3.6 Stage – 4: Field Trials

On the basis of results obtained from the pot study (stage – 3) using *Artemisia* and *Tridax* further experiments were conducted in Field making 1X1 m^2 plots. Each experiment was completed in 90-120 days after sowing (DAS). First experiment was conducted using *Tridax* leaf mulch to see the effect on Green gram and *Parthenium* growth. During the whole study no soil fertilizers or Pesticides were applied.

Experiment 1. It was performed as explained in chapter 2.5 Ten Plants were collected to study different parameters from each plot (i.e. 20 samples for each treatment) during vegetative stage. During Flowering and Fruiting stage total 25 plants were collected from each plot (i.e. total 50 samples for each treatment) (Plate 7,8)

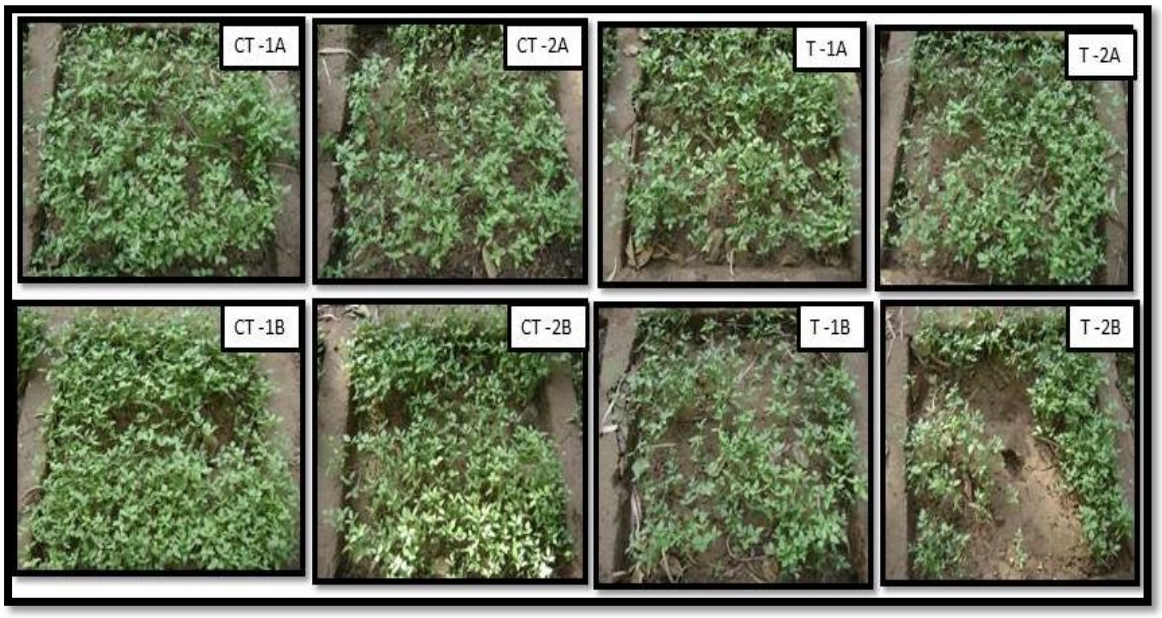


Plate 7: Plot arrangement and Green gram Growth in Experiment -1

(CT-1 (A & B) – Only Green Gram ,CT-2 (A&B) – Green Gram and *Parthenium* seeds,T-1 (A&B) – Green Gram+*Parthenium* – *Tridax* leaf mulch 40gm in each plots, T-2 (A&B) – Green Gram+*Parthenium*- *Tridax* leaf mulch 80gm in each plot)

(Note- PlotT-2B was disturbed by animal for two –three times during cultivation period)

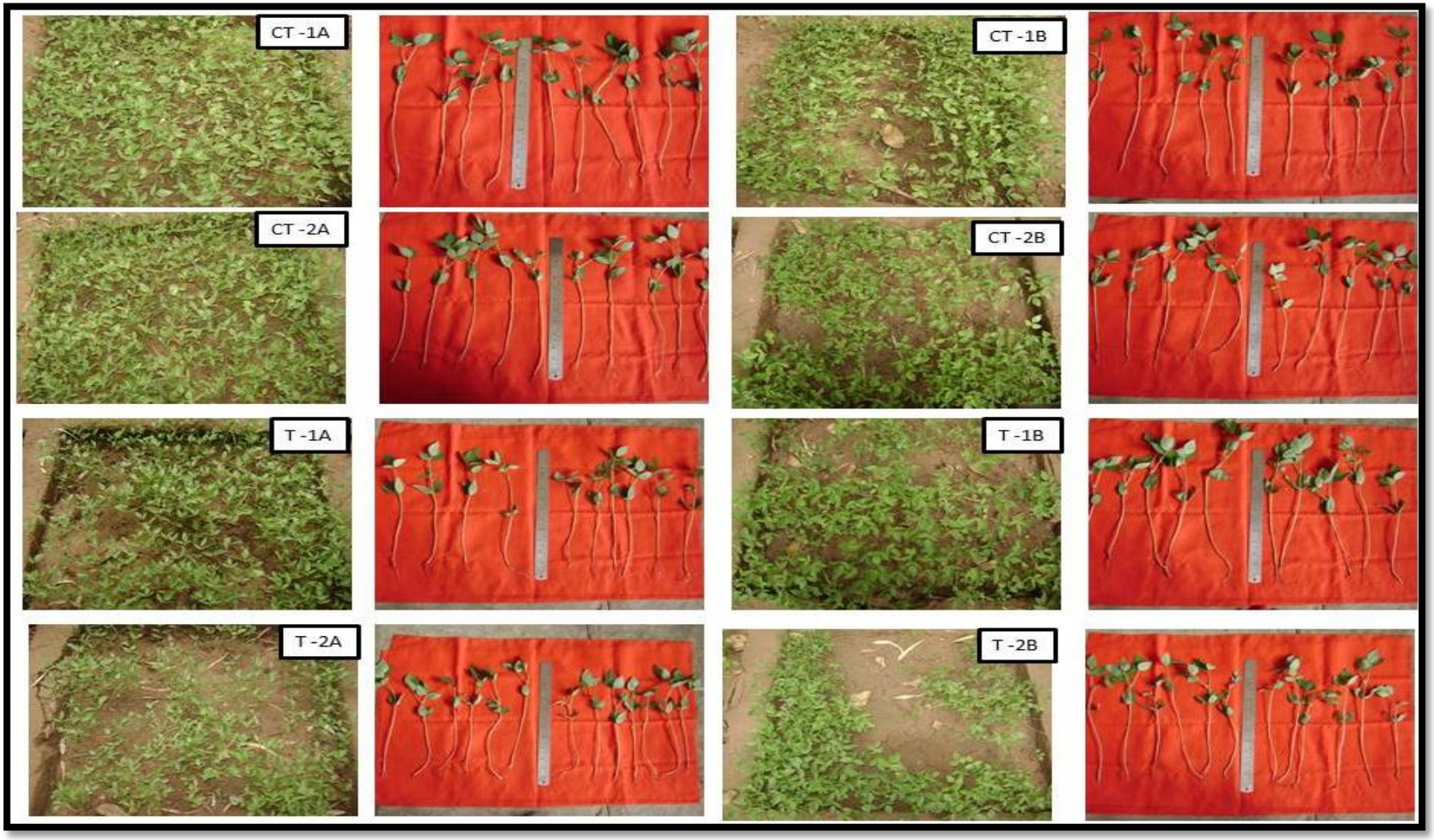


Plate 8 : Green gram Growth in each plot - Random sampling of 10 plants from each plot

i) **Vegetative Stage –at 20 DAS**: Random collection of Green gram plants with approx. Height of **30cm** was done. All the plants were having two to three leaves .In all experimental plots equal number of green gram seeds germinated (Plate 8)

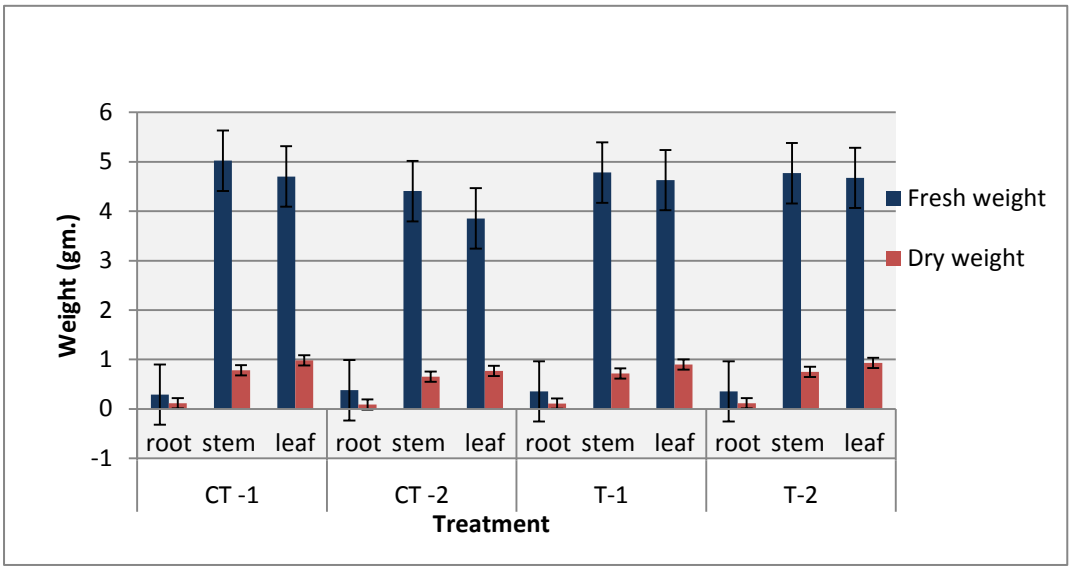


Figure 3.99 Biomass Accumulation in Green gram (Experiment 1-20 DAS)

Root Fresh weight of control was more in CT-2 But dry weight was similar for both CT-1 and CT-2. In treated plants also, root weight was similar to control. Fresh weight of stem and leaf in green gram showed noticeable difference between control and treatment. Biomass of treated green gram was similar to CT-1 but higher than CT-2.Similar results were obtained in dry weight. Dry weight of the root and Fresh weight of leaf was decreased with small change during CT -2.Root biomass was reduced in CT -1 as compared to other treated plants. *Parthenium* seeds did not germinate in any plots till that time (Figure 3.99)

ii) Vegetative Stage – at 40 DAS

Plants were collected with approx. height between 50-60 cm. Maximum root length was observed in CT -2, also in T-2 compare to CT-1 and T-1. Similarly

shoot length was also more in CT -2. Fresh weight of Leaf was more in T-2, but no extreme stimulation or suppression was observed with dry weight of the plants (Figure 3.100)

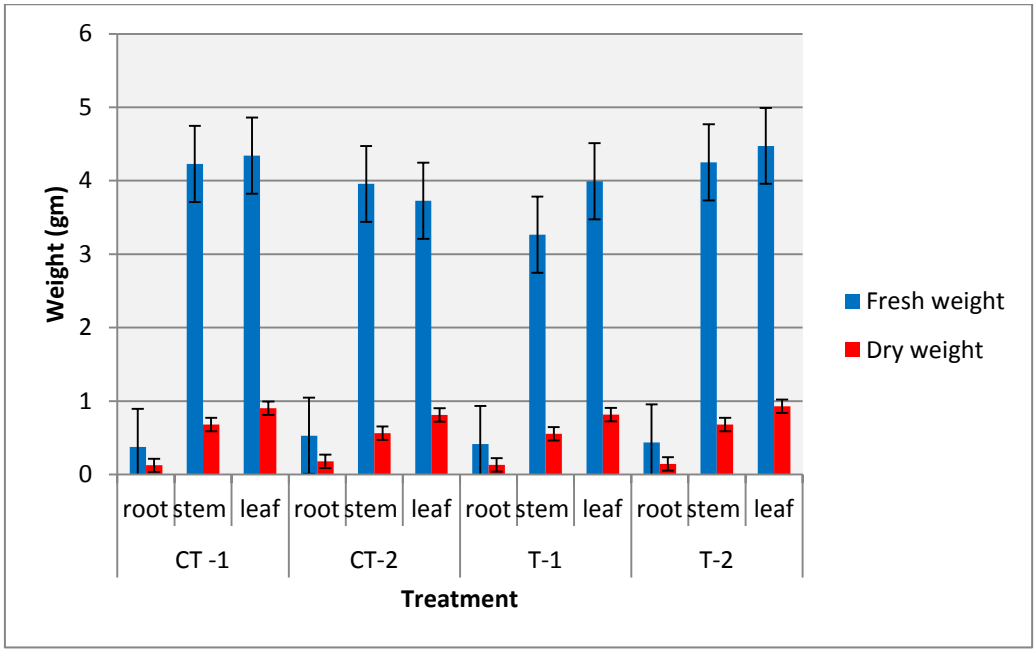
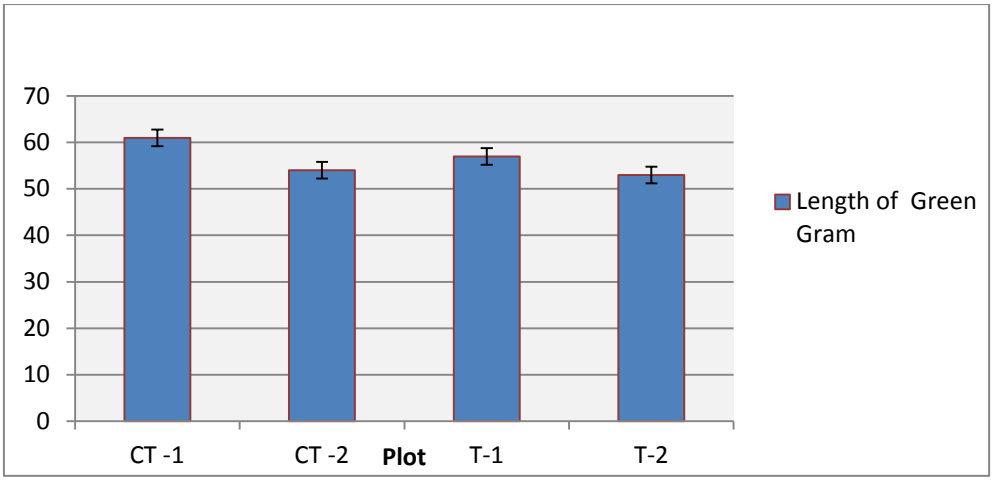


Figure 3.100 Biomass accumulation in Green gram (Experiment 1-40 DAS)

Different Growth parameters were measured, such as Plant height, length of root, number of Nodules on root, Number of leaves present on each plant at 40 DAS. As results in figure 3.92 (a) show that maximum height of green gram plant reached to >50cm in all plots. Maximum height was observed in CT -1. Comparatively length of primary root was measured. Maximum root length was observed in T-1. Maximum number of leaves was observed in T-2 as compared to control and T-1. Treatment -2 showed less height stem but more number of leaves. As length of root was more in CT-1, Number of nodules were also high as compared to other. Nodule count per plant was reduced to some extent during T2. as compared to other plots.(Figure 3.101)



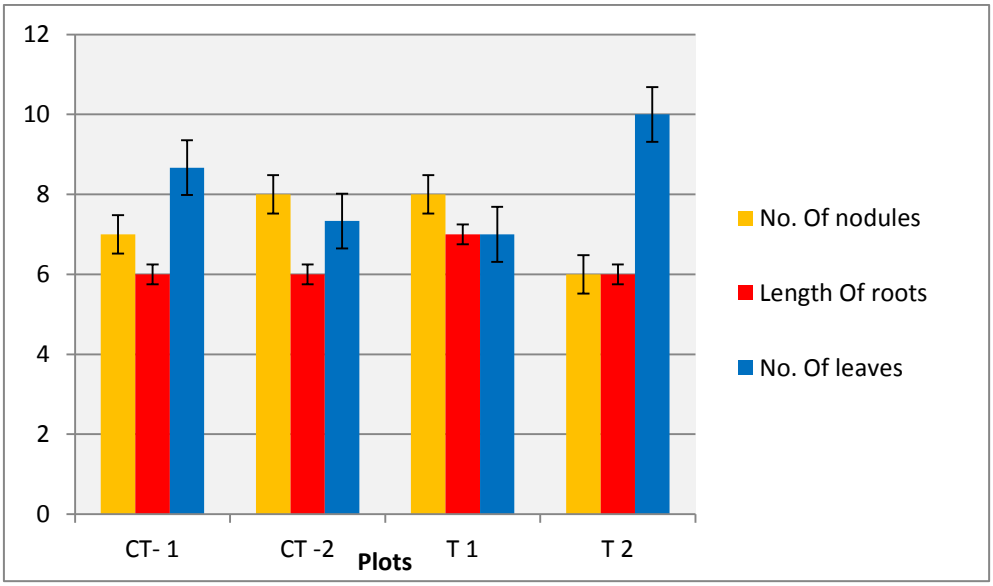


Figure 3.101 (a) and (b) Different Growth Parameters of Green gram (Experiment 1-40 DAS)

T-2 represented distinct stimulation in number of leaves whereas inhibition in root height was observed. T-1 showed minimum effect in all growth parameters Figure 3.101 (b).

Plot No	Total No Of Other Weeds	Dicot				Mono cot		Average	Presence Of *Parthenium*
		Digera	*Capparis*	*Portulaca*	*Evolvulus*		Total number of Weeds / Treatment		
CT - 1A	112	43	17	23	2	27			
CT-1B	68	51	11	0	1	5	178	89	00
CT - 2A	121	64	23	19	0	15			
CT - 2B	28	21	6	0	0	1	149	75	many small
T-1A	47	36	6	0	0	5			
T-1B	70	59	7	0	0	4	117	59	less than ctrl
T-2A	25	20	5	0	0	0			
T-2B	19	9	10	0	0	0	44	22	very few

Table 3.28 Presence of weeds along with *Parthenium* in Untreated (1-4) and Treated plots (5-8) (Experiment 1-40 DAS)

Many weeds other than *Parthenium* were observed as in table 3.28, Total number of weeds were maximum in untreated plots. Number was gradually decreased as concentration of *Tridax* mulch in plots was increased. Significant reduction was observed in the population of all weeds including monocots in T-2 (Plot 7-8) *Parthenium* just started emergence during 40DAS. Number of *Parthenium* seed emergence was more in CT -2 as compared to treated plots. One of the plot from T-2 did not show any seed germination for *Parthenium*.

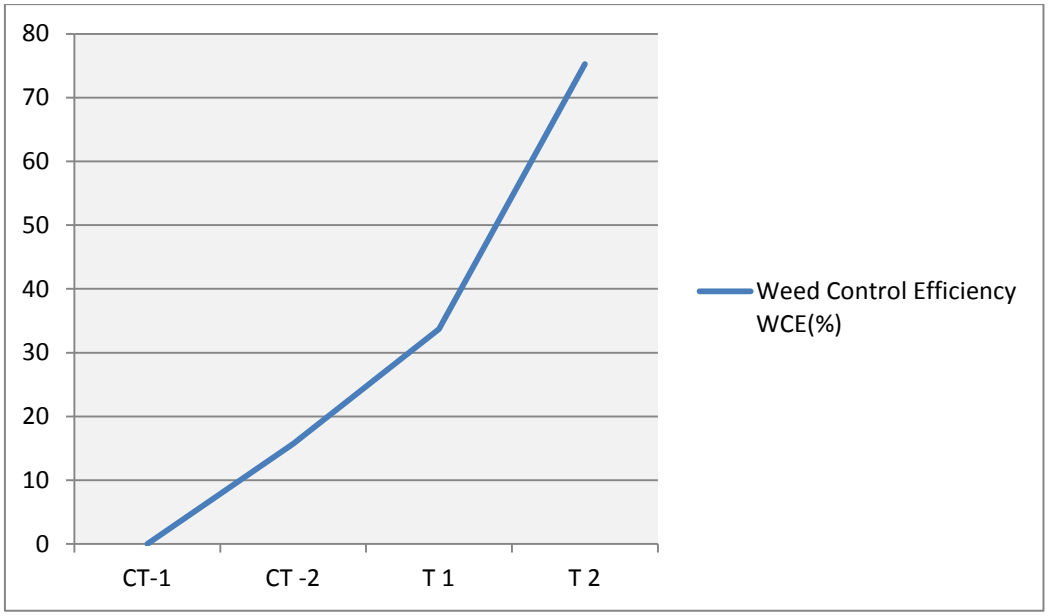


Figure 3.102 WCE (%) (Weed control efficiency) of treated plants- (Experiment 1-40 DAS)

Plots showed presence of many weeds including monocots. *Parthenium* started growing after 30th DAS in CT2. Germination of *Parthenium* was delayed by 4-5 days in T -2 as compared to control. Weed control efficiency of the treated plot was measured for other weeds. WCE (%) was very high in T2 as compared to control plots. Treatment 1 was also efficient to regulate the number of *Parthenium* and other weeds at low concentration of *Tridax*.(Figure 3.102)

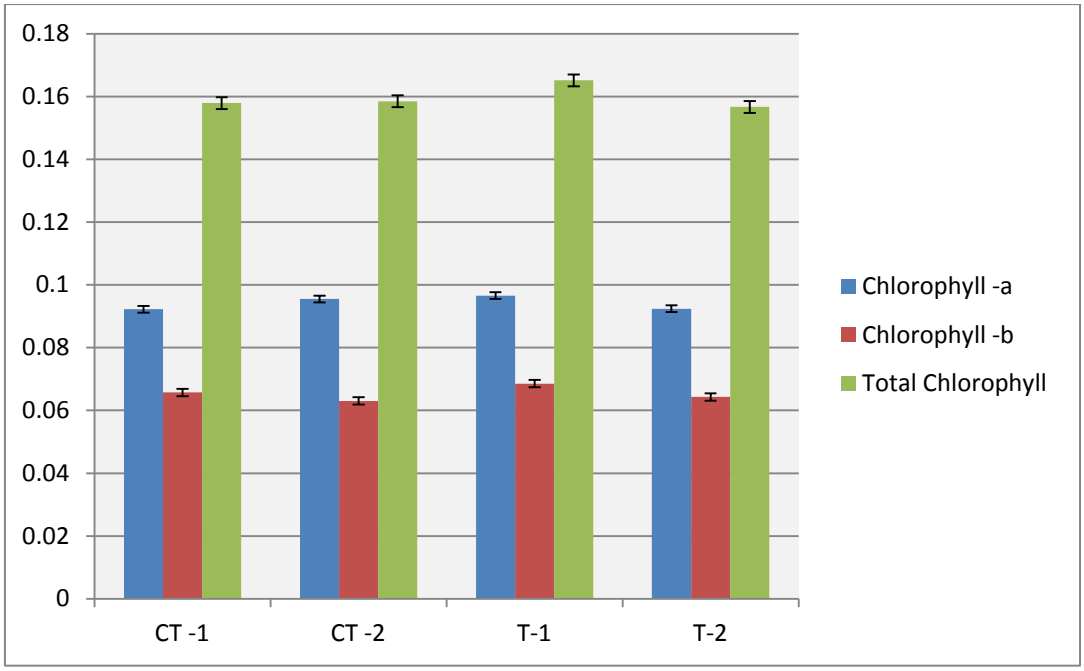


Figure 3.103 Chlorophyll estimation of Green Gram leaf at Vegetative Stage -2 –

(Experiment 1-40 DAS)

Maximum vegetative growth of green gram was observed during 40 DAS in all plots and so chlorophyll content of the leaf were analysed at this stage. Though maximum chlorophyll content were obtained in T1, Chlorophyll content were not showing any major difference between treated and untreated leaves. (Figure 3.103)

iii) Flowering stage– 3 at 60 DAS

Flowering started in all the plots during 50-55th DAS, flowering was initiated first in T-2 at 50DAS. Plants were collected from each plot to study many growth parameters such as number of flowers/ buds. Number of *Parthenium* plants were counted in each plot.Height of randomly collected green gram plants was 60-65 cm.(Figure 3.104)

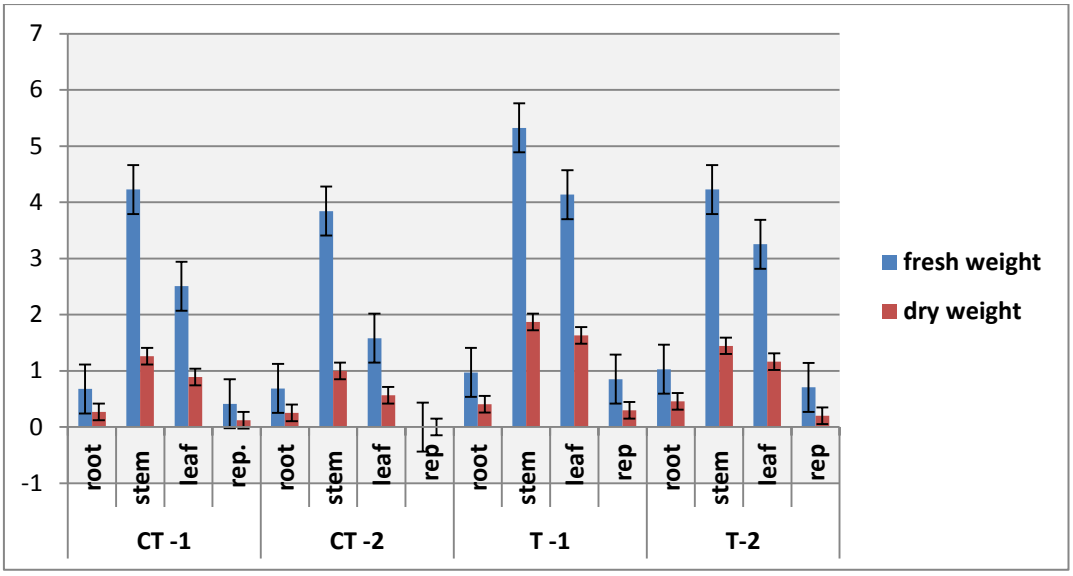


Figure 3.104 Biomass accumulations in green gram Flowering stage. (Experiment 1-60 DAS)

Biomass accumulation was represented in figure 3.95 during 60 DAS, when flowering started in the entire plot. Flowering stage was not yet induced in CT -2. On other hand treated plant were showing early flowering and fruit setting as compared to Control. Biomass of reproductive parts was more in treated plants. Root weight was more in T -1 and T-2. Stem weight was more in T-1 as compared to control and other treatment. Leaf biomass was reduced in treatment and CT-2 as compared to CT -1.(Figure 3.104)

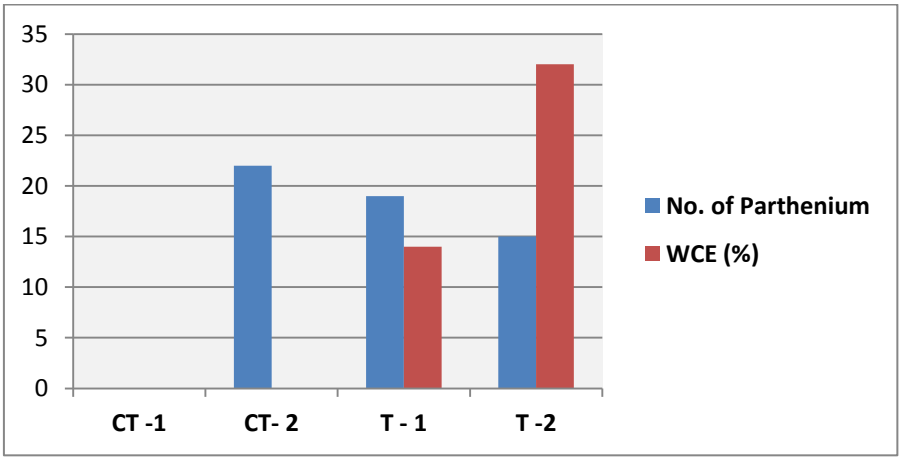


Figure: 3.105 Number of *Parthenium* and WCE (%)plant emergent in each plot.

Parthenium started growing in plot CT -2, T-1 and T-2 at 60 DAS. Number of *Parthenium* was very less in treated plots. Numbers of leaves in *Parthenium* was more in case of CT-2. During any stage of experiment uprooting of *Parthenium* was not done, so that effect of treatment can be observed. Leaves were collected from *Parthenium* to study chlorophyll analysis.(Figure 3.105)

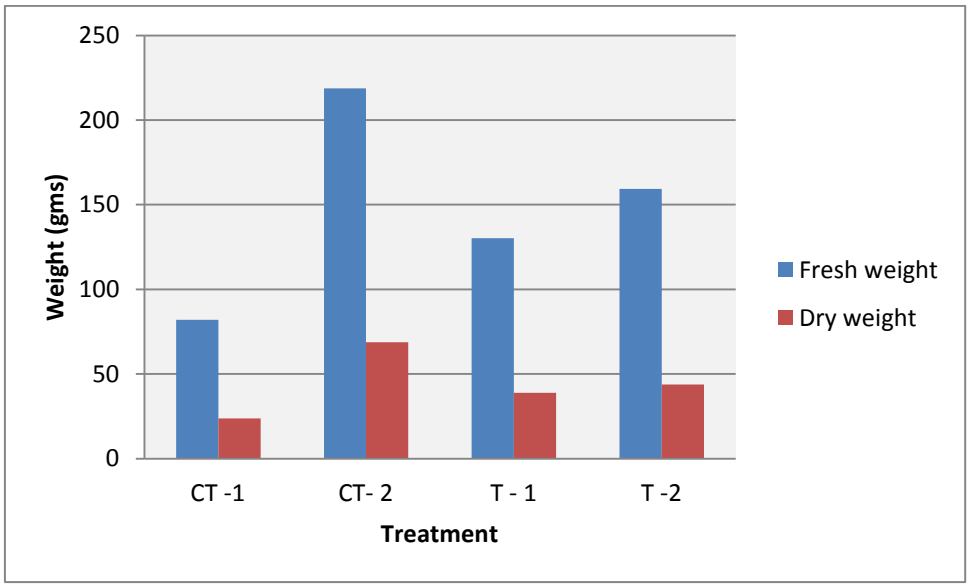


Figure 3.106 Monocot weed population in experimental plots (Experiment 1-60 DAS)

As mentioned above there were number of other weeds present in plot CT -2 especially monocots. During manual weeding before flowering stage, Collection of only monocot plants was done to measure biomass. Maximum biomass was observed in CT-2 and in T-2. Numbers of Monocots were comparatively less in CT-1 and T-1.(Figure 3.106)

iv) Fruiting stage – 80 DAS

As mentioned earlier *Parthenium* started growing well in all plots during the flowering and fruiting stage (i.e. after 60DAS) which can be clearly observed . Number of weeds were very less as compared to legumes growing in plots

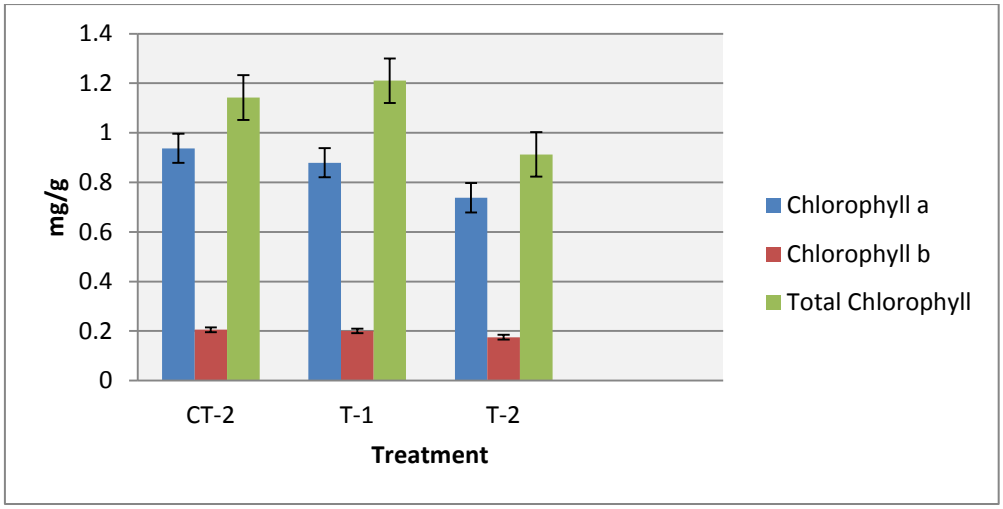


Figure: 3.107 Chlorophyll estimation of *Parthenium* (Experiment - 80 DAS)

Chlorophyll analysis of the *Parthenium* leaf was studied for each plot to see the effect of treatment on its growth and chlorophyll content. There was no change in Chlorophyll b content for CT- 1 and T -1, but Chlorophyll a was remarkably reduced in *Parthenium* leaves collected from T-2 plot. Chlorophyll content of the CT-2 was also affected as there was a presence of other weeds in large population.(Figure 3.107). Chlorophyll content were increased in T-1 then both CT and T-2. Fruit development in green gram started just after flowering stage. Early fruit setting was also observed in T2. For this stage various growth and yield parameters were studied.

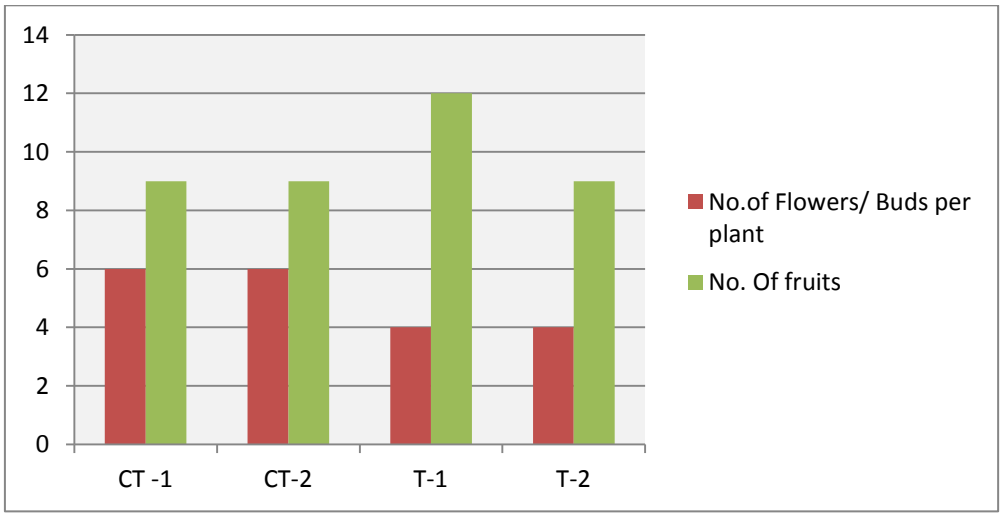


Figure 3.108 Growth parameters of Flowers and Fruits at 80 DAS

Maximum number of flowers per plant were observed in T.1. Minimum number of flowers were observed in both control plant. Number of fruits were less in treated plants and more in control (Figure 3.108)

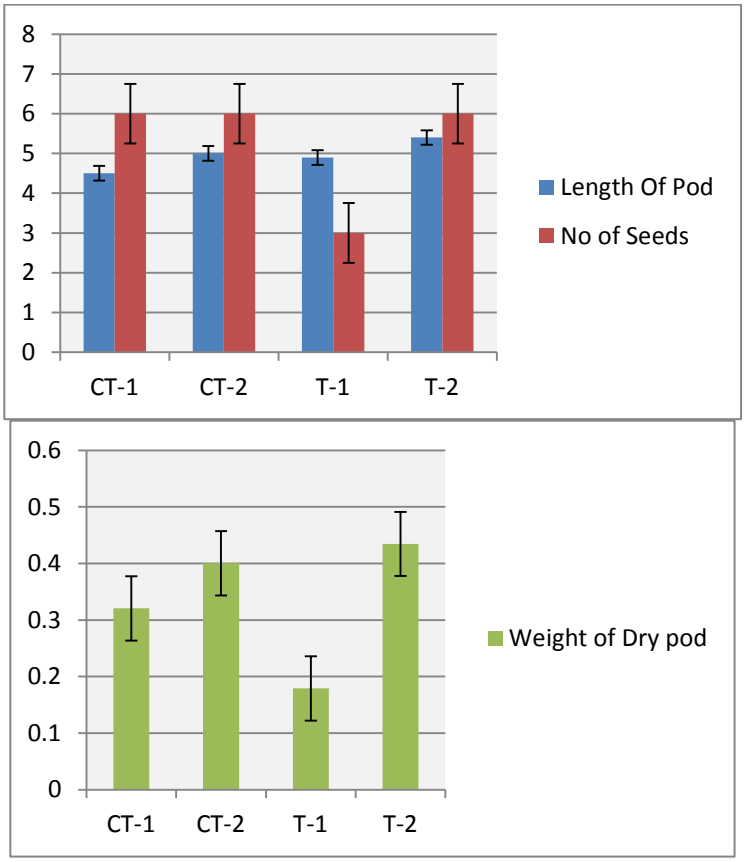


Figure 3.109 Biomass(gm) of Pod and number of seeds/ pod

Length of pod was not variable for any treated or untreated plants. Dry weight of the pod was remarkably less in T-1.Maximum weight of the pod was observed in T-2. Number of seeds/ pod remained same for all plots except T-1. This was showing less number of seeds per pod(Figure 3.109)

Protein content of the Green gram seeds was maximum in CT -1, which was reduced in CT -2. Protein content of the treated seed was more than CT –2 but less than CT -1. Protein content does not show any significant difference between two treatments. (Figure 3.110)

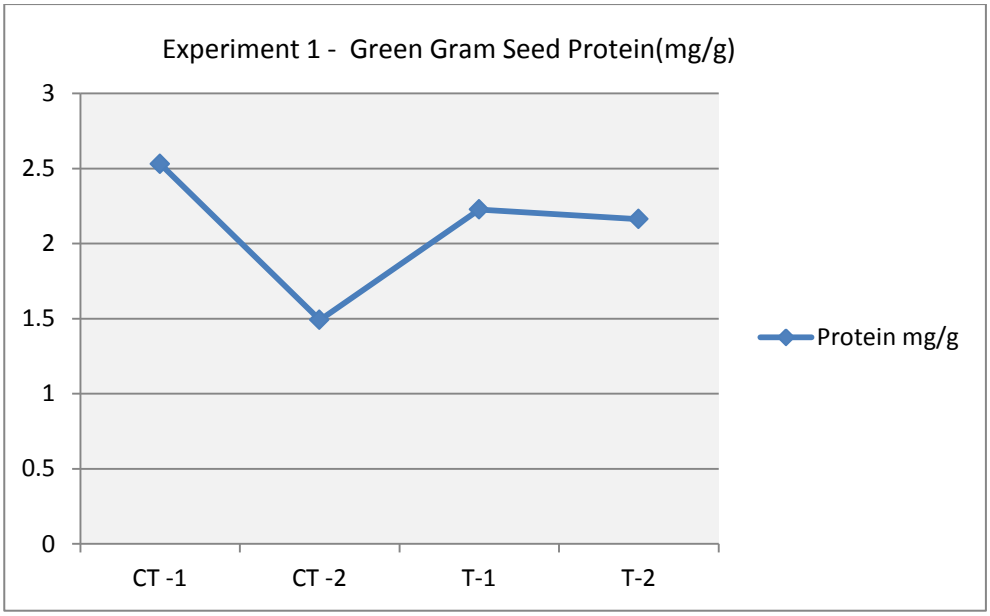


Figure 3.110 Protein Content (mg/g) in Green Gram seed from Treated and Untreated Plots.

Experiment 2.

Second experiment was done using *Artemisia* leaf mulch. On the basis of preceding study with pots. *Artemisia* mulch was utilized in less concentration to avoid any adverse effect on Green gram growth. Set up of the experiment was as follows;(Plate 9)

Artemisia – Green Gram - *Parthenium*(Treatment -1 =10 gm/ Plot, Treatment -2 =20gm/plot, Treatment -3 =50gm/plot)

As mentioned above for this experiment three concentrations were utilised. There was no proper germination in T-3 for green gram seeds so further observations were not recorded.

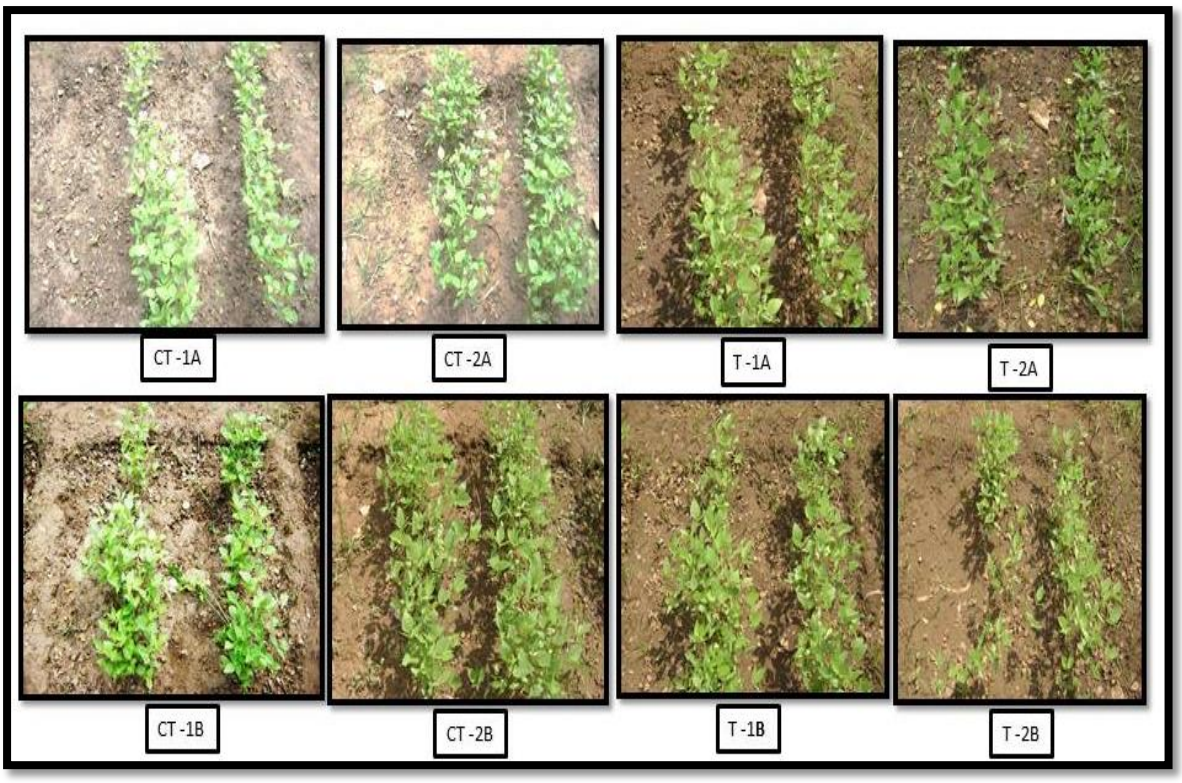


Plate 9 :Green Gram plantation in different rows

i) Vegetative stage : 1

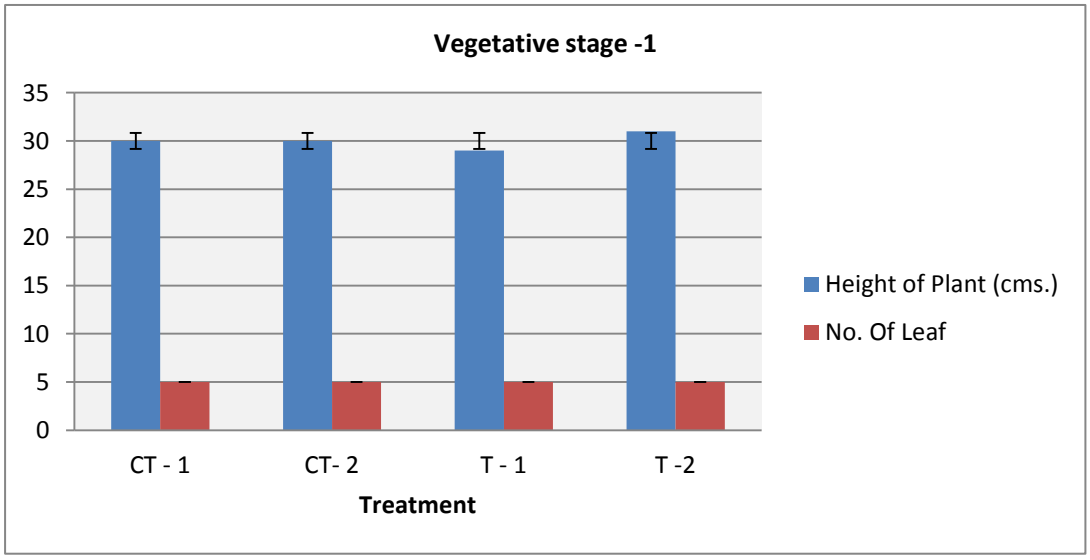


Figure 3.111 Growth parameters (Experiment 2-20 DAS)

Maximum length of the plant was observed in T-2, in T-1 and CT-2 length remained as similar as CT-1. Number of leaves were five in all the samples collected.(Figure 3.111) .

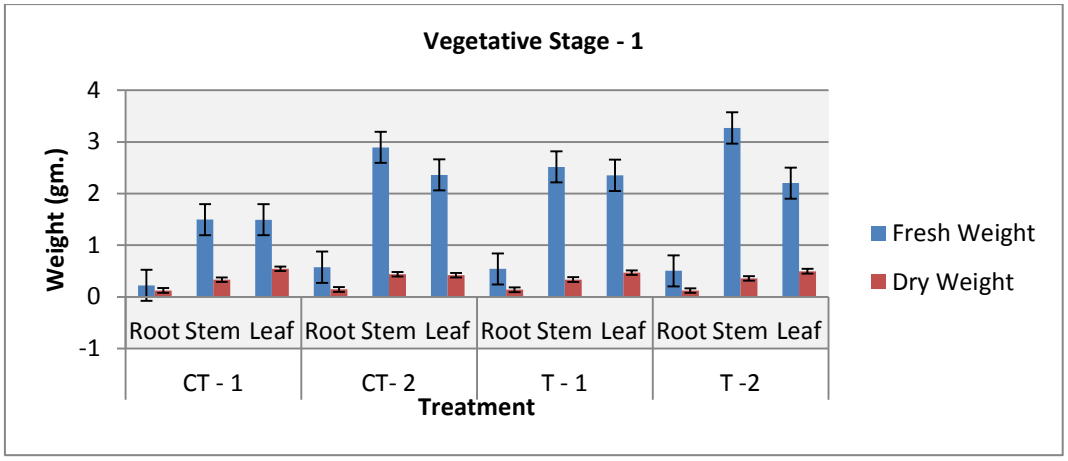


Figure 3.112 Biomass accumulation in Green gram at vegetative stage (Experiment 2- 20 DAS)

Vegetative biomass of the plant was observed at 20 DAS. Fresh root biomass was minimum in CT -1, but no significant change was observed in Dry weight as compared to other treatments. Stem weight was more in T-2. leaf biomass was similar for all treatments except CT -1. (Figure 3.112)

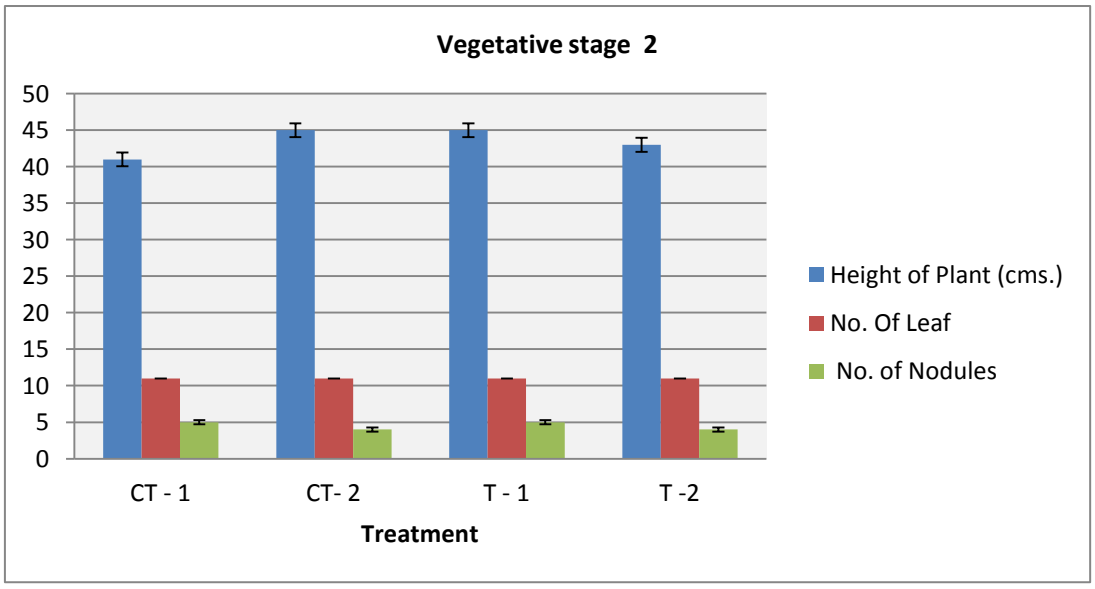


Figure 3.113 Growth parameters in green gram at Vegetative stages (Experiment 2- 40DAS)

Maximum height of green gram plant was observed in CT – 2 and T-1. Plants were showing more growth with *Artemisia* treatment as compared to control.

Number of leaves was similar for all the plants observed, Number of nodules were (5±0.78) for all the plots (Figure 3.113). No effect was observed on nodule numbers on primary roots as compared to control. Size of the nodules varied from plant to plant.(Plate-10)

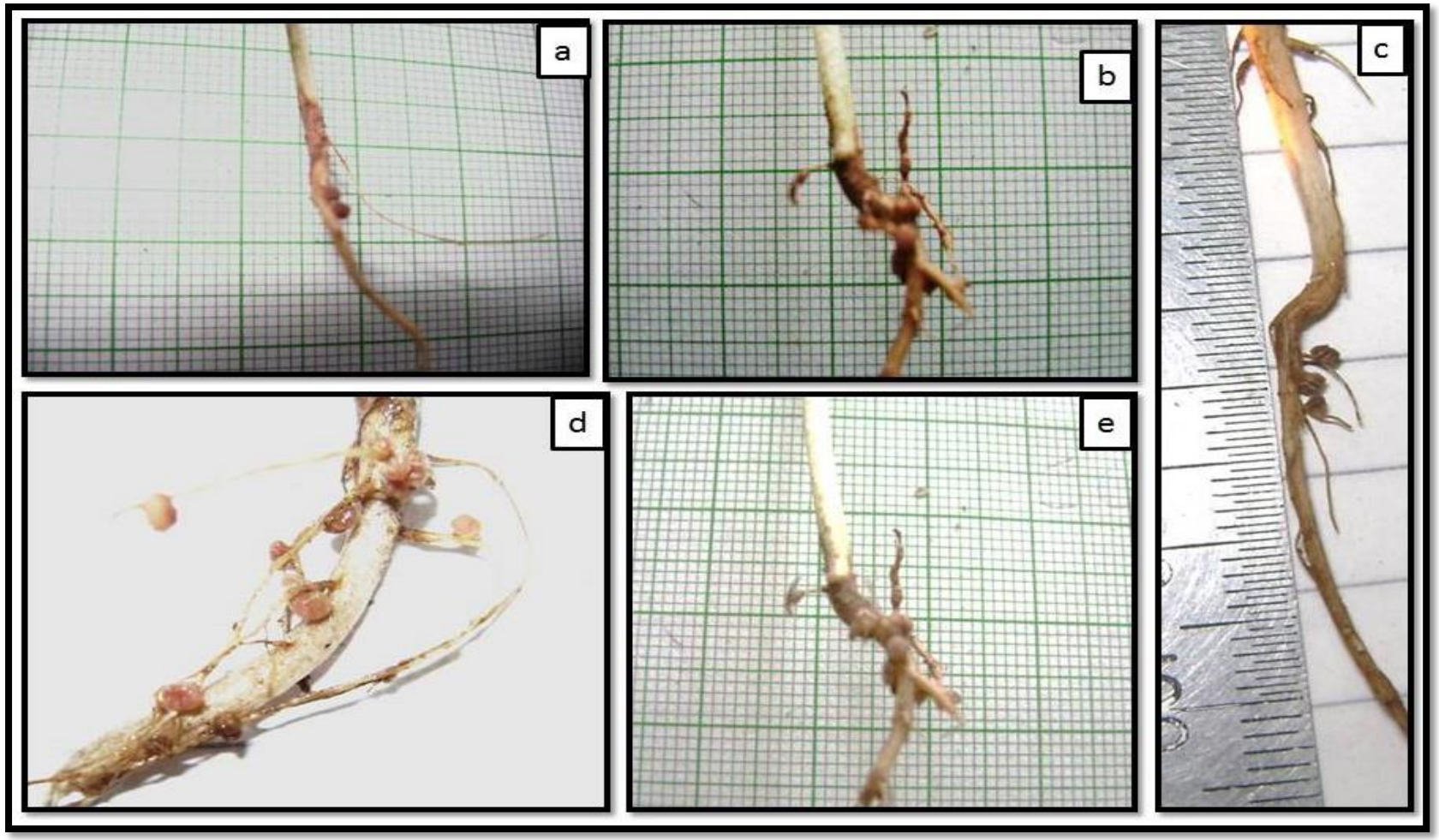


Plate 10: Nodules on primary root of Green Gram at 40DAS

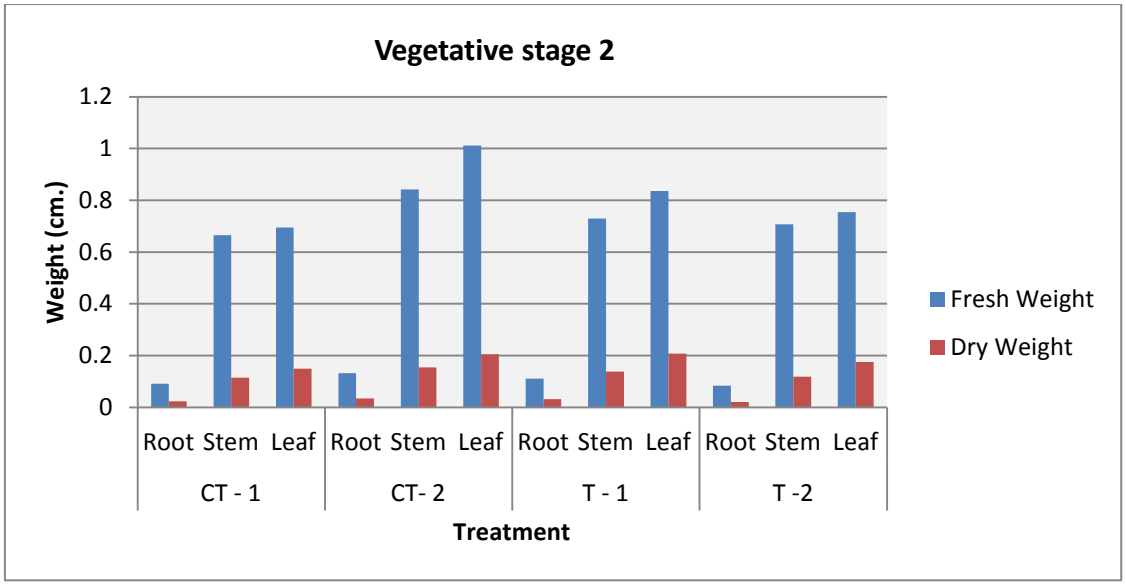


Figure 3.114 Biomass accumulation in Green gram at vegetative stage -2 (40 DAS)

At 30 DAS maximum root and stem weight was observed at CT -2 and T -1 . Maximum leaf biomass was observed in CT -2 and T-1.(Figure 114)

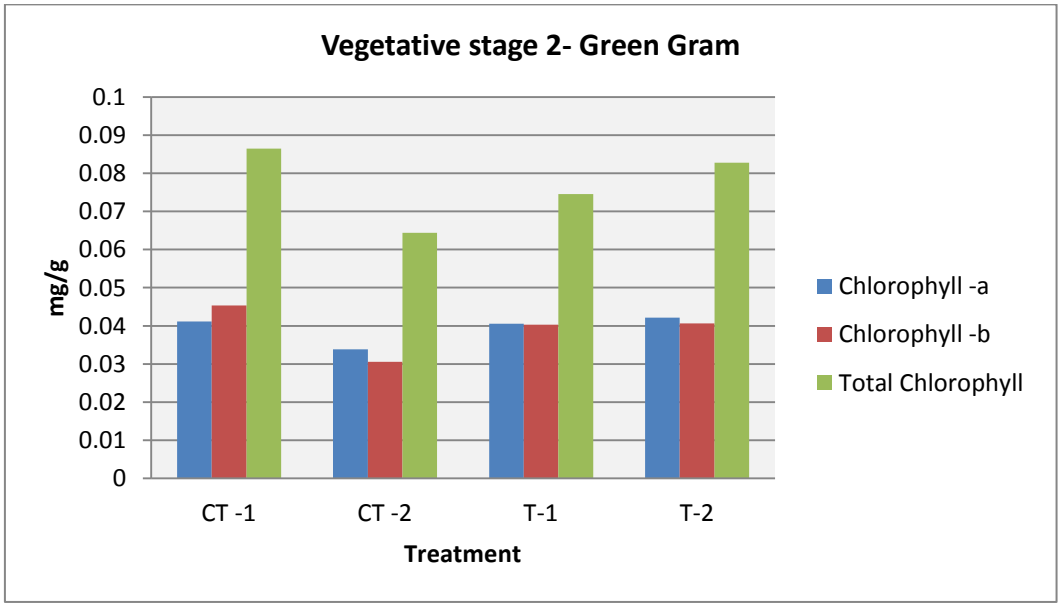


Figure 3.115. Chlorophyll estimation at 40 DAS with *Artemisia* treatment

Maximum total chlorophyll was observed in CT -1 and T-2. CT -1 showed more of chlorophyll b than a. Treated leaves were showing equal amount of chlorophyll a and b for green gram plants. Treated leaves were not showing any significant reduction in chlorophyll as compared to control.(Figure 3.115)

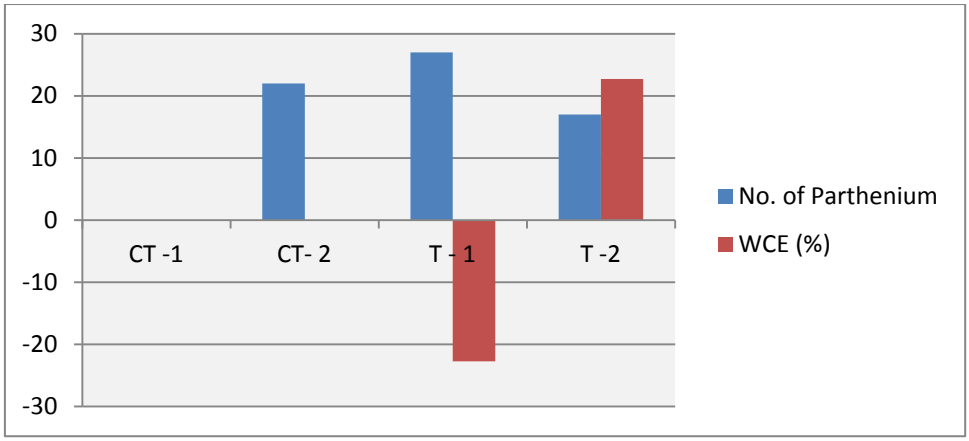


Figure 3. 116. Number of Weeds and WCE(%) of *Artemisia* treatment at 40 DAS

More number of *Parthenium* emerged in T-1 as compared to Control. While T-2 showed inhibition to the *Parthenium* growth and number of *Parthenium* was also reduced. Weed control efficiency of T-2 is maximum. T-1 does not show positive weed control efficiency.(Figure 3.116)

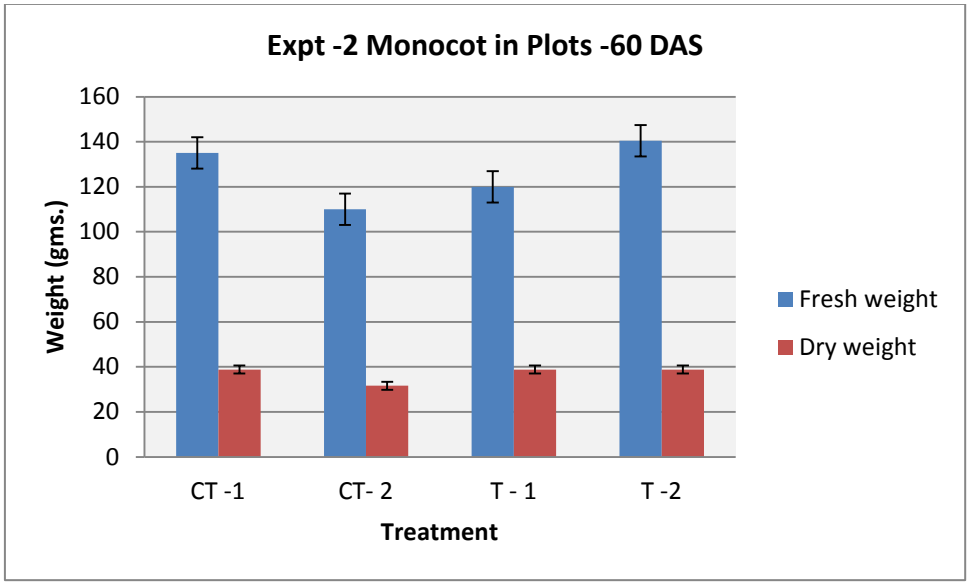


Figure 3. 117 Monocot weeds in treated and untreated plots with *Artemisia*

During hand weeding at flowering stage, Number of weeds other than *Parthenium* were present in the plot,mainly monocots. After manual weeding biomass calculation of the weeds were done as presented in Figure 3.117

iv) Fruiting stage – 80 DAS

Growth parameters were observed in randomly selected plants from each plot. Number of nodules in roots of each plant was counted out of which CT -2 were showing maximum number i.e.6 nodules per plant. Number of leaves was increased in CT – 2 and T-2 as compared to CT -1. Maximum number of flowers per plant were observed in CT-1 and T-1. CT – 2 and T-2 were showing remarkable reduction in number of flowers.

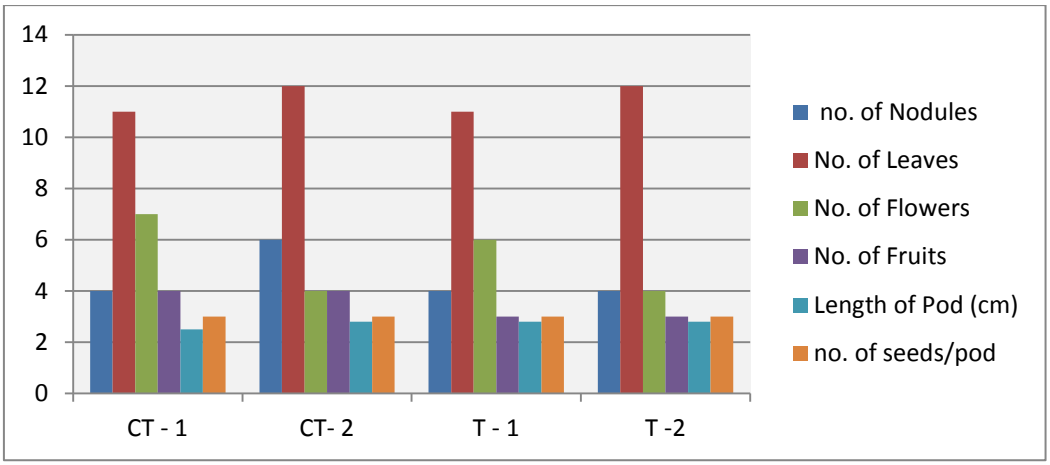


Figure 3.118 Growth and Yield parameters at 80 DAS with *Artemisia* treatment.

This reduction was also due to the plants collected from CT -2 and T -2 were started the fruit formation. Little reduction in number of fruits was observed in treated plots as compared to the control. Length of fruit was observed almost equal in all the experimental plots.(Figure 3.118)

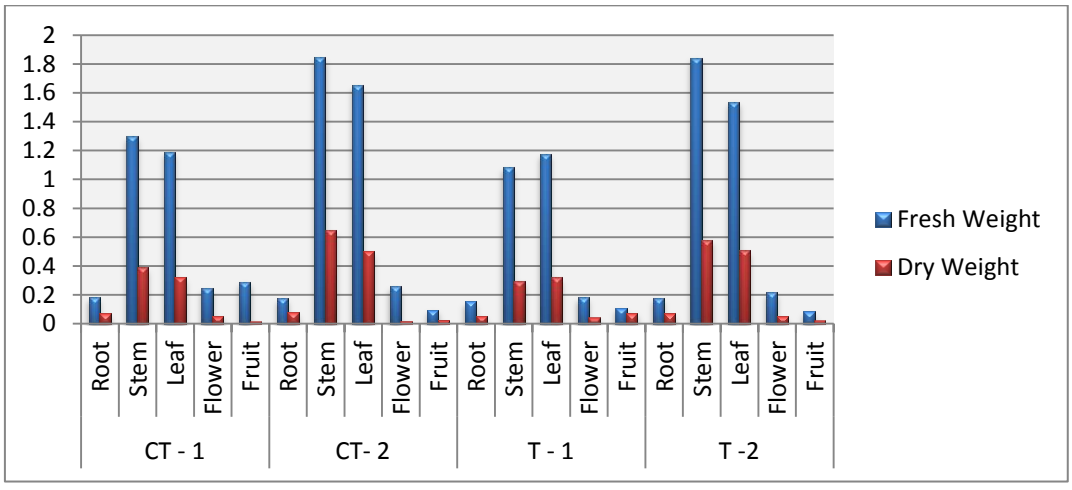


Figure 3.119 Biomass accumulations at seed setting stage – 80 DAS

Growth of plants at 80 DAS was measured separating Root, Stem, leaf, flowers and Fruits for each sample. Root fresh weight showed variable results in all plot samples. Dry weight of the root was almost similar in all the treatment. Minimum dry weight was observed in CT-2. Biomass of the stem and leaf was maximum in CT -2 and T-2. Maximum Flower weight was observed in CT -2 and T-2.Fruit weight per plant was observed more in CT -1 as compared to other treatments. (Figure 119).

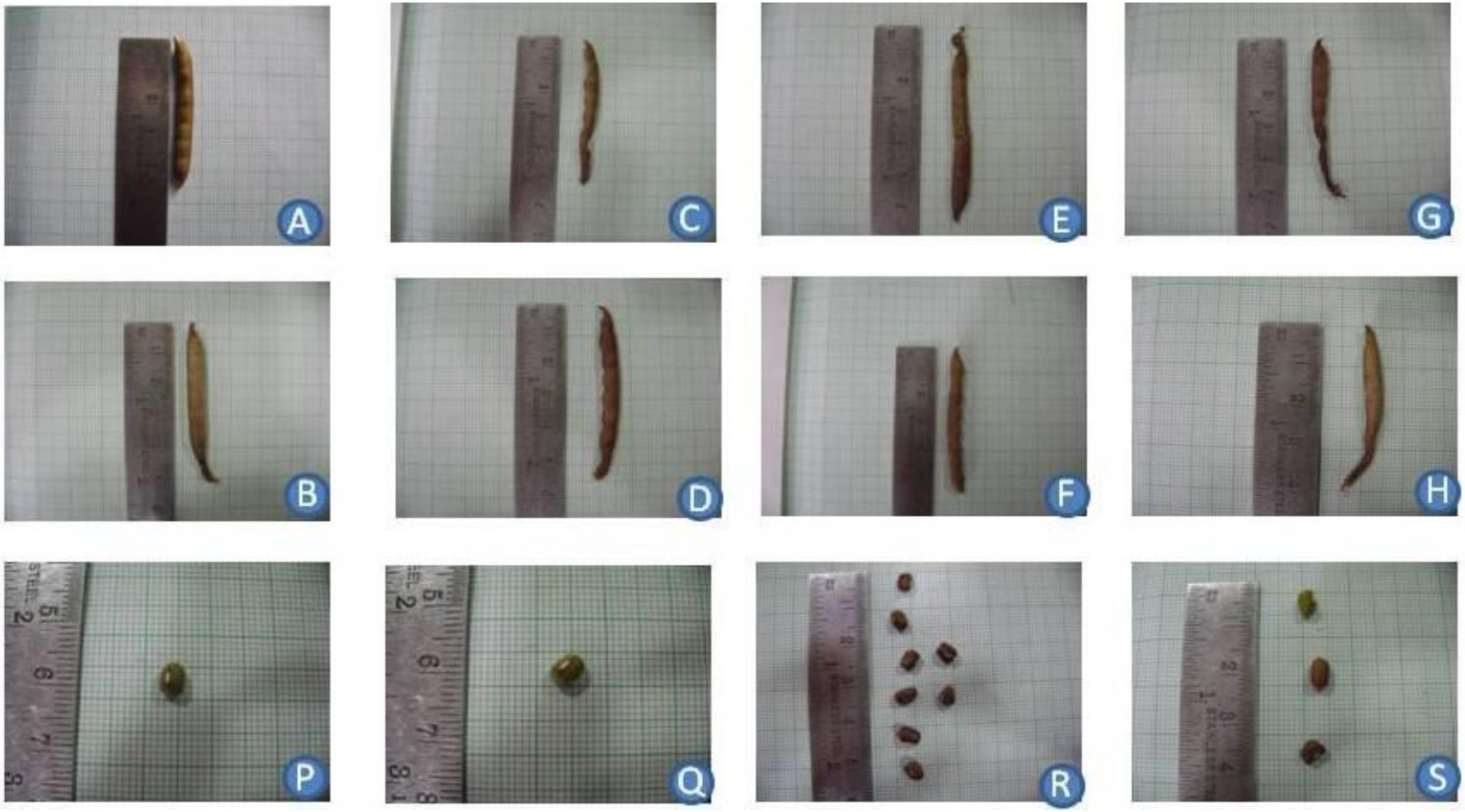


Plate 11: Green Gram Pod and seed at 80DAS

Plate 12. Flowering and Fruiting at 80DAS

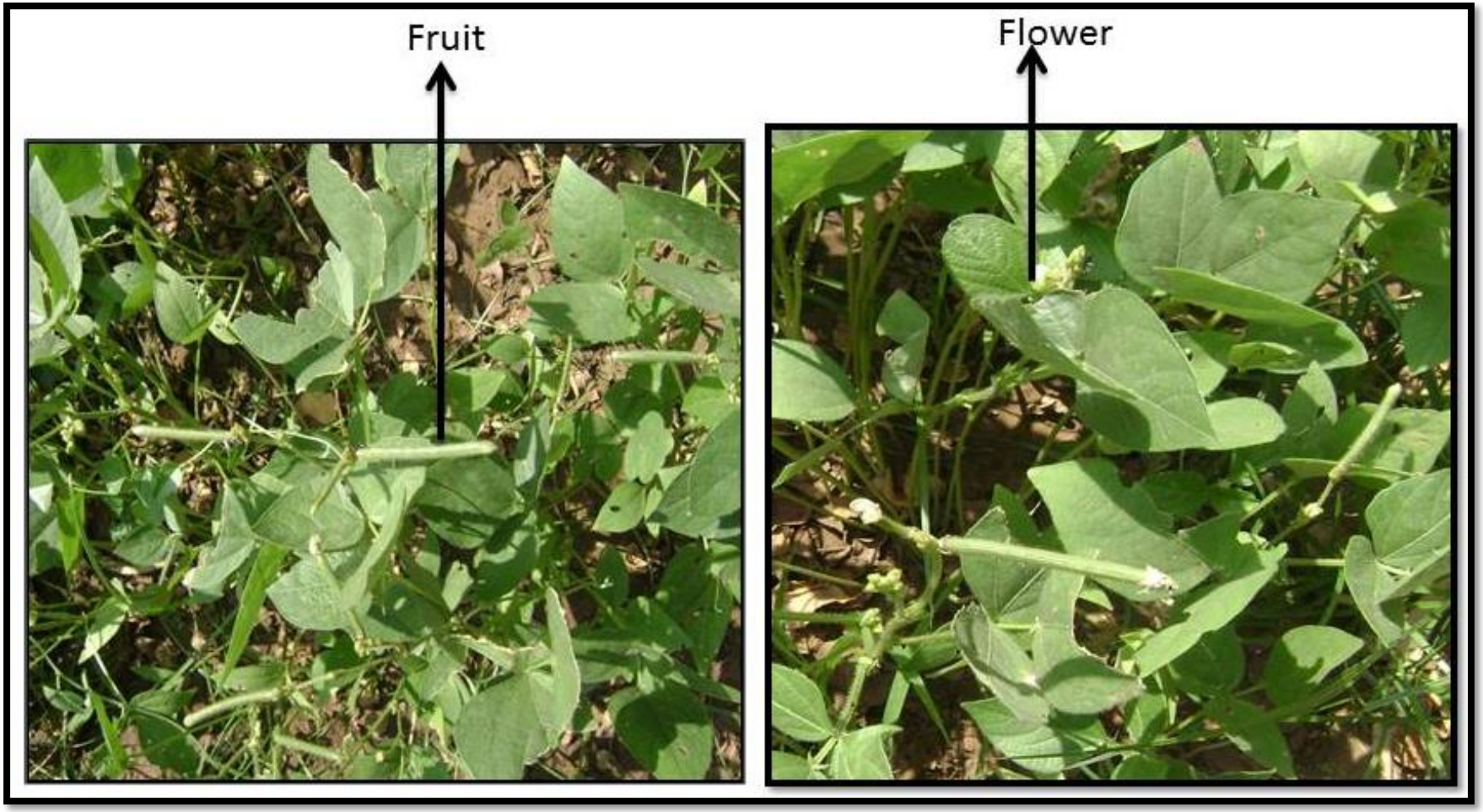


Plate 13 : Flowering and Fruiting in Green gram 80 DAS

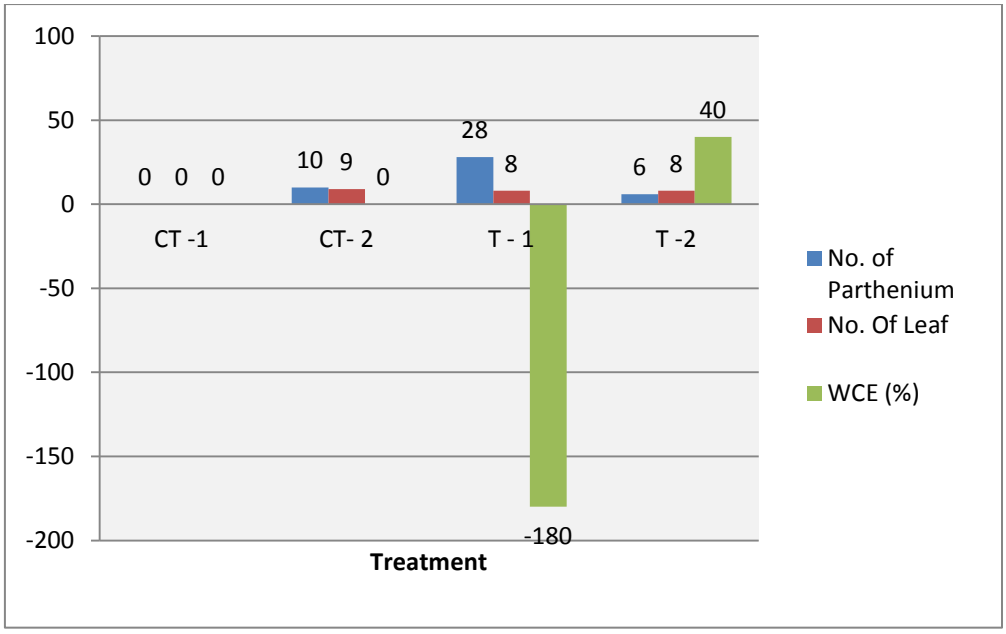


Figure 3.120. Weed growth at 80 DAS with *Artemisia* treatment.

Results of *Parthenium* growth were obtained as similar to 60 DAS. (Plate 13,14) More number of *Parthenium* emerged in T-1 as compared to Control and T-2. Maximum inhibition was observed in T-2. Number of leaves were similar in treated plots where it showed less growth as compared to control. CT-2 was having more growth and more number of leaves per plant. Weed control efficiency was only observed in T-2. This was followed by chlorophyll estimation of *Parthenium* leaves for CT -2, T-1 and T-2(Figure 120).

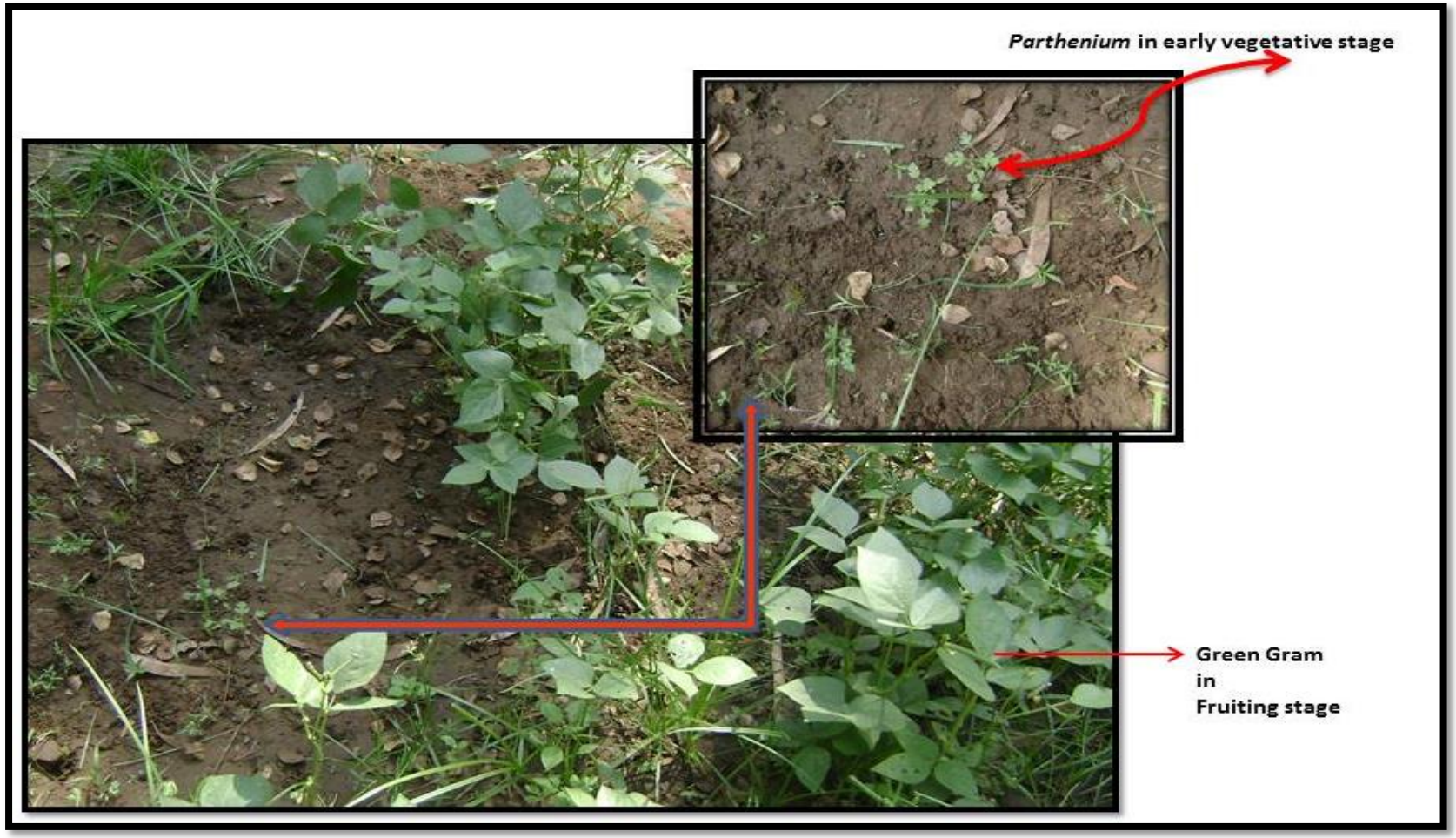


Plate 13: *Parthenium* in early Vegetative growth, Green gram at fruiting stage

Plate 14.Presence of weeds in between Green gram rows during fruiting stage

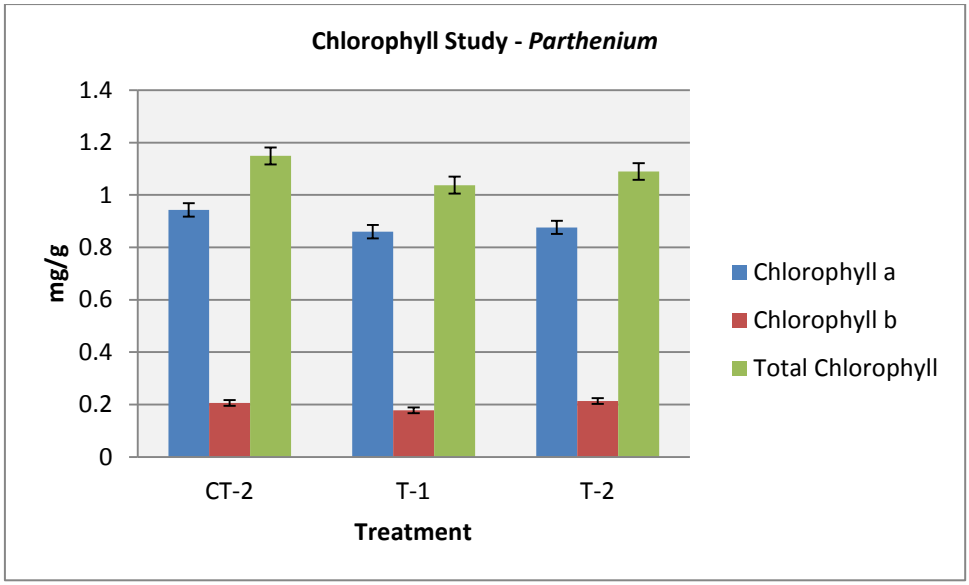


Figure 3.121 Chlorophyll analysis of *Parthenium* Untreated and treated plots at 80 DAS.

Chlorophyll study was done for *Parthenium* leaves grown in control and treated plots. Total chlorophyll was more in CT-2.Total Chlorophyll and Chlorophyll contents (a and b) were declined at T-1. Whereas for T-2 it was slightly increased.(Figure 3.121)

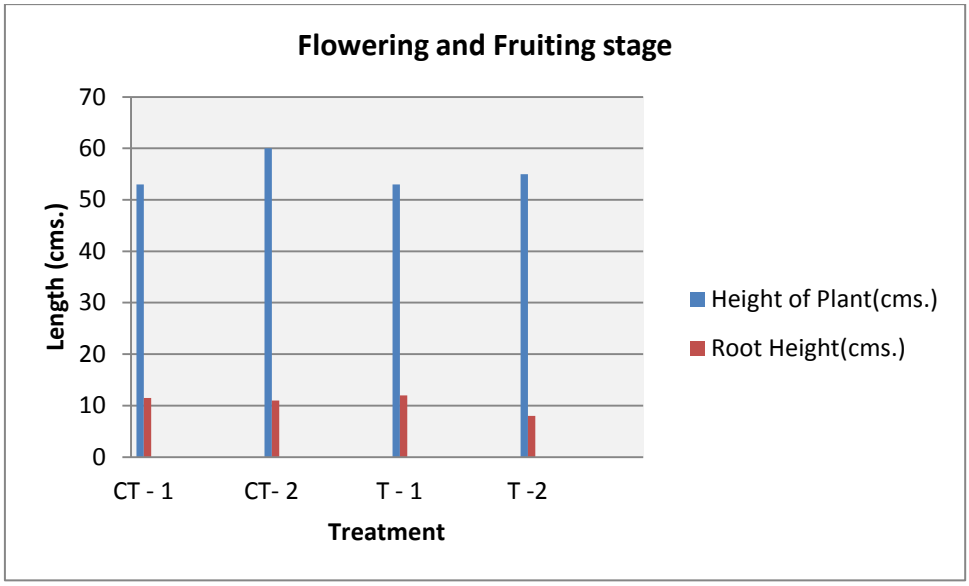


Figure 3.122 Plant growths at 80 DAS with treatment of *Artemisia* leaf mulch

Maximum height of Green gram plant was obtained in CT -2 and T-2 during at flowering period. Root height was reduced at T-2. (Figure 3.122)

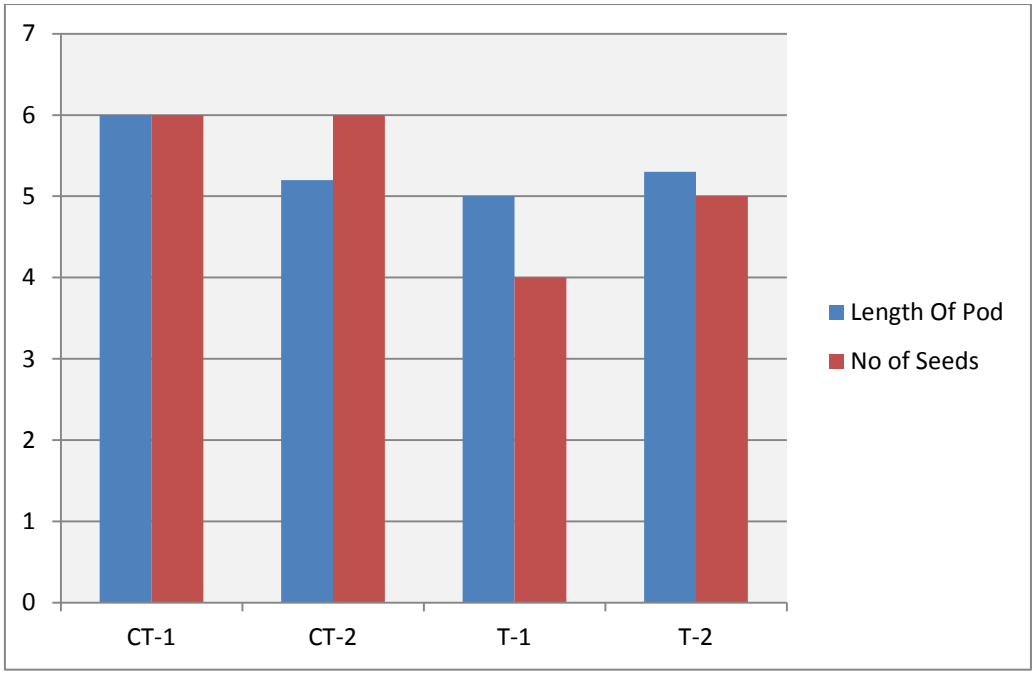


Figure 3.123: Length of Pod and number of seeds per pod

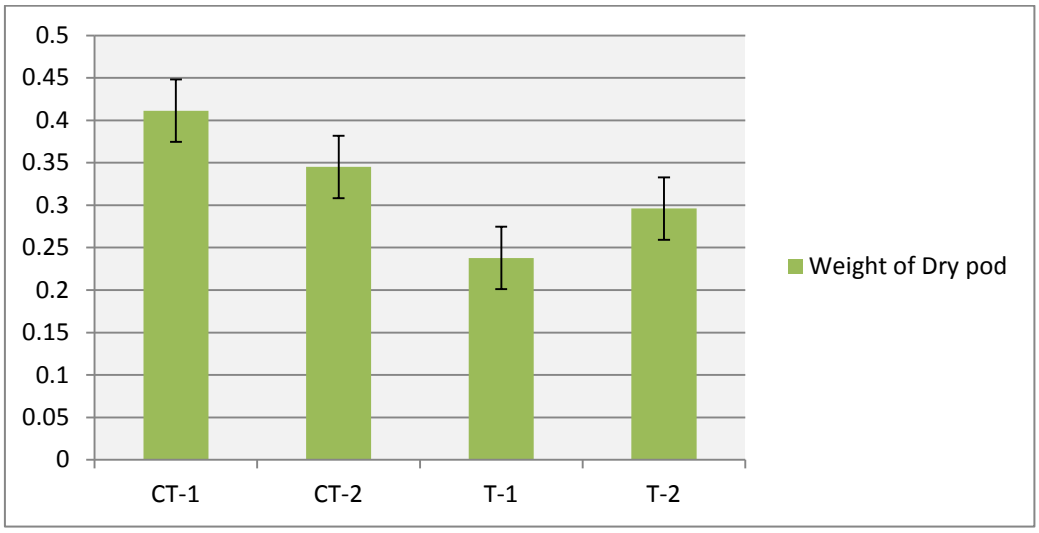


Figure 3.124 Biomass of Green Gram Fruit/ Pod in Untreated and Treated plots

Length of Pod and number of seeds per pod were represented in figure 3.113 Maximum length of pod was observed in CT-1 and T-1. CT-2 was represented with less length but more number of seeds(Figure 3.123).. Biomass of Dry Pod was maximum in CT -1. Which was reduced in CT -2 , T-1 and T-2. Dry weight of T-2 Pod was increased as compared to T-1.(3.124)

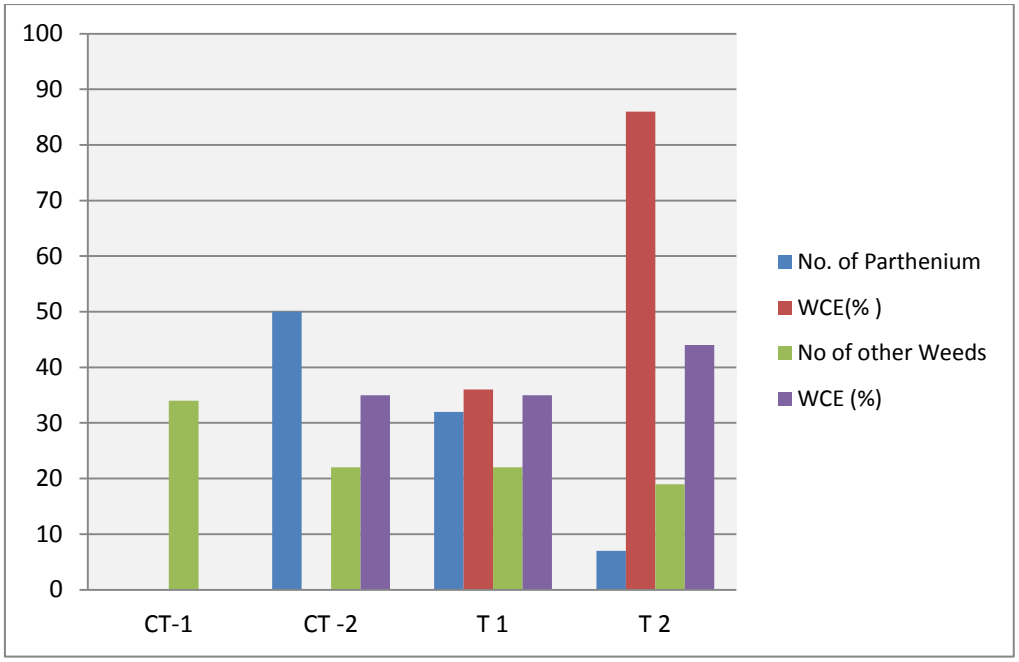


Figure 3.125: Weed growth at 80 DAS

Parthenium started growing in all the plots except CT – 1, maximum number of *Parthenium* was observed in CT – 2, Which was reduced in T – 1 and significant reduction in number was observed with T- 2. Weed control efficiency of the treatment was estimated which was related to the number of *Parthenium* in *Artemisia* treated and untreated plots. Maximum WCE was observed in T-2 (more than 80%) and 36% for T – 1 .

Many weeds especially Monocots were present in CT – 1 and CT -2. CT -1 represented the highest number of weeds which were reduced in CT – 2 and T-1. Maximum resistance against the weeds were observed in T – 2 with presence of less than 20 numbers of other weeds. Weed control efficiency of the T – 2 was around 43%, which was highest amongst others.(Figure 3.125)

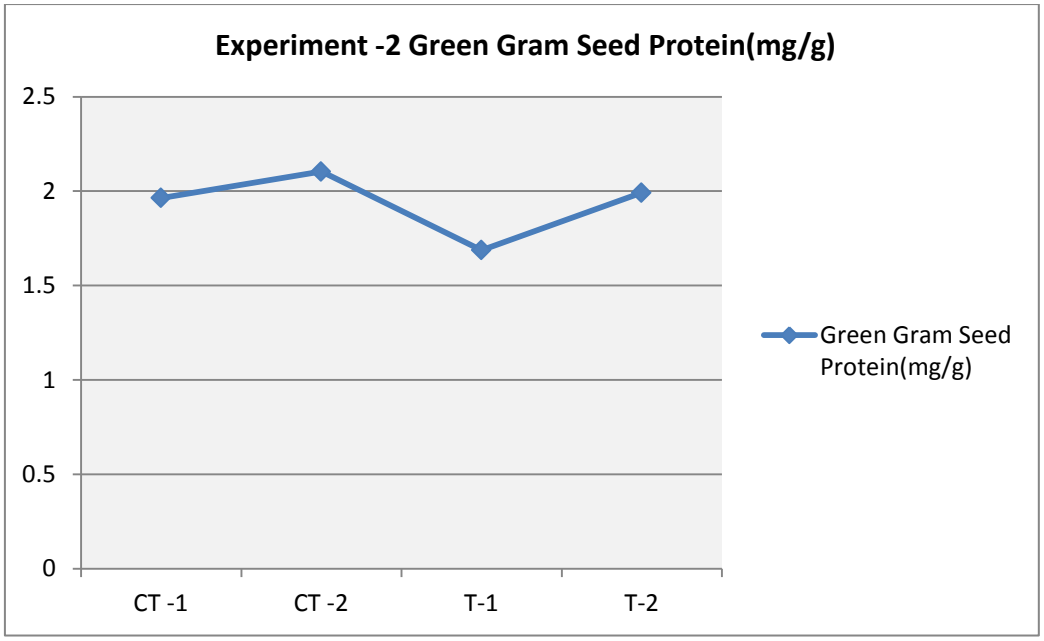


Figure 3.126 Comparative Protein content (mg/g) of Green gram seeds for untreated and treated plant seeds with *Artemisia*

Protein content of the green gram seeds was showing variation with treatment. CT -1 andT-2 has similar protein contents. Minimum protein content was observed in T-1 with minor difference as compared to Control and T-2.(Figure 3.126)

Qualitative analysis of Green gram seed protein with SDS – electrophoresis.

Following results were obtained during comparative study of green gram seed of CT -1 and T- 2. No significant difference in comparative bands was observed between Control and treated seeds during basic study using SDS- gel-electrophoresis.(Plate 15,16)

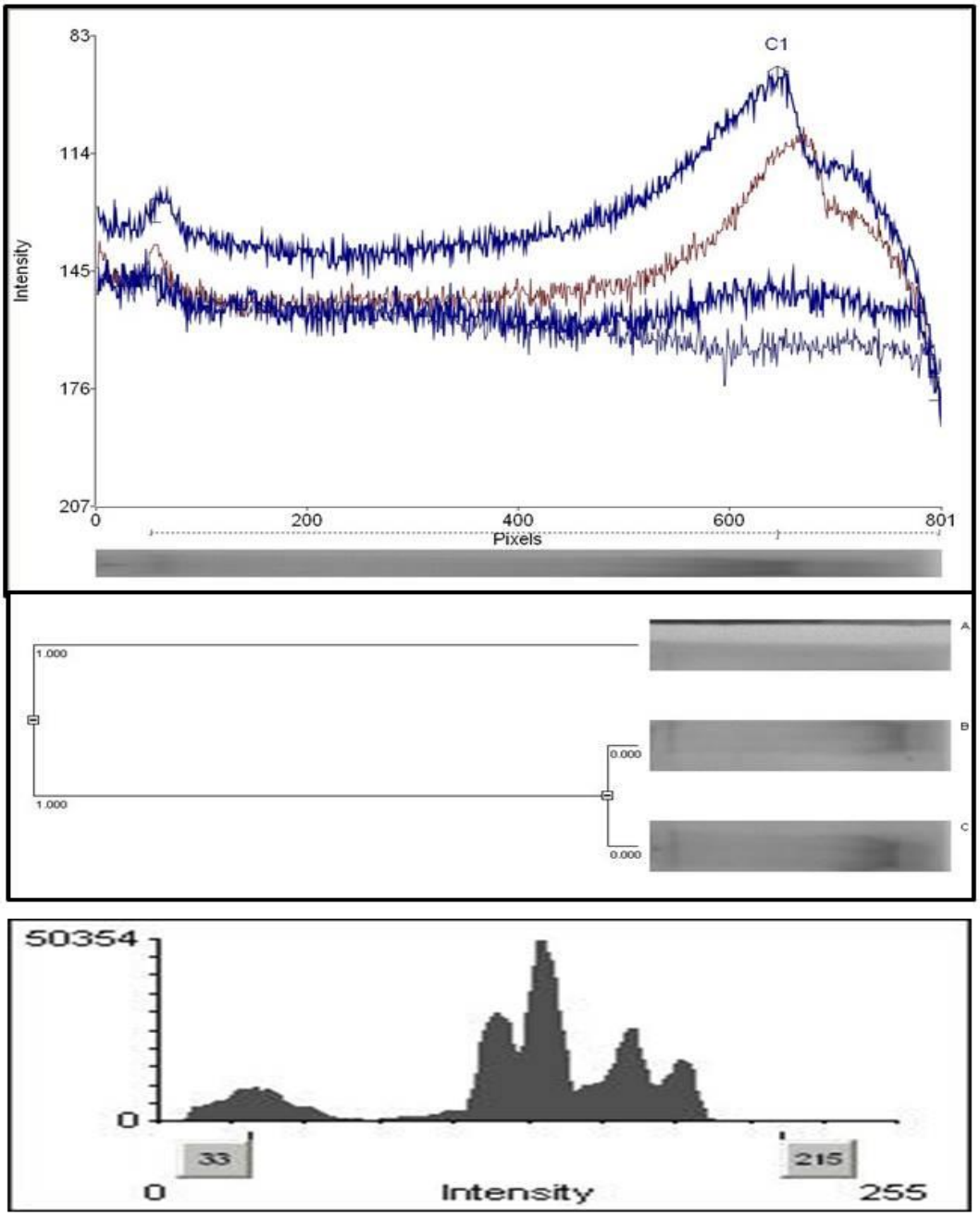


Plate 15: Comparative peak densitogram of Green gram protein (Electrophoresis- 80 DAS)

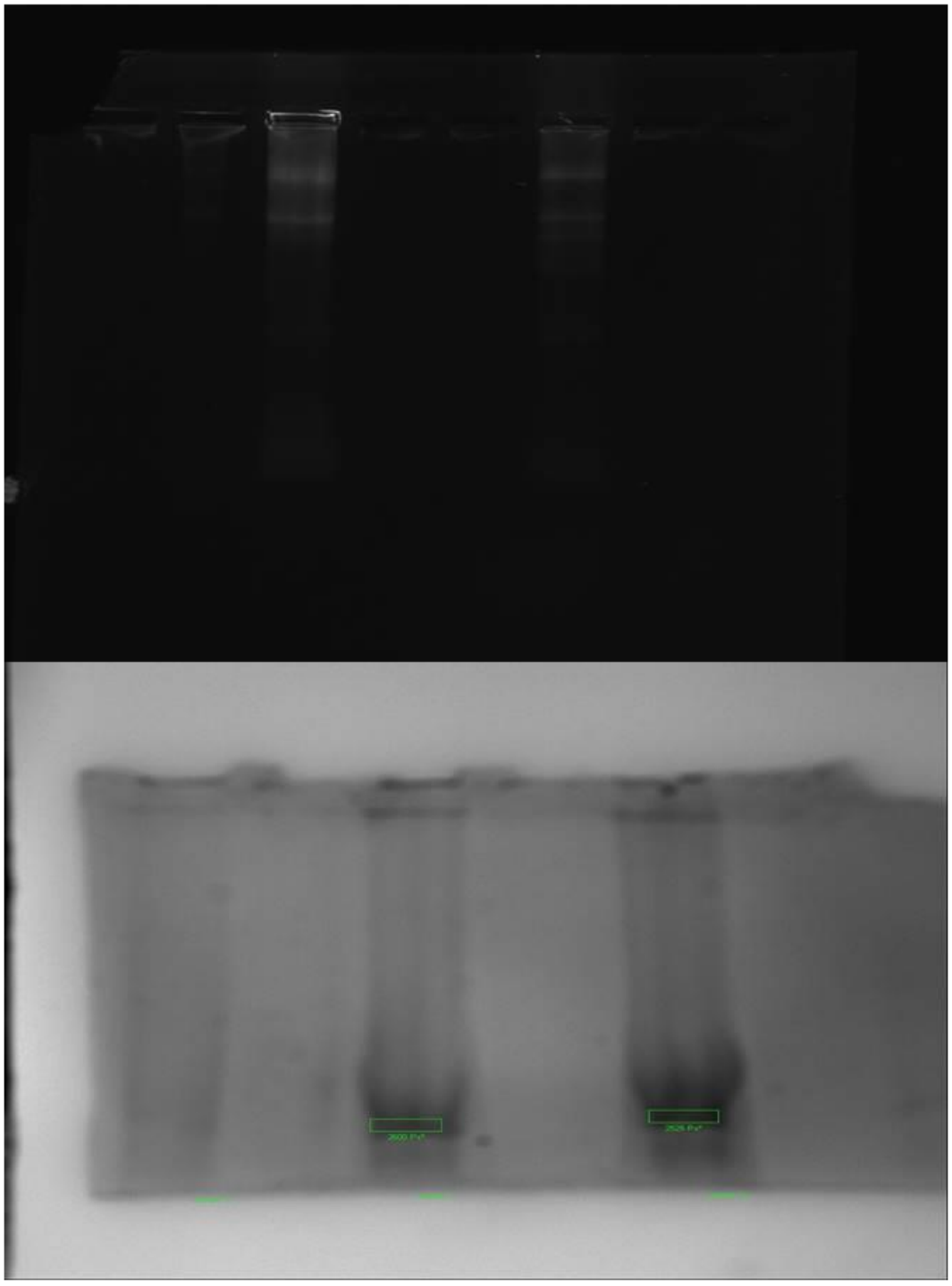


Plate 16: Protein bands using Gel electrophoresis (Experiment 2, 80 DAS)

Analysis report of the band is given as below.