 30 DAS *fb IC* at 45, 60 and 75 DAS (T₁₀) followed by metolachlor 50 % EC @ 2000 g *a.i ha*⁻¹ as PRE *fb IC* @ 45 and 60 DAS (T₄) at 15 (4.06 g m⁻²) and 30 DAS (8.46 g m⁻²).

At 45 DAS, metolachlor 50 % EC @ 1000 g *a.i. ha*⁻¹ as PRE *fb* pyriithiobac sodium 10 EC @ 125 g *a.i. ha*⁻¹ as POE @ 2-5 leaf stages of weeds *fb IC* @ 60 DAS (T₇) recorded the lower weed dry matter production (3.83 g m⁻²) followed by (T₈) diuron 80 % WP @ 1500 g *a.i. ha*⁻¹ as PRE *fb* pyriithiobac sodium 10 EC @ 125 g *a.i. ha*⁻¹ as POE @ 2-5 leaf stages of weeds *fb IC* @ 60 DAS (5.07 g m⁻²), (T₉) pendimethalin 30 EC @ 1250 g *a.i. ha*⁻¹ as PRE *fb* pyriithiobac sodium 10 EC @ 125 g *a.i. ha*⁻¹ as POE @ 2-5 leaf stages of weeds *fb IC* @ 60 DAS (5.00 g m⁻²). The higher weed dry matter weight recorded in T₁ [metolachlor 50 % EC @ 800 g *a.i ha*⁻¹ as PRE *fb IC* @ 45 and 60 DAS (11.71 g m⁻²)] was next to weedy check (13.47 g m⁻²). Almost similar trend was observed at 75 DAS and harvest.

Vigour is just as crucial as quantity for determining weeds' competitive abilities. Weeds at lower densities can nevertheless harm crops just as much as those at higher densities. Therefore weed dry matter per unit area is a better index than weed count to evaluate the impact of weeds on crops. Among herbicidal applications, at initial days from 15 DAS up to 45 DAS the treatments receiving PRE emergent applications reported lower weed dry matter weight [8] and later flush of

weeds were controlled effectively by the application of PRE emergent followed by POST emergent herbicidal application [16].

3.1.3.2 Dry weight of dicot weeds ($g\ m^{-2}$)

The application of metolachlor 50 % EC @ 2000 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS (T₄) recorded lower weed dry weight at (3.94 g m⁻²) 15 and 30 DAS (9.35 g m⁻²) after weed free check (Two hand weeding @ 15 and 30 DAS *fb* IC at 45, 60 and 75 DAS).

There was a change in dry matter accumulation after 45 DAS and up to harvest which follows a same trend. The treatment T₇ recorded the lower weed dry weight (3.75 g m⁻²) after weed free check followed by T₈ (4.81 g m⁻²) and T₉ (3.77 g m⁻²) at 45 DAS. The higher weed dry weight was observed in T₁ (11.71 g m⁻²) after weedy check followed by (9.81 g m⁻²) T₂ (Metolachlor 50% EC @ 1000g *a.i.* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS).

Among the POST emergent herbicidal applications, pyriithiobac sodium chemical was found as the most superior herbicide. Metolachlor provides an alternative mode of action for use on pre emerged weeds, creates flexibility for the post emergent application. Hence it controlled more weeds than other chemicals. These findings are in agreement with the report of [5, 17, 20].

3.1.4 Weed control efficiency (%)

The weed control efficiency depicted in the Fig. 2 showed a significant variation in its efficiency at different stages of growth with the different method of weed control treatments. At 15 DAS two hand weeding @ 15 and 30 DAS *fb* IC at 45, 60 and 75 DAS found the highest weed control efficiency (100 %) followed by metolachlor 50 % EC @ 2000 g *a.i* ha⁻¹ (50.65 %), metolachlor 50 % EC @ 1200 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS (41.62 %), metolachlor 50 % EC @ 1000 g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS (34.93 %). The least efficiency was noted in (T₁) metolachlor 50 % EC @ 800 g *a.i.* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS followed by (T₉) Pendimethalin 30 EC @ 1250 g *a.i.* ha⁻¹ as PRE *fb* Pyriithiobac sodium 10 EC @ 125 g *a.i.* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS. Similar, trend was noticed at 30 DAS.

At 45 DAS (82.33 %), 75 DAS (85.46 %) and harvest (90.22 %) higher weed control efficiency was observed with the application of metolachlor 50 % EC @ 1000 g *a.i.* ha⁻¹ as PRE *fb* pyriithiobac sodium 10 EC @ 125 g *a.i.* ha⁻¹ as POE @ 2-5 leaf stages of weeds *fb* IC @ 60 DAS (T₇) followed by T₈ and T₉. The lower weed control efficiency was recorded with the application of metolachlor 50% EC @ 800g *a.i* ha⁻¹ as PRE *fb* IC @ 45 and 60 DAS (T₁) at 45 DAS (29.97 %), 75 DAS (29.07 %) and harvest (31.70 %).

Table 2. Effect of different herbicidal application on dry weight of monocot and dicot weed in *Bt* cotton, g m⁻²

Treatments	Dry weight of monocot weeds					Dry weight of dicot weeds				
	15 DAS	30 DAS	45 DAS	75 DAS	At harvest	15 DAS	30 DAS	45 DAS	75 DAS	At harvest

T1 - Metolachlor 50 % EC @ 800g a.i. ha ⁻¹ as PRE fb IC @ 45 and 60 DAS	5.33	11.35	11.71	12.60	10.29	5.11	11.61	11.80	12.67	10.29
T2 - Metolachlor 50 % EC @ 1000 g a.i. ha ⁻¹ as PRE fb IC @ 45 and 60 DAS	4.74	9.60	9.81	9.32	7.49	4.41	9.65	9.81	9.34	7.54
T3 - Metolachlor 50 % EC @ 1200 g a.i. ha ⁻¹ as PRE fb IC @ 45 and 60 DAS	4.38	9.35	9.79	9.30	7.47	4.06	9.42	9.70	9.25	7.29
T4 - Metolachlor 50 % EC @2000 g a.i. ha ⁻¹ as PRE fb IC @ 45 and 60 DAS	4.06	8.46	9.63	9.26	7.27	3.94	9.35	9.63	9.23	7.27
T5 - Diuron 80 % WP @ 1500 g a.i ha ⁻¹ as PRE fb IC @ 45 and 60 DAS	4.77	9.62	9.77	9.39	7.42	4.48	9.67	9.74	9.46	7.40
T6 – Pendimethalin 30 EC @ 1250 g a.i.ha ⁻¹ as PRE fb IC @ 45 and 60DAS	4.76	9.61	9.74	9.37	7.25	4.45	9.66	9.81	9.41	7.49
T7 – Metolachlor 50 % EC @ 1000 g a.i. ha ⁻¹ as PRE fb Pyriithiobac sodium 10 EC @ 125 g a.i. ha ⁻¹ as POE @ 2-5 leaf stages of weeds fb IC @ 60 DAS	4.78	9.63	3.83	4.81	3.77	4.50	9.68	3.75	4.80	3.77
T8 - Diuron 80 % WP @ 1500 g a.i. ha ⁻¹ as PRE fb Pyriithiobac sodium10 EC @ 125 g a.i. ha ⁻¹ as POE @ 2-5 leaf stages of weeds fb IC @ 60 DAS	4.79	9.64	5.07	6.15	4.67	4.51	9.69	4.98	6.15	4.71
T9 - Pendimethalin 30 EC @ 1250 g a.i. ha ⁻¹ as PRE fb Pyriithiobac sodium 10 EC @125 g a.i. ha ⁻¹ as POE @ 2-5 leaf stages of weeds fb IC @ 60 DAS	4.80	9.65	5.00	6.12	4.78	4.52	9.70	4.81	6.04	4.81
T10 -Two hand weeding @ 15 and 30 DAS fb IC at 45, 60 and 75 DAS	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
T11 -Weedy check	5.73	12.76	13.47	14.92	12.13	5.70	12.84	13.73	15.06	12.05
S.Em±	0.17	0.33	0.34	0.31	0.24	0.20	0.32	0.31	0.30	0.26
CD at 5%	0.50	0.96	0.99	0.91	0.70	0.59	0.95	0.92	0.89	0.76

EC - Emulsifiable concentrate, WP – Wettable powder, IC – Intercultivation
 PRE - Pre-emergence, POE – Post emergence, DAS- Days after sowing
 Data subjected for transformation using $(x + 1)^{1/2}$, Where x is weed coun

The efficiency of weed control is inversely correlated with the amount of weed dry mattedr used in the experiment. Among all other chemical treatments during the early phase at 15 and 30 DAS, treatments receiving PRE emergent herbicides showed the highest weed control efficiency. These findings are consistent with those made by [11, 22].

The herbicides that applied in a sequential manner had considerable effect on weed. The weed control efficiency of such treatments were comparable with weed free check and these findings are consistent with those previously published by [4, 10, 13]. Metolachlor and pyriithiobac sodium were the two most effective treatments controls majority of weeds. This was attributed by the

alternative mode of action and also the presence of grassy weeds which effectively suppress the bulk of weeds. These findings concur with those previously published by [2, 7, 14, and 23].

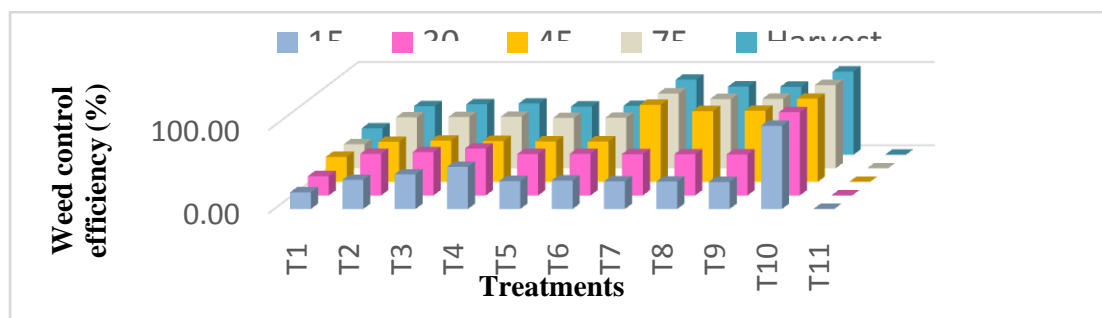


Fig. 2 Weed control efficiency in *Bt* cotton as influenced by weed management Treatments

CONCLUSION

The experiment plot was dominated particularly with dicot weeds; hence the herbicides which kill broad-leaved weeds were used for controlling the weeds. Among all the treatments weed free check recorded the lowest weed density or the count. The weed free check followed by the application of PRE emergent herbicides up to 45 DAS had the lowest weed density or the weed count in all the treatments. PRE *fb* POST emergent herbicide administered treatments were then used to suppress subsequent growth. Significantly the weedy check had the greatest weed count. The weed control efficiency was inversely correlated with the weed dry matter or the weed count. Subsequently to attain a good weed management in a particular area, the weed flora and its morphology should be well studied. Application of herbicides in sequential manner avoids the weed shifting and it can kill a wide range of weeds than a single herbicides. Herbicidal applications along with intercultural operations had reported the best weed management practice in cotton growing tract of TBP command area.

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