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Performance of Various Herbicides on Bt. Cotton under Rainfed Condition

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Abstract: ***A field experiment entitled " Performance of Various Herbicides in Bt. Cotton under Rainfed Condition" was conducted during kharif season of 2015-16 at the farm Of Agronomy in Bhagwant University, Ajmer (Rajasthan). The experiment was laid out in RBD design replicated three with eight treatments, Pendimethalin 1.5 kg a. i. ha^{-1} PE + Hoeing, Quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing, Pendimethalin 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing, Pyrithiobac sodium 0.62 kg a. i. ha^{-1} PoE + Hoeing, Pyrithiobac sodium 0.62 kg a. i. ha^{-1} + Quizalofop-ethyl 0.50 kg a. i. ha^{-1} + Hoeing, Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS, Weed free check and Weedy check. Cotton seed varietyMNH-886 Bt was sown on July 15, 2015 at a spacing 90 x 60 cm with RDF 60:35:35 NPK Kg ha^{-1} with a view to study the effect of post emergence weedicides on growth and yield of seed cotton, nutrient uptake by weeds and crop and to evaluate weed control efficiency and biomass production of weeds and cotton.In the field Commelina benghalensis, Cynodon dactylon, Cyperus rotundus, Digera arvensis, Parthenium hysterophorus and Celosia argentea were found dominant weeds. The best control of monocots and dicots, highest weed control efficacy and lowest weed biomass production was in weed free check (T_7) followed by glyphosate @ 1.0 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6), quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_2) and pendimethalin 1.5 kg a. i.ha^{-1} PE Fb quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_3). Maximum improvement in growth characteristics like number of branches, plant height, number of functional leaves, leaf area, chlorophyll content, plant dry matter, AGR, RGR and NAR were found in weed free check followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS, quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing, pendimethalin 2.0 kg a. i. ha^{-1} PE + Hoeing and pyrithiobac sodium 0.62 kg a. i. ha^{-1} + quizalofop-ethyl 0.50 kg a. i. ha^{-1} + Hoeing. Significantly highest seed cotton yield was found in weed free check followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS, pendimethalin 1.5 kg a. i.ha^{-1} PE + Hoeing and pendimethalin 2.0 kg a. i.ha^{-1} PE Fb quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing. Lowest depletion of nutrients (NPK Kg ha^{-1}) by weeds and highest uptake by crop was in weed free check followed by glyphosate @ 1.0 kg a. i. ha^{-1} as directed spray at 45 DAS, pendimethalin 1.0 kg a. i.ha^{-1} PE + Hoeing and pendimethalin 1.0 kg a. i.ha^{-1} PE Fb quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing. Highest GMR and NMR was recorded under weed free check but highest B:C ratio with glyphosate @ 1.5kg a. i. ha^{-1} as directed spray at 45 DAS. Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS was found most effective in controlling weeds and increasing seed cotton yield.***

Keywords- FYM (Farm yard manure), DAS (Days after sowing), LAI (Leaf area index), NAR (Net assimilation rate), RGR (Relative growth rate), CD (Critical difference).

I. INTRODUCTION

Cotton (*Gossypium sp.*) is one of the most important fibre and cash crop in India belongs to *Malvaceae* family and known as *"King of Fiber"* and *"White gold"* plays a pivotal role in the rural, national and international economy. It is grown mainly in tropical and subtropical region of more than 80 countries in the world. It is grown mostly for fiber used in the manufacture of cloths for mankind. In recent years, cotton apparels are being preferred to the synthetic ones due to the increasing the health consciousness among the people. Besides fiber, cotton is also valued for its oil (15 - 20%) which are used as vegetable oil and shop industries and cotton seed cake is very proteinous and used as cattle feed and can also be used as manure which contain 6.4, 2.9 and 2.2 per cent N, P and K, respectively. It is likely to play a pivotal role in paper, particle board and cardboard industries. With the advanced technology, short fiber or fuzz or lint can now be used to make excellent grade paper like currency paper, linoleum cellophane, rayons, and photographic films, dynamic and moulded plastics. Cotton provides livelihood to more than 60 million people in India

by way of support in agriculture, processing, and use of cotton in textile.Therefore it is popularly known as white gold. Cotton seed contains about 15-20 per cent oil and is used as vegetable oil and in soap industries. After extraction of oil, the left over cake is proteinous and used as cattle feed. It is the king among the fibre crops, taking in to consideration the economic impact it generates. Besides its vital role in national economy, its contribution in the foreign exchange is tremendous. Nearly one third of India's export earnings are from textile sectors of which cotton alone constitutes nearly 70 per cent of raw material. Cotton contributes 29.8 per cent of the Indian agricultural gross domestic product. Still there exits large potential for export of raw cotton and value added products. India ranks 1st in area and 2nd in production of the cotton. The area covered under cotton crop in India is 116.69 lakh ha with production of 330 lakh bales with 497 kg/ha productivity. Whereas the Maharashtra is one of leading cotton growing states in India having 41.46 lakh ha area with the production of 74.00 lakh bales with 305.30 kg/ha productivity. In Vidarbha, cotton is grown on about 15.60 lakh ha and the production is nearly 35.50 lakh bales with 228.00 kg/ha productivity (Annual progress report USDA-2013). In Ajmer region cotton is grown predominantly as a rainfed crop. Weed control under rainy period is biggest hurdle in crop production. Rainfed cotton crop production has direct bearing on the agrarian economy of the region (Annual Progress Report USDA-2013).

II. OBJECTIVES OF STUDY

With the changing scenario of weed management farmers need post emergence herbicide and there is an urgent need to evaluate the performance of new herbicides for grassy weed control in cotton, Hence present investigation was conducted to study the "Performance of Various Herbicides on Bt. Cotton under Rainfed Condition" with following objectives. (1)To find out the suitable Herbicides strategies for the control of weed in Bt cotton. (2) To study the effect of Herbicide on growth, yield and quality of Bt cotton. (3) To study the weed control efficiency and economics of Herbicide treatments.

III. SCOPE AND LIMITATIONS

Farmers take up the inter-cultivation with conventional method like hand weeding or bullock drawn implements mainly for the purpose of checking weed growth. These mechanical methods in rainfed cotton crop at early growth stage would not be possible in sluggish condition as result of frequent rains. There are few drawbacks in relying completely on the use of herbicides alone for weed control in cotton. Pre emergence herbicides at recommended doses are generally capable of controlling annual weeds upto a period of 20-30 days by this period the herbicides are broken down in soil and thereafter the weeds which survived the pre emergence treatment or those which were resistant to those herbicides come of slowly depending upon the crop canopy, rainfall and nature of weeds.There are some drawbacks of pre emergence herbicides. Their performance is dependent upon soil moisture. Secondly they are to be applied at or soon before planting, thus not knowing the nature and extent of weed infestation. Farmers are also reluctant to use these herbicides due to coincidence of spraying with peak period of sowing. Research conducted elsewhere has revealed that selective herbicide like quizalofop ethyl and pyrithioback sodium herbicides could be applied in cotton as directed post emergence. This application can be done after judging the weed problem in the field and hence saving on herbicides could be made possible. Several studies have shown that herbicides alone are not control it must be supplemented with one or two hand weeding and hoeing for better and effective control of weeds. It is reported that pre sowing use of Pendimethalin control the weeds in early stages and thereby the inputs put in by the farmer are utilized more efficiently. The weeds which emerge (grasses and perennial weeds) in later period of the growth (i.e. 50 days onward) can be controlled mechanically. The application of herbicide as post emergence like Quizalofop ethyl may also give adequate weed control, particularly grasses which cannot be controlled effectively by cultural method. Therefore a judicious combination of chemical and cultural method of weed control seems necessary for effective control of weed and for the best possible utilization of costly input which would ultimately results in higher yield. This investigation deals with the review of research work done by different workers on the effects of chemicals and cultural methods of weed control in cotton. Main preference has been given to the work done on cotton, but the work done on other crops has also been included wherever found appropriate to support the findings of the investigation.

Crop Weed Competition:-The phenomenon of competition plays an important role in determining the crop yield and is a critical factor in the growth of usual plants. Weed being allied species to the crop, competes for soil moisture, nutrients (Crafts and Robbins, 1993 and Muzik, 1970 and kilngman, 1973). The degree of competition depends upon weed intensity, weed species, time of emergence and growth and development pattern of weeds. Sandhu et al. (1996) reported at Ludhiana, keeping the cotton crop weed free for initial 60 days yielded at par with weed free throughout. The reduction in yield over weed free throughout was 39. , 20.9

and 10.6 percent when crop was kept weed free usually for 30, 45 and 60 days respectively.

Weed flora in cotton:-From field observations and surveys it seems that different crops have their specific weeds. Weed flora in cotton differs from location to location, soil type and level of management. Brar (1980) studied the weed flora composition in cotton and noted *Echino chloacolonum, Eleusineindica, Eragrostistenella, Cynodon dactylon* as the grasses and *Cyperus rotundus* as the sedge and *Digeraarvensis, Commelinabenghalensis* (monocot broadleaf). *Celosia argentea.Amaranthusvirdis, Acalyphaindica, physalis minima* as the dicot broadleaf weeds.

Uptake of nutrients by cotton and weed, losses in yield by Weeds:-Earlier studies made to evaluate the yield losses due to weed competition revealed 45 to 85 percent reduction in yield of cotton. (Wankhade, 1963, Hunsigiet al. 1969, Chandra Singh et al. 1973). Rethinam and Sankaran (1979) observed that weeds remove N,P and K at a faster rate than the crop in early stage of crop growth which subsequently results in heavy reduction in crop yield. Removal of weeds in early period of growth resulted in increased growth and yield of cotton crop. They reported that weeds in unweeded crop removed 42.5, 1.9, 27.9, kg NPK ha^{-1} respectively. Anonymous (1989) observed stolons of cyperus contained 1.79 % N, 0.19 % P and 2.13 % K. Results also showed a removal of 36.52kg N, 3.88 Kg P and 43.45 Kg K ha^{-1} by stolon equivalent to an amount of 80.26Kg urea, 53.89 Kg superphosphate and 86.90Kg Murate of Potash respectively indicating a serious competitions of this weed with cultivated crop for nutrients.

Cultural weed Control:- History of weed control is as old as that of agriculture, but science of weed control has developed more in the last 35-40 years. Rightly realizing the need of controlling weeds, some efforts were made in the past to evolve different methods of weed control under varying field and crop conditions. Weeds in cotton are controlled manually, mechanically and chemically. Nagre and Patil (1980) found that hand weeding was slightly better than hoeing. Three hand weedings between 3 and 9 weeks after sowing gave the highest yield in cotton. Among the weed control treatments, hoeing and hand weeding were superior over the herbicides (Anonymous, 1981). Repeated hand weedings carried out at 10 days interval was found to improve growth characteristics such as number of monopodial and sympodial branches as well as number of bolls per plant which ultimately increased seed cotton yield per hectare (Patel, 1989). Many workers have reported that 2-3 hoeings and 2-3 weedings were superior to the chemical method of weed control in cotton (Mudholkaret al. 1981, Kurlekar and khupse, 1984 and Detrojaet al.1992). Singh and Singh (2002) resulted that grain yields obtained due to fenoxyprop-p-ethyl at 80 and 90 g ha^{-1} irrespective of application stages were at par with weed free treatment during both the year.

Chemical weed control :-(i) Pendimethalin:- Bhol *et al.* (2007) resulted that pendimethalin @ 1.0 Kg a.i.ha^{-1} + one hand weeding at 50 DAS proved second best weed management practices, which was found equally effective as weed free condition. (ii) Quizalofop-ethyl:-Bhattacharya *et al.* (2004) observed that highest weed control was achieved with two hand weeding treatment followed by post emergence application of Turgasuper @ 2.0 ml L^{-1} of water at 15 DAS + 1 hand weeding at 35 DAS. Thorat *et al.* (2007) recorded that significantly higher yield attributes, low weed intensity and biomass, high weed control efficiency with application of quizalofop ethyl @ 50g ha^{-1} 30DAS + 14 + 1 HW at 60 DAS in cotton. (iii) Glyphosate:-Sreenivas (2000) revealed that the lowest weed count and dry weight of weed were recorded with pre emergence oxyfluorfen 0.25 kg ha^{-1} followed by glyphosate 1.5 kg ha^{-1} with higher kapas yield. (iv) Pyrithiobac sodium:- Almeida *et al.*(1999) observed that single pyrithiobac (0.5 L ha^{-1}) + 0.25% tharagen-s and double rates pyrithiobac 0.25 L ha^{-1} + tharagen-s 0.25 L ha^{-1} of the herbicide were efficient in controlling *C. echinatus* and *I. grandifolia* during the 1-3 and 3-4 leaf stages of cotton, respectively without hazard injury to the crop. Panwar *et al.* (2001) reported that application of pyrithiobac + fluazifop-butyl at 100 + 500 g ha^{-1} resulted in significantly higher seed cotton yields than other herbicide treatments applied alone.

Economics of weed control:- Pal *et al.* (2005) resulted that the application of quizalofop ethyl @ 40 g a.i. ha^{-1} at 15 DAS + HW at 40 DAS gave better net return for investment of every rupee on it than other weed management practices. Bhol *et al.* (2007) revealed that the highest gross realization (Rs. 42292 ha^{-1}), net realization (Rs 27366 ha^{-1}) and B:C ratio (1.83) were recorded under weed free situation in cotton which was followed by pendimethalin @ 1.0 Kg a.i. ha^{-1} + one hand weeding at 50 DAS with gross returns (Rs 32333 ha^{-1}) and net return (Rs.19449 ha^{-1}).

IV. MATERIALS AND METHODS

The details regarding soil, climate, material and methods adopted for the present investigation are summarized in this chapter under appropriate heads.

Details of experimental material:- (i) Experimental site:-The present investigation was carried out on the plot number 20 in the field of Bhagwant University Agriculture farm, Ajmer, during 2015-2016. Topography of the field was fairly uniform and level. The soil

was sandy cotton soil belonging to *Aifisol*. (ii) Soil characteristics:-Soil samples from 0-30 cm depth were taken from randomly selected spots, spread over the experimental area. A composite sample was then prepared by thoroughly mixing the soil. The sample was air dried and ground in a mortar in such way that the aggregate particles were crushed but the particle of soil samples were not disturbed. It was properly sieved and used for the analysis of important physio-chemical properties. From the data presented in Table 1 it would be seen that the soil of experimental site was clayey in texture. As regards chemical composition, it was low in available nitrogen and phosphorus, medium in organic carbon content and fairly rich in potassium content.

Table:-1. Mechanical and chemical composition of soil of experimental plot

S. No	Particular	Value	Analytical method adopted
A. Mechanical composition			
1.	Sand (%)	72.56	Bouyoucos Hydrometer Method (Piper, 1966)
2.	Silt (%)	10.1	
3.	Clay (%)	17.1	
4.	Textural class	Loamy sand	
B. Chemical composition			
1.	Available nitrogen (kg ha^{-1})	134.10	Alkaline permanganate method (Subbiah and Asija, 1956)
2.	Available phosphorus (kg ha^{-1})	16.56	Olsen's method, (Jackson, 1967)
3.	Available potassium (kg ha^{-1})	160.56	Flame emission Spectro-photometer (Jackson, 1967)
4.	Organic Carbon (g kg^{-1})	2.7	Walkley and Black's rapid titration method (Jackson, 1967)
5.	Soil pH	8.4	Beckman's glass electrode pH meter (Jackson, 1967)
6.	Electrical conductivity (d Sm^{-1})	1.24	Solu-bridge (Richards,1954)
C. Soil Physical composition			
1.	Bulk density (Mg m^{-3})	1.52	Core sampler method (Piper,1966)

Cropping history of experimental field:- The cropping history of experimental plot for last three years is presented in Table 2.
Table:- 2. Cropping history of experimental field

Year	Season		
	Kharif	*Rabi*	Summer
2008-09	Bajara	-	-
2009-10	Cotton	-	-
2010-11	Soybean	-	-
2011-12	Maize	-	-
2012- 13	Cotton	-	-
2013- 14	Bajara	-	-
2014-15	Maize	-	-
	Present investigation		

Climate and weather conditions:-Ajmer is situated in the sub-tropical zone at the latitude of 24°32' North longitude of 67°02' East. The altitude of the place is 307.41 meter above mean sea level. The climate of Ajmer is semi-Arid and characterized by three distinct seasons' *viz.*, hot and dry summer from March to May, warm and rainy monsoon from June to October and mild cold winter from November to February. Most of the rain received from south-west monsoon during June to October. Ajmer received average annual rainfall of about 750 mm, out of which 80 per cent of rainfall is received in *Kharif* season (July-September) by the southwest monsoon. During summer, the maximum temperature may go as high as 37^0C while in the winter it may fall as low as 5^0C. This region is prone to high wind velocity and soil erosion due to dust stroms in summer. Table 3 shows that maximum temperature ranged between 35.40 ^{0}C and 35.45^{0}C during the crop growing season were recorded in the 20th and 22th standard meteorological weeks Likewise, the minimum temperature between 10.3^{0}C and 10.6^{0}C were recorded in the 50th and 52nd standard meteorological weeks, respectively. During crop season, total 750.0mm rainfall received. The maximum relative humidity ranged between 58 and 87.0 per cent during the crop growing season were recorded in the 22th and 33th standard meteorological weeks. Open pan evaporation (2.3 to 8.3 mm) and wind speed (0.3 to 10.6 km hr^{-1}) were observed to fluctuate mostly on lower side than normal during most of the meteorological weeks. Rate of evaporation was marginally higher than normal during 29th MW. Thereafter, it was almost lower than normal during 30th, 31th MW. Later on, it remained lower than normal throughout the season.

Methods adopted:- (i) Experimental design and treatments:-The present investigation "Weed management in Bt cotton" was laid out in Randomized Block Design (RBD) with eight treatments and replicated three times. The allotment of the treatments to various plot were done randomly. The details of the treatments along with symbols used to denote the treatment are given below.

Experimental details:-

Year of the study:- 2015-16	Design of experiment:- Randomized Block Design (RBD)	
Season :- *Kharif*	Plot size :- (i) Gross = 7.20 x 5.4 m^2 (ii) Net = 5.40 x 4.8 m^2	
Name of crop:- Bt Cotton	Number of treatments :- 08	Seed rate:-2 kgha^{-1}
Date of sowing:- 15-07-15	Number of replications:-03	Soil type:- Alfisol
Variety:- MNH886	Fertilizer dose (RDF):- 60:35:35 NPK kg ha^{-1}	
Spacing :- 90 x 60 cm	Total number of plots:- 24	

Treatment details:-The details of treatments under taken in the experiment are as follows:

S. No.	Treatments
1	T_1 - Pendimethalin 1.5 kg a. i.ha^{-1} PE + Hoeing (1 DAS
2	T_2 - Quizalofop-ethyl 0.50 kg a. i. ha^{-1}PoE + Hoeing (23 DAS)

3	T_3 - Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1}PoE + Hoeing (1 DAS and 23 DAS)
4	T_4 - Pyrithiobac sodium 0.62 kg a. i.ha^{-1} PoE +Hoeing (23 DAS)
5	T_5 - Pyrithiobac sodium 0.50kg a. i. ha^{-1} + Quizalofop-ethyl 0.050 kg a. i.ha^{-1} + Hoeing (23 DAS)
6	T_6 - Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS
7	T_7 – Weed free check
8	T_8 – Weedy check

Details of cultural operations:-The details of various cultural operations carried out in the experimental field during growing period of investigation are presented in Table 3.

Table: - 3. Details of cultural operation of experiment.

S. No.	Particulars	Frequency	Implements used	Date of operation
A	Preparatory tillage			
1	Ploughing	1	Iron plough	15.05.2015
2	Harrowing	1	Harrow	26.05.2015
3	Layout of experiment	1		11.07.2015
B	Sowing			
1	Marking rows	1	Manually	10.07.2015
2	Sowing of seed by dibbling	1	Manually	15.07.2015
4	Date of emergence	1	Manually	18.07.2015
4	Gap filling	1	Manually	20.07.2015
5	Thinning	1	Manually	24.07.2015
C	Manures and fertilizer application			
1	Nitrogen as per recommended	2	Manually	11.07.2015 02.08.2015
2	Phosphorus as per recommended	1	Manually	12.07.2015
3	Potassium as per recommended	1	Manually	11.07.2015
D	Interculture operation			
1	Applicartion of herbicide			
	Pendimethalin (6ml L^{-1})	1	Knapsack Sprayer	13.07.2015
	Quizalofop ethyl (2ml L^{-1})	1	Knapsack Sprayer	04.08.2015
	Pyrithiobac sodium (1ml L^{-1})	1	Knapsack Sprayer	04.08.2015
	Pyrithiobac sodium + Quizalofop ethyl (1ml+2ml L^{-1})	1	Knapsack Sprayer	04.08.2015
	Glyphosate (10 ml L^{-1})	1	Knapsack Sprayer	25.08.2015
2	Hand weedings	4	Manual labour	08.08.2015 25.08.2015 25.09.2015 17.10.2015
5	Hoeings	2	As per treatment	-
E	Plant protection measures			

1	Monocrotophos + Confidor	2	Power sprayer	12.08.2015-05.09.2015
2	Endosulphan	1	Power sprayer	12.09.2015
3	Quinolphos	1		22.10.2015
F	Harvesting and threshing			
1	Picking	2	Manual labour	30.11.2015 20.12.2015

Soil analysis:- (i) Soil chemical properties:- (a) Soil reaction:- Soil pH was determined in soil suspension by a glass electrode pH meter after equilibrating the soil with water for 30 minutes with occasional stirring (Jackson, 1973). (b) Electrical conductivity:- Electrical conductivity was determined in soil suspension (1:2.5 soil : water) after equilibrating the soil with water and keeping the sample undisturbed till the supernatant is obtained and measured using conductivity meter (Jackson, 1973).(c) Organic carbon:-For the determination of organic carbon the modified Walkley and Black method was followed (Walkley and Black, 1934).

(ii) Available nutrients:- (a) Nitrogen:-Available nitrogen was determined by alkaline permanganate method using microprocessor based automatic distillation system (Subbiah and Asija, 1956). (b) Phosphorus:-Available phosphorus was determined by Olsen's method using 0.5 M sodium bi-carbonate as an extracting using UV based double beam spectrophotometer (Olsen and Sommer, 1982). (c) Potassium:-Available potassium was determined by neutral normal ammonium acetate method using flame photometer (Knudsen and Peterson, 1982). (d) Sowing, gap filling and thinning:-Sowing was done by dibbling 2 seeds at each hill after receding sufficient rains. The plant population was maintained by gap filling and subsequently by thinning with keeping one plant per hill. (iii) Crop variety:- A cotton Mallika Bt was used for the study. The variety is recommended for this region. It is high yield potential and early maturity (150-160days). (iv) Fertilizer application:- The crop was fertilized with same N, P and K levels as per the treatments. Nitrogen was applied through urea, phosphorous through SSP and potassium through MOP. Full dose of Phosphorous, potassium and half dose of nitrogen were applied as basal dose. Remaining half dose of nitrogen was applied at 30DAS. (v) Application of herbicide:-The quantity of herbicide required for the gross plot area was calculated as per treatment and the quantity of water @ 700 L ha^{-1} required for spraying of pre emergence and 400 L ha^{-1} for post emergence of weedicides was determined by calibration of sprayer. (vi) Plant protection:-Plant protection measures were undertaken as per the incidence of pest to protect the crop from sucking pests. The details of schedule adopted are presented in table 5. (vii) Intercultural operations:-Hoeing by hand hoe and hand weeding by manual labour under taken to maintain the crop weed free and to keep the soil loose and porous for good aeration and better penetration of roots under farmers practice. Only one hoeing was done in IWM treatments 20-25 days after weedicides spray. The weeding was done from cotton rows and in between cotton row the glyphosate was sprayed in (T_6). The schedule of intercultural operations undertaken is mentioned in Table 5. (viii) Harvesting:-Picking of cotton was manually. In all two pickings were undertaken. After picking of seed cotton, plants were cut from soil surface manually. Plants were subjected to sun drying for recording dry weight as a stalk yield.

(ix) Detail of Herbicide used: Pendimethalin:-

Common Name:- Pendimethalin	Herbicidal group:- Dinitro anilines
Trade Name:- Stomp, Pendilene, Tata Penida	Type of herbicide:- selective
Chemical Name:- N-(1-ethyl-propyl)-3, 4-dimethyl-2,6 dinitrobenzen amine	
General doses:- 1.0-1.5 kg a.i ha^{-1}	Price:- Rs.500 L^{-1}
Application:- pre-emergence and early post emergences	Formulation:- 30% EC
Mode of Action:- It is rapidly absorbed by foliage and very slowly by root and translocate in both the xylem and phloem and kills.	

Important weed control:-Pendimethalin: - Controls most annual grasses and certain broad leaves weeds in many crops. It is applied as pre-emergence, early pre-emergence, pre plant soil incorporation or post-emergence and incorporate in soil depending upon the crop. It is mostly used in cotton, soybean, groundnut, pea, sunflower and certain transplanted vegetables, which have shown physiological selectivity to it. *Trianthema* spp. is very susceptible to soil applied Pendimethalin. Stomp is the trade name of herbicide Pendimethalin [N-(1-ethyl propyl) – 3,4 dimethyl – 2,6 dinitrobenzenamine] manufactured by Cynamid India Company Ltd. It is formulated as 30 EC stomp. It is generally sprayed as pre-emergence. It is absorbed by roots and shoots but translocation is very limited. Pendimethalin inhibits cell division and cell elongation in the roots and meristems of succeptible weeds. Nucleic acid inhibition is considered to be the primary mechanism of action of Pendimethalin. It also interferes photosynthesis and respiration.

Biometric observations:- The various biometric observations were recorded treatment wise on randomly selected five plants from each net plot during the course of investigation. The details of observations recorded and their frequency are presented in Table 4

Table 4: Details of biometric observations

S. No.	Particular	Frequency	Days after sowing
I.	Weed Studies		
1	Weed flora		
2	Weed count(m^{-2}) (monocot and dicot)	6	20,30, 60, 90, 120 and at harvest
3	Dry matter of weed (m^{-2})	6	20,30, 60, 90, 120 and at harvest
4	Weed biomass (kg ha^{-1})	1	At harvest
5	Weed control efficiency (%)	2	30 and at harvest
6	Weed Index (%)	1	At harvest
II.	Crop studies		
1	Emergence count	1	At emergence
2	Final plant stand	1	At harvest
3	Plant height (cm)	5	30, 60, 90, 120, and at harvest
4	Number of branches		
	i) Monopodial	4	60, 90, 120 and at harvest
	ii) Sympodial	4	60, 90, 120 and at harvest
5	Number of functional leaves $plant^{-1}$	5	30, 60, 90, 120 and at harvest
6	Leaf area plant(d m^{-2})	5	30, 60, 90, 120 and at harvest
7	Leaf and root biomass (kg ha^{-1})	1	At harvest
9	Dry matter $plant^{-1}$ (g)	5	30, 60, 90, 120 and at harvest
10	Crop phytotoxicity	1	After spraying of herbicide
III.	Growth indices		
1	AGR (g day^{-1})		30, 60, 90, 120 and at harvest
2	RGR (g g^{-1} day^{-1})		30, 60, 90, 120 and at harvest
3	NAR (g dm^{-2} day^{-1})		30, 60, 90, 120 and at harvest
IV.	Yield contributory characters		
1	Number of bolls picked per plant		At each picking
2	Weight of seed cotton (g) per plant		At each picking
V.	Yield studies		
1	Seed cotton yield (kg ha^{-1})		Post harvest
2	Cotton stalk yield (kg ha^{-1})		Post harvest
3	Biological yield (kg ha^{-1})		Post harvest
4	Harvest index (%)		Post harvest
5	Seed index (g)		Post harvest
VI.	Economic studies		
1	Gross monetary returns (Rs ha^{-1})		Post harvest
2	Net monetary returns(Rsha^{-1})		Post harvest

3	Cost of treatment (Rs ha^{-1})		Post harvest
4	B:C ratio		Post harvest
5	Energetics		Post harvest
VII.	Quality studies		
1	Ginning percentage (%)		Post harvest
2	2.5 % span length (mm)		Post harvest
3	UR (%)		Post harvest
4	Fineness micronaire		Post harvest
5	Bundle strength		Post harvest
6	Oil content (%)		Post harvest
7	Oil yield (kg ha^{-1})		Post harvest
VIII.	Chemical analysis		
1	Nutrient status of soil	1	Nutrient status of soil
2	NPK uptake by crop	2	NPK uptake by crop at boll bursting
3	NPK uptake by weed	3	NPK uptake by weed at 90 DAS

Weed studies:- (i) Weed count:-For weed population study in each net plot a quadrate of 1m × 1 m area was randomly fixed. Number of weeds observed in that area was counted at 30 days interval up to harvest of the crop. By observing weed flora these weeds were grouped as monocot and dicot. (ii) Dry matter of weeds:-Weed dry matter weight was recorded by using a quadrate of 1 m × 1 m from a random spot in the plot where weed infestation was representative of the fix quadrate area in the treatment. At the time of weeds removal through hand weeding and hoeing or any other treatment execution, selected fixed quadrate area was also carefully hand weeded and hoed or treatment wise treated. The weeds were first air dried and then kept in an oven at 65^0C till the constant dry weight was obtained. These observations were taken periodically. Weed biomass at harvest was calculated from dry matter at harvest and at 30 DAS. (ii)Weed control efficiency:-The weed control efficiency was calculated by following formula (Gautam et. al. 1975)

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

Where, - WCE = Weed control efficiency in per cent, DMC = Dry matter of weeds in control plots, DMT = Dry matter of weeds in treated plots.

Weed index: - The weed index was calculated by the formula proposed by Gill and Vijay Kumar (1969).

$$WI\ (\%) = \frac{X - Y}{X} \times 100$$

Where,:- WI = Weed index in per cent, X = Grain yield from weed free plot, Y = Grain yield from treated plot.

Crop studies:- (i)Plant population:-The plant population was recorded by actually counting the number of plants in each net plot after thinning and at harvest. (ii) Plant height (cm):-Height is generally considered as an indication of crop growth. It was measured from ground level to the tip of terminal bud. Five sampling plants were selected for recording height and average height per plant was worked out at various crop growth stages. (iii) Number of monopodial and sympodial branches $plant^{-1}$-Monopodial (vegetative) and sympodial (fruiting) branches were counted at an interval of 30 days from 60 days onwards up to harvest. (iv) Number of functional leaves $plant^{-1}$ and leaf area $plant^{-1}(dm^2)$:-The number of green leaves on the five sampling plants were counted and recorded from 30 DAS at regular interval and the average number of leaves per plant was worked out. The leaves from the plant sampled for dry matter study were used for estimating the leaf area. The leaf area (dm^2) was estimated by using the automatic laser area meter model CI-203, CID Inc USA at Department of Agronomy, Bhagwant University.

Leaf area index (LAI):-It is the ratio of leaf area per plant to the land area expressed in the same unit. The LAI was computed by

using the formula given by Watson (1952).

$$LAI = \frac{\text{Leaf area plant}^{-1}\ (dm^2)}{\text{Land area plant}^{-1}\ (dm^2)}$$

(i) Chlorophyll content index:-Randomly five plants were selected in each plot and calculated the chlorophyll content index by chlorophyll meter. Chlorophyll content index in leaves recorded from 30 DAS at regular interval up to harvest stage of crop. (ii) Leaf and root biomass (kg ha^{-1}):-Leaf and root biomass at harvest were recorded by taking five plant from each plot, leaf fall per plant and roots of uprooted plant was kept in brown paper bags, for sundry first and then kept in oven at 60-65^{0}C for drying. The weight of dried leaves and roots were recorded treatment wise. (iii) Dry matter $plant^{-1}$ (g):-The dry matter accumulation was recorded by taking one plant from each plot at 30 days interval. Plant was cut from surface of soil from each plot. The plant was kept in brown paper bags, for sundry first and then kept in oven at 60-65^{0}C for drying. The weights of dried plants were recorded treatment wise.(iv) Absolute growth rate (AGR):-The rate of increase in a growth variable (W) at the time (t) is called as absolute growth rate. It is measured as differential coefficient of 'W' with respect of time't'. Absolute growth rate of total dry matter weight was calculated by following formula reported by Richard (1969) and expressed as g day^{-1} $plant^1$.

$$AGR\ (g\ day^{-1}\ plant^{-1}) = \frac{(W_2 - W_1)}{(t_2 - t_1)}$$

Where,:- W_2 and W_1 refer to the total dry matter of plant in g at t_2 and t_1 time, respectively.

Relative growth rate (RGR):-Blackman (1919) pointed out that an increase in dry matter of plant is a process of continuous compound interest wherein the increment in any interval adds to the "Capital" for subsequent growth. This rate of increment is called as relative growth rate (RGR), which was worked out as per formula given by Fisher(1921) and expressed in g g^{-1} day^{-1} $plant^{-1}$.

$$RGR\ (g\ g^{-1}\ day^{-1}) = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{t_2 - t_1}$$

Where, W_1 and W_2 are the initial and final plant dry weight (g). t_1 and t_2 are the initial and final day of observation i.e. time intervals in days. Log_e i.e. Natural logarithm to the base e (e = 2.3026).

Net assimilation rate (NAR):-Analysis of dry weight accumulation based on differentiation between assimilating leaves and rest of the plant parts is more informative. The concept of net assimilation rate (NAR) on an area basis was introduced and used by Gregory (1917) to obtain simple growth measurement as an estimate of assimilatory efficiency of leaves. It was calculated as:

$$NAR\ (g\ dm^{-2} day^{-1}) = \frac{(W_2 - W_1)}{(t_2 - t_1)} \times \frac{(\text{Log}_e LA_2 - \text{Log}_e LA_1)}{(LA_2 - LA_1)}$$

Where, W_1 and W_2 are dry weight of whole plant and LA_1 and LA_2 are leaf area $plant^{-1}$ (dm^2) of consecutive samples collected at times t_2 and t_1 in days, respectively. Log_e i.e. Natural logarithm to the base e (e = 2.3026).

Crop phytototxicity visual score rating scale (0 to 10):-Data related to crop phytototxicity are presented in Table 5. The observations were recorded from after application of herbicide in plot.

Table 5: Crop phytototxicity visual score rating scale (0 to 10)

Effect	Rating	Effect on crop
None	0	No injury, normal
Slight	1	Slight stunting, injury or discolouration
	2	Some stand loss, stunting or discolouration
	3	Injury more pronounced but not persistent
Moderate	4	Moderate injury, recovery possible
	5	Injury more persistent, recovery doubtful
	6	Near severe injury, no recovery possible
Severe	7	Severe injury, stand loss

	8	Almost destroyed, a few plants surviving
	9	Very few plants alive
Complete	10	Complete destruction

Yield attributes :-(i) Number of picked bolls per plant and m^2:- Picked bolls $plant^{-1}$ was one of the most important production factors which decide the yield of seed cotton. Hence, bolls picked $plant^{-1}$ after last picking on each observation plant of various treatments were recorded separately. (ii) Seed cotton yield $plant^{-1}$ (g):-Randomly selected plants keep as such without picking up to last picking. At last picking seed cotton from all five plants were calculated in one packet and yield per plant was worked out. (iii) Seed cotton yield (kg ha^{-1}):-Seed cotton from each net plot was picked and the same was weighted separately at each picking. The total yield per net plot was worked out by summation of quantity of seed cotton picked in each picking from the total yield per plot including five plants yield and per hectare yield was calculated for each treatment.(iv) Stalk yield (kg ha^{-1}):-After picking of complete seed cotton, the plants in the net plot were cut at ground level and kept separately in each plot. After sun drying the weight was recorded per plot and per hectare yield was calculated treatment wise. (v) Biological yield (kg ha^{-1}):-Before picking of complete seed cotton, the plants in the net plot were cut at ground level and kept separately in each plot. After sun drying the weight was recorded per plot and per hectare yield was calculated treatment wise. Biological yield (kg ha^{-1}) = Seed cotton yield (kg ha^{-1}) + Stalk yield (kg ha^{-1}). (vi) Harvest index (%):-The harvest index was calculated by dividing seed cotton yield per hectare by total biological yield and expressed in percentage.

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

(vii) Seed index (g):-Seed index ensures evolution of properly developed seed and leads to development of lint index. It was worked out by taking weight of 100 seeds from each treatment sample and expressed in grams.

Quality studies :-(i) Ginning percentage:-A sample of 300g of seed cotton was obtained from each treatment and was ginned on a hand gun after cleaning. The weight of lint and seed obtained was recorded separately. Ginning percentage was calculated treatment wise by using the following formula.

$$\text{Ginning percentage (\%)} = \frac{\text{Lint weight (g)}}{\text{Seed cotton weight (g)}} \times 100$$

Economic studies:- (i) Gross monetary returns (Rs. ha^{-1}):-Seed cotton yield and cotton stalk yield obtained from each net plot were converted into gross monetary returns (Rs. ha^{-1}) at the prevailing market price. Gross monetary returns per ha were calculated by multiplying hectare factor. (ii) Cost of cultivation (Rs ha^{-1}):-Taking into the consideration the various inputs used in the present investigation, cost of cultivation was calculated by addition of all the cost incurred towards purchasing of inputs, cost incurred towards mechanical operations and labour charges for picking. Treatment wise cost of cultivation was worked out and given in Appendix 1. (iii) Net monetary returns (Rs ha^{-1}):-Net monetary returns were calculated by subtracting the cost of cultivation from gross monetary returns. (iv)Benefit: cost ratio: - It is the ratio of gross monetary returns to the cost of cultivation.

$$\text{Benefit cost ratio} = \frac{\text{Gross monetary returns (Rs ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}^{-1}\text{)}}$$

Energetics:-Energy values which were take for energy estimation. The standard energy coefficient for seed cotton and stalk was multiplied with their respective yield and summed upto obtain the total energy output, energy use efficiency, energy output: input ratio, energy intensiveness and energy productivity were calculated as per the following formula.

(i) Energy input (MJ x 10^{-3}) – Worked out by using the item wise energy values of each treatment. (ii) Energy output (MJ x 10^{-3}) – Worked out from cotton seed and stalk of cotton crop.

$$\text{(iii) Energy output: input ratio (kg MJ)} = \frac{\text{Energy output}}{\text{Energy input}}$$

$$\text{(iv) Energy use efficiency (kg MJ}^{-1} \text{ x } 10^{-3}\text{)} = \frac{\text{Total produce}}{\text{Energy input}}$$

Chemical studies :-(i) Chemical analysis of soil:-A composite sample (0-30 cm depth) was collected from each plot of experimental area after harvest. The samples were air dried in shade, powdered and analyzed for the estimation of nitrogen, phosphorus and potassium. The method adopted for these studies are given in Table1. (ii) Nutrient uptake by cotton and weed:-The plant and weed samples from each net plot were taken at 50 per cent boll bursting stage and 90 DAS respectively. The plant and weeds were dried in oven and grind to fine powdered and used for estimation of total uptake of nitrogen, phosphorus and potash. (a) Nitrogen:-Total nitrogen was determined by digesting the plant sample in microprocessor based digestion system (KES-12L) using conc. H_2SO_4 and salt mixture (Micro- Kjeldahl's method) (Chapman and Pratt, 1961) and distillation with automatic distillation system. (b)Phosphorus:-Phosphorus was estimated from di-acid extract by vanado molybdate phosphoric acid yellow colour method (Piper, 1966) using UV based double beam spectrophotometer. (c) Potassium:-Potassium was estimated from di-acid extract by using flame photometer (Piper, 1966). (iii) Uptake of nutrients:-The uptake of nutrients in different plant and weeds was calculated from the data on their concentration in component plant and weeds and their average dry weights and converted on hectare basis. The total uptake was worked out by summing the uptake of respective nutrient in plant and weeds. Statistical analysis and interpretation of data:-The statistical method of analysis of variance was used for analyzing the data. The data were statistically analysed by 'Analysis of Variance' method (Panse and Sukhatme, 1967) and 'F' test of significance was used for testing the 'null hypothesis' in order to determine whether the observed treatment effects were real and discernible from chance effects. Whenever the results were found to be significant, critical difference (C.D.) was calculated for the comparison of treatment means at 5 per cent levels of significance (P = 0.05). The results have been presented in the form of summary table providing S.E. (m) in each case and C.D. at 5 per cent level. The values of C.D. have been taken into account for drawing conclusions.

V. RESULTS

The present investigation entitled "Performace of various Herbicides on bt. Cotton under rainfed condition" was conducted during *kharif* season of 2015-2016.The observations taken during the course of investigation and the results obtained have been discussed in this chapter and the inferences have been supported with logical reasoning and appropriate evidences.

Weed studies: - Weed flora: - Different weed species observed in experimental field were identified and a list is presented in Table 6.

Table 6: Weed flora observed in experimental plot

S. No.	Common name	Botanical name
A. Monocot weeds		
1.	Haryali	Cynodon dactylon
2.	Lona grass	Dinebra Arabica
3.	Pauna	Poa annua
4.	Barnyard grass	Echinochloa crusgalli
5.	Chimanchara	Eragrostis major
6.	Motha	Cyperus rotundus
B. Dicot		
1.	Pandharphuli	Lagas camollis
2.	Dudhi (chhoti)	Euphorbia geniculata
3.	Kunjaru	Digera arvensis
4.	Kena	Commelina benghalensis
5.	Gajargavat	Parthenium hysterophorus
6.	Cock's comb	Celosia argentea

7.	Dudhi (mothi)	Euphorbia hirta
8.	Hazardana	Phyllanthus niruri
9.	Gokharu	Xanthium strumarium
10.	Reshimkata	Alternanathera sessile

Weed count (m^{-2}):-Monocot weeds (m^{-2}):-Data related to number of monocot weeds m^{-2} are presented in Table 7. The observations were recorded from 20 DAS upto harvest of the crop. The data revealed that at 20 DAS monocot weeds m^{-2} were lowest was sprayed as per emergence after dibbling of cotton. When pendimethalin 1.5 kg a. i.ha^{-1} + Hoeing followed by pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb quizalofop-ethyl @ 0.50 kg a. i. ha^{-1}PoE + Hoeing followed by weed free check (19.77). Treatment T_6, T_5, T_2, T_4 and T_8 was at par with each other. Lowest mean monocot weed m^{-2} was recorded at 30 DAS (20.02) and highest at harvest (25.64) of crop. At 30 DAS minimum weed population of monocot weed m^{-2} (7.45) were recorded in weed free check followed by T_2 (13.58) and T_3 (14.57) these are at par with T_7 i. e. weed free check. At 60 DAS minimum (9.55) weed population of monocot weed m^{-2} were recorded in weed free check followed by T_6, T_2 and T_3 these are at par with T_7. Similar finding was reported by Street *et al.* (1981). Anonymous (1981), Jalis and Shah (1982), Akhtar *et al*. (1986), Detroja *et al*. (1992), Almeida *et al*. (1999) and Sreenivas (2000).

Table 7: Monocot weeds (m^{-2}) as influenced by different treatments Monocot weeds (m^{-2})

Treatments	Monocot weeds (m^{-2})					
	20 DAS	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	13.50	16.67	24.41	24.55	26.33	25.45
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	35.60	13.58	14.46	15.45	16.67	18.32
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	18.40	14.57	15.73	15.71	18.67	20.10
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	35.60	18.47	22.00	24.36	25.33	26.76
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	35.35	17.46	18.43	17.53	21.27	21.34
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	30.45	35.56	11.66	15.97	15.45	17.32
T_7- Weed free check	17.46	7.45	9.55	13.64	13.33	15.34
T_8- Weedy check	34.46	43.33	45.67	49.55	50.45	53.35
SE(m) ±	1.90	1.60	1.90	2.06	2.78	3.00
CD at 5 %	4.88	5.57	5.75	6.56	7.90	9.00
GM	27.60	20.02	19.77	20.92	22.71	25.64

Dicot weeds (m^{-2}):-Data in respect of number of dicot weeds m^{-2} are presented in Table 8. These observations were recorded from 20 DAS upto harvest of crop. The mean dicot weed m^{-2} was lowest at 30 DAS (15.41) and highest at harvest (17.73). Less number of dicot weeds m^{-2} were observed as compared to monocot weeds. Lowest dicot weed m^{-2} was noticed in T_7 (Weed free check) throughout the growth period of crop whereas highest in weedy check. Among herbicidal treatment T_6 (Glyphosate @ 1.0 kg a. i.ha^{-1} as directed spray at 45 DAS) was superior over all treatments and good weed control upto at harvest in T_1 and T_3 i.e. Pendimethalin Fb Quizalofop-ethyl, which is selective in control of dicot weeds. Other herbicidal treatment resulted poor in dicot weed control but significantly better than weedy check. Similar finding was noted by Street *et al*. (1981). Anonymous (1981), Jalis and Shah (1982), Akhtar *et al*. (1986), Detroja *et al*. (1992), Almeida *et al*. (1999) and Sreenivas (2000).

Table 8: Dicot weeds (m^{-2}) as influenced by different treatments

Treatments	Dicot weeds (m^{-2})					
	20 DAS	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	6.80	8.95	12.56	13.35	14.35	15.34
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	19.35	15.45	17.51	18.14	19.45	19.20
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE+ Hoeing	7.56	9.34	11.75	12.86	14.34	15.45
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	18.00	12.65	13.45	15.29	16.87	17.83
Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050 Kg a.i.ha^{-1}PoE + Hoeing	21.45	13.50	16.45	17.23	18.34	19.20
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	19.35	22.35	8.76	10.34	12.25	13.13
T_7- Weed free check	10.45	8.45	9.36	10.45	11.45	12.43
T_8- Weedy check	20.33	24.56	26.13	27.56	28.34	29.26
SE(m) ±	1.30	1.56	1.37	1.54	1.52	1.70
CD at 5 %	3.34	4.35	4.15	4.34	4.60	5.15
GM	15.41	14.40	14.49	15.62	16.92	17.73

Total weeds (m^{-2}):-Data pertaining total weeds m^{-2} are presented in Table 11 graphically illustrated in table no 09, which was recorded from 20 DAS upto harvest of crop. The data revealed that mean number of total weeds m^{-2} was maximum at harvest (42.36) and minimum at 60 DAS (34.02) because PE and PoE herbicides spraying. Highest weed control was observed in weed free check and lowest in control. At 20 DAS lowest weed population (19.25) was recorded in T_1 (Pendimethalin 1.5 kg a. i.ha^{-1} PE + Hoeing) followed by pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb quizalofop-ethyl @ 0.50 kg a. i. ha^{-1}PoE + Hoeing due to pre emergence spray of pendimethalin found better control of weeds at initial stage of cotton followed by T_7 (29.324) where one hoeing was done at 20DAS. Treatment T_6, T_5, T_2 and T_4 these are at par with each other. At 30 DAS maximum weed was control due to post emergence spray of herbicide. The T_7
(Weed free check) was significantly superior over all other treatments (123.62). Among herbicidal treatments glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS resulted better in respect of total weed control m^{-2} and shad minimum count of weed. From the data it was observed that the weed free check found better overall herbicidal treatments followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS had shown less weed population. Similar findings was given by Street *et al.* (1981), Anonymous (1981), Jalis and Shah (1982), Akhtar *et al.* (1986), Detroja *et al.* (1992), Almeida *et al.* (1999), Manickam and Gnanamoorty (1994) and Sreenivas (2000).

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Table 9: Total weed population (m^{-2}) as influenced by different treatments

Treatments	Total weed population (m^{-2})					
	20 DAS	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	19.25	24.51	35.87	37.77	39.67	42.41
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	56.31	27.41	30.43	32.78	35.28	37.23
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	21.54	22.78	25.91	29.34	31.67	34.45
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE+ Hoeing	56.74	31.64	34.41	37.55	41.29	43.12
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kga.i.ha^{-1}PoE+ Hoeing	53.64	28.75	34.31	35.35	38.41	41.39
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	51.43	56.54	19.53	23.31	26.54	29.77
T_7- Weed free check	29.34	13.62	18.21	21.31	23.42	26.31
T_8- Weedy check	58.34	66.99	73.55	76.74	78.79	84.24
SE(m) ±	1.54	1.58	1.64	1.45	1.25	1.34
CD at 5 %	4.45	4.79	5.35	4.34	3.57	4.11
GM	43.32	34.03	34.02	36..73	39.38	42.36

Total dry matter accumulation by weed (g) and weed biomass production (kg ha^{-1}):-Total dry matter accumulation by weed (g):-The data revealed that during crop growing period maximum mean dry matter was recorded at harvest (73.13 g) and minimum at 20 DAS (42.67 g). The glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS was superior over all other treatments followed by T_7, T_3, T_2 and T_1. Highest weed dry matter (g) was recorded in control (197.67 g) at harvest. Among the herbicidal treatment glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS recorded lowest weed dry matter m^{-2} (36.67 g) and highest dry matter accumulation by weed 197.67 g m^{-1} was recorded will weedy check, where no control measure was taken. Herbicidal treatments were significantly superior over control. Similar results were noticed by Balyan *et al.* (1980), Sandhu *et al.* (1996), Singh *et al.* (1988), Kakade *et al*. (1999), Kandasamy et al (1998) and Sreenivas (2000).

Table 10: Total dry matter accumulation by weed (g m^{-2}) and weed biomass (kg ha^{-1}) as influenced by different treatments:-

Treatments	Total dry matter accumulation by weed (g) m^{-2}						Weed biomass (kg ha^{-1})
	20 DAS	30 DAS	60 DAS	90 DAS	120 DAS	at harvest	
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	24.33	42.33	49.33	55.00	62.67	68.00	680
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	44.00	34.33	43.33	46.67	51.37	56.00	560

T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	22.33	28.33	30.33	35.00	41.00	45.67	456
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	51.67	43.95	51.33	55.67	63.33	71.67	716
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE+ Hoeing	52.00	42.33	51.00	53.33	57.67	68.33	683
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	51.33	71.67	23.67	26.33	31.00	36.67	366
T_7- Weed free check	41.33	22.33	25.00	29.00	34.67	41.00	410
T_8- Weedy check	55.33	99.67	121.67	142.00	179.67	197.67	1976
SE(m) ±	2.48	2.66	1.63	1.82	1.44	1.08	10
CD at 5 %	7.53	8.07	4.95	5.51	4.36	3.28	32
GM	42.67	47.99	49.33	55.25	65.04	73.13	731

Weed biomass production (kg ha^{-1}) at harvest:- Data regarding to weed biomass production (kg ha^{-1}) are presented. The mean weed biomass production was recorded 731 kg ha^{-1}. Highest biomass of weed was under weedy check (1976 kg ha^{-1}) and lowest weed biomass was recorded in weed free check (410 kg ha^{-1}). Among the herbicidal treatments quizalofop-ethyl 0.50 kg a. i. ha^{-1}PoE + Hoeing was recorded lowest weed biomass (560 kg ha^{-1}) which was lowest than other treatments. Similar results were given by Tankar and Mundhe (1982), Singh *et al.* (1993) and Kandasamy et al (1998).

Weed control efficiency (%) and weed index at harvest:-Weed control efficiency at 30 DAS, 60 DAS and at harvest:- Data pertaining to weed control efficiency at 30 DAS and at harvest are presented in Table 11. At 30 DAS highest weed control efficiency was recorded in weed free check (79.49 %) followed by T_3 (Pendimethalin @ 2.0 kg a. i.ha^{-1} PE Fb Quizalofop-ethyl @ 0.50 kg a. i. ha^{-1}PoE + Hoeing) at 30 DAS in cotton (721.57 %) and T_2 (Quizalofop-ethyl 0.050 Kg a.i.ha^{-1} PoE + Hoeing) (66.55 %). At 60 DAS and at harvest highest weed control efficiency was recorded with glyphosate spray (81.44 %) followed by weed free check (79.25 %) and T_3 (76.89 %). Among weedicides T_3 (Pendimethalin @ 1.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1}PoE + Hoeing) (71.57) recorded highest weed control efficiency at 30 DAS and at harvest T_6 (Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS) (80.54). Same results were observed by Tankar and Mundhe (1982), Kakade et al (1999) and Manickam and Gnanamoorty (1994).

Table 11: Weed control efficiency (%) at 30 DAS, 60 DAS and at harvest and weed index (%) at harvest as influenced by different treatment

Treatments	Weed control efficiency (%)			Weed index (%)
	30 DAS	60 DAS	at ha- - rvest	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	59.53	61.27	66.59	15.89
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	66.55	65.38	72.66	29.48
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	72.57	76.07	77.89	21.62
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	56.90	57.81	64.74	31.56
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	58.52	58.08	65.43	24.45

T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	29.09	80.54	82.44	7.56
T_7- Weed free check	78.59	79.49	79.25	-
T_8- Weedy check	-	-	-	59.93

Weed index (%) at harvest:-Data pertaining to weed index at harvest are presented in Table 11.
The highest weed index was recorded in weedy check (59.93 %) and lowest in glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS at harvest (7.56 %), followed by T_1 and T_3. It indicated highest seed cotton yield was reflected in glyphosate spray plot ever all other treatment. Same results were noted by Tankar and Mundhe (1982), Kakade et al (1999) and Manickam and Gnanamoorty (1994). Crop Phytotoxicity:-Phytotoxicity symptoms due to herbicides on crop was recorded by using a visual score scale of $0^{-1}0$. Visual assessment of herbicide toxicity on crop was monitored 10 days after application of herbicide in respective treatment.

Table 12: Phytotoxicity symptoms on crop (score $0^{-1}0$ scale).

Treatment	Crop Phytotoxicity score
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	0
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	0
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	0
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	0
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	0
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	2
T_7- Weed free check	0
T_8- Weedy check	0

(0 – No injury. 2 – Some stand loss, stunting or discoloration.)
The data in Table 12 revealed that there were no Phytotoxicity symptoms observed on plant leaf and no harmful effect on growth of plant.
Crop studies:-Emergence count and final plant stand:- Data pertaining to initial stand of the crop after complete emergence and final stand at harvest stage of the crop are presented in Table 13. The data revealed that various treatments had no significant influence on the initial and final plant stand thereby indicating uniform emergence and its persistence throughout the crop growth period i.e. average plant population at initial stage and at harvest as 19544 and 19176 ha^{-1} respectively, hence plant population was not variable factor.

Table 13: Initial and final plant stand of cotton as influenced by different treatments

Treatments	Initial plant stand ha^{-1}	Final plant stand ha^{-1}
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	19517	19183
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	19616	19141
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	19513	19003
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	19517	19225
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	19585	19191

T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	19516	19250
T_7- Weed free check	19578	19418
T_8- Weedy check	19516	19002
SE(m) ±	1.52	1.76
CD at 5 %	NS	NS
GM	19544	19176

Plant height (cm):-Data on plant height (cm) was recorded periodically at an interval of 30 days up to harvest are presented in Table 14 .Plant height increased as the crop advanced in age. Mean plant height increased from 23.38 cm at 30 DAS to 55.07 cm at harvest. The rate of increase in plant height was rapid during 20-80 DAS, moderate between 80 to 100 DAS; subsequently the rate of increase was slow towards harvest stage due to senescence. The plant height was significantly influenced due to various treatments at all stages of crop growth except at 30 DAS. Highest plant height was recorded in Weed free check throughout crop period which was at par with T_1, T_3, T_5 and T_6. Among the herbicidal treatments glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS was found to be superior over all other treatments. Lowest plant height was recorded with weedy check throughout the growing period of crop due to higher population of weeds suppressed the growth of cotton and compete for solar radiation, moisture and nutrients. Significantly tallest plant were observed in treatment of weed free check (T_7) closely followed by T_6, T_5, T_1, T_3 which was mainly due to elimination of weed competition right from sowing to harvest. Application of pendimethalin controlled pre-emergence weeds in T_1 and T_3. Use of quizalofop ethyl as PoE in T_2 controlled monocot weeds. It was seen that as there was increase in weed intensity, there was decrease in plant height. In weedy check (T_8) the plant height was very less due to weed competition for plant nutrients, soil moisture and their shading effect on crop plants. These results are quite in agreement with the result of Jain *et al*. (1985), Patel (1989), Kakade *et al.* (1999), Sreenivas (2000) and Satao *et al.* (1998).

Table 14: Plant height (cm) as influenced by different treatments

Treatments	Plant height (cm)				
	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	22.05	41.07	48.15	52.29	53.84
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	23.87	39.96	47.00	51.30	53.26
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	21.90	40.79	47.79	51.95	53.41
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	23.96	35.28	44.75	48.97	50.84
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	23.99	44.75	53.01	57.92	59.08
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	24.00	43.93	52.47	58.15	59.87
T_7- Weed free check	24.15	46.29	54.06	58.98	60.47

T_8- Weedy check	23.19	34.92	44.08	48.32	49.86
SE(m) ±	1.58	2.45	2.28	2.22	2.47
CD at 5 %	NS	7.45	6.91	6.74	7.49
GM	23.38	40.87	48.91	53.48	55.07

Number of branches per plant:-Monopodial branches per plant:-The data on number of monopodial branches plant^{-1} are presented in Table 15. Observations were recorded at 30 days interval from 60 DAS upto harvest of crop. Mean number of monopodial branches were 1.18. Non-significant results was obtained with number of monopodial branches throughout the crop growing period Similar results were found by Patel (1989), Satao *et al.* (1998)and sreenivas (2000).

Table 15: Number of Monopodial branches plant^{-1}as influenced by different treatments

Treatments	Monopodial branches plant^{-1}			
	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	1.22	1.27	1.31	1.33
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	1.19	1.31	1.41	1.44
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	1.25	1.25	1.25	1.25
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	1.01	1.05	1.14	1.17
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	1.21	1.31	1.35	1.37
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	1.17	1.41	1.47	1.41
T_7- Weed free check	1.21	1.51	1.53	1.53
T_8- Weedy check	1.21	1.21	1.23	1.25
SE(m) ±	0.06	0.08	0.08	0.08
CD at 5 %	NS	NS	NS	NS
GM	1.18	1.29	1.33	1.34

Sympodial branches per plant:-The data presented in Table 16 regarding number of sympodial branches plant^{-1}. Results showed significant variation in respect of number of sympodial branches from 60 DAS to harvest. The highest number of sympodial branches per plant (14.76). The same results were noted by Patel (1989), Anonymous (2005) and Sreenivas (2000).

Table 16: Number of sympodial branches plant^{-1} as influenced by different treatments

Treatments	Sympodial branches plant^{-1}			
	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	8.09	10.21	12.90	13.41
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	8.73	10.91	11.31	12.31
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	8.23	9.91	12.05	12.81
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	9.10	11.03	11.91	12.71
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	8.71	10.31	13.01	14.21
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	8.91	11.03	12.71	14.08
T_7- Weed free check	9.13	12.07	13.23	14.76
T_8- Weedy check	7.95	8.11	8.51	9.02
SE(m) ±	0.34	0.36	0.43	0.47
CD at 5 %	0.97	1.11	1.21	1.15
GM	8.61	10.44	11.95	12.91

Number of functional leaves per plant:-The data regarding to mean number of functional leaves per plant as influenced by various treatments at different plant growth stages are presented in Table 17. The mean number of functional leaves per plant was increased from 30 DAS (5.97) to 90 DAS (70.16). Later on declined at 120 DAS (53.43) and at harvest (33.21), this might be due to crop approachment to maturity stage and dropping of older leaves by senescence. Maximum rate of leaf production was observed between 30 DAS to 90 DAS. Effect of weed control treatments on functional leaves was found to be significant during all the crop growth stages except at 30 DAS. The weed free checks recorded maximum number of functional leaves (78.63) at 90 DAS which was at par with T_2, T_1, T_6, T_3, T_4 and T_5 during crop growth period of crop. The minimum number of functional leaves were observed (66.68) in weedy check at 90 DAS, due to less number of branches and lowest plant height and more number of weeds compete with crop for sunlight, moisture and nutrients which reduced the leaf number per plant. The result supported the findings of Manjunath and Panchal (1988) and Sreenivas (2000).

Table 17: Number of functional leaves plant^{-1} as influenced by different treatments

Treatments	Number of functional leaves plant^{-1}				
	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	7.65	49.15	72.00	54.67	34.67
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	7.00	51.00	73.33	56.09	34.35
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	7.25	48.60	70.84	53.37	33.67

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T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	6.09	47.57	67.77	53.35	32.69
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	6.17	47.84	68.71	53.65	33.33
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	7.11	49.00	71.36	58.09	36.11
T_7- Weed free check	7.77	53.17	78.63	60.34	39.71
T_8- Weedy check	7.04	43.09	66.68	45.16	28.33
SE(m) ±	0.61	1.67	2.19	2.53	1.71
CD at 5 %	NS	4.94	6.54	7.63	5.12
GM	7.01	48.67	71.16	54.34	34.10

Leaf area (dm^2) per plant and leaf area index at 90 DAS:-Leaf area (dm^2) per plant:-The leaf area per plant at 30 days interval as influenced by different treatments are presented in Table 18. The mean leaf area per plant increased from (2.67 dm^2) at 30 DAS, (43.61 dm^2) at 60 DAS to (72.41 dm^2) at 90 DAS. The rate of increase was rapid between 30 DAS to 90 DAS and declined there after due to leaf senescence (47.33 dm^2) at 120 DAS and (22.27dm^2) at harvest. Significant results were obtained from the different weed control treatments. Leaf area was maximum in weed free check (T_7) and it was at par with T_2, T_6, T_1, T_3 and T_5. Minimum leaf area per plant recorded in weedy check (T_8) due to lowest height and less number of branches per plant and more competition for solar energy, aeration, moisture and nutrients.

Table:- 18 Leaf area plant^{-1} (dm^2) and leaf area index at 90 DAS as influenced by different treatments

Treatments	Leaf area plant^{-1} (dm^2)					LAI
	30 DAS	60 DAS	90 DAS	120 DAS	at harvest	90 DAS
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	2.23	44.23	74.42	48.42	23.81	1.40
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	2.77	44.77	75.27	50.17	23.17	1.41
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	2.37	43.97	73.77	47.29	20.25	1.37
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	2.88	40.57	70.17	44.71	19.29	1.31
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	2.89	42.77	73.17	47.51	23.10	1.37
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	2.85	46.80	75.10	48.27	24.15	1.39
T_7- Weed free check	2.95	47.42	79.12	51.15	27.25	1.46
T_8- Weedy check	2.45	38.39	58.26	41.15	17.15	1.07
SE(m) ±	0.18	1.32	1.18	1.20	0.98	0.04
CD at 5 %	NS	3.99	3.57	3.64	2.97	0.15
GM	2.67	43.61	72.41	47.33	22.27	1.34

Leaf area index at 90 DAS:-The leaf area index at 90 DAS was maximum (1.46) in weed free check and minimum in weedy check (1.07). Similar results were reported by Manjunath and Panchal (1988) and Sreenivas (2000). Total dry matter (g) per plant:- The accumulation of dry matter plant^{-1} is probably the best index of growth put forth by the crop. Relevant data to this character recorded at various stages are presented in Table 19. In general total dry matter accumulation was increased continuously upto harvest. The rate of dry matter accumulation was slow upto 30 DAS (3.71 g) and maximum mean total dry matter per plant was recorded at 120 DAS (834.08 g). The data revealed that differences in dry matter per plant were significantly influenced due to various treatments during crop growth period except 30 DAS. Treatment T_7 (Weed free check) showed superior over all the treatments in accumulation of highest dry matter per plant at par with T_1, T_2, T_3, T_5 and T_6 in all stages of crop growth. T_7 was also at par with T_1 at 60 DAS and 90 DAS, but afterward significantly differ due to increase of weed competition with crop resulted in decrease of dry matter per plant. Among the herbicidal treatment glyphosate spray in cotton rows controlled weed and produced maximum dry matter per plant during complete crop growth period. Minimum dry matters per plant were accumulated in weedy check. Whereas, plant has lowest number of branches, plant height, number of leaves due to presence of weed in the plot in all stages of the crop growth. Dry matter per plant was declined at harvest after 120 DAS due to leaf fall and first picking of seed cotton from plants. Similar results were recorded by Jain *et al*. (1985), Manjunath and Panchal (1988), Satao *et al.* (1998), Anonymous (2001), Kandasamy et al (1998) and Patil *et al.* (1998).

Table: 19-Total dry matter accumulation (g) plant^{-1}as influenced by different treatments

Treatments	Total dry matter accumulation plant^{-1}(g)				
	30 DAS	60 DAS	90 DAS	120 DAS	at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	3.76	41.47	80.32	83.77	56.73
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	4.01	40.10	82.10	86.41	58.25
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	3.40	41.17	80.07	83.25	56.14
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	3.84	37.77	70.25	82.75	54.37
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	3.98	47.34	83.83	87.00	58.03
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	4.09	46.95	80.85	87.12	58.35
T_7- Weed free check	4.27	48.76	84.79	88.20	60.54
T_8- Weedy check	2.36	31.80	72.38	74.18	48.48
SE(m) ±	0.18	2.73	2.05	2.47	1.92
CD at 5 %	NS	8.29	4.25	7.51	5.87
GM	3.71	41.92	79.32	84.08	56.36

Leaf biomass and root biomass (kg ha^{-1}) at harvest:-Leaf biomass (kg ha^{-1}):-Data regarding leaf biomass and root biomass of cotton (kg ha^{-1}) are presented in table 20 recorded at harvest by collection of leaf fall from 1 m^2 area and converted to one hectare. From data it is revealed that leaf biomass was significantly influenced by different treatments. Mean leaf biomass was recorded 999 kg ha^{-1}. Highest leaf biomass (1044 kg ha^{-1}) was noticed under weed free check (T_7) might be due to higher number of leaves per plant. Lowest value of leaf biomass (941 kg ha^{-1}) was recorded under weedy check, where growth shorted and produced very less number

of leaves.

Table 20: Leaf biomass and root Biomass (Kg ha^{-1}) at harvest as influenced by different treatments

Treatments	Leaf biomass (kg ha^{-1})	Root biomass (kg ha^{-1})
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	1001	475
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	1023	478
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	999	471
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	975	445
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	986	466
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	1029	477
T_7- Weed free check	1044	499
T_8- Weedy check	941	423
SE(m) ±	21	9
CD at 5 %	60	27
GM	999	465

Root biomass (kg ha^{-1}):-Root biomass was significantly influenced due to different weed management practices. Mean root biomass was 465 kg ha^{-1}. The maximum root biomass was recorded (499kg ha^{-1}) under weed free check (T_7) and lowest root biomass (421 kg ha^{-1}) with weedy check. It indicates the completion before cotton plant and weed plant reduces the growth of root.

Absolute growth rate (g day^{-1}), relative growth rate (g g^{-1} day^{-1}) and net assimilation rate (g dm^{-2} day^{-1}):-Absolute growth rate (g day^{-1}):-Data related to absolute growth rate are presented in Table 21. The mean absolute growth rate was maximum during 30-60 DAS and decreased towards harvest of crop. Mean absolute growth rate from 30-60 DAS, 60-90 DAS, 90-120 DAS and 120 DAS at harvest recorded as 1.2773g day^{-1}, 1.2738g day^{-1}, 0.2694g day^{-1} and -0.8654 g day^{-1}. The maximum absolute growth rate was observed in treatment weed free check and lowest under weedy check during crop growth period. Similar finding was noted by Manjunath and Panchal (1988), Patil *et al.* (1998) and Kandasamy et al (1998).

Table: 21- Absolute growth rate (g day^{-1}) for dry matter as influenced by different treatments.

Treatments	Absolute growth rate (g day^{-1})			
	30-60 DAS	60-90 DAS	90-120 DAS	120 DAS-at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	1.2565	1.2927	0.2174	-0.8334
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	1.1997	1.4034	0.1421	-0.8704
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	1.2567	1.2967	0.1051	-0.8344
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE+ Hoeing	1.1301	1.3484	1.1517	-0.8794

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T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE+ Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	1.4454	1.2167	0.1061	-0.9001
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	1.4317	1.1297	0.2094	-0.8924
T_7- Weed free check	1.5174	1.1506	0.1640	-0.8990
T_8- Weedy check	0.9814	1.3527	0.0601	-0.8144
GM	1.2773	1.2738	0.2694	-0.8654

Relative growth rate (g g^{-1} day^{-1}):-Data related to relative growth rate are presented in Table 22; it is recorded from 30 DAS up to harvest of crop. The mean relative growth rate was maximum during 30-60 DAS and it was decreased towards harvest of crop. Mean relative growth rate from 30-60 DAS, 60-90 DAS, 90-120 DAS and 120 DAS at harvest recorded as 0.0892 g g^{-1} day^{-1}, 0.0221 g g^{-1} day^{-1}, 0.0016 g g^{-1} day^{-1} and -0.0124 g g^{-1} day^{-1}. Absolute growth rate was higher weed free check and lowest AGR was in weedy check during crop growth period. Similar finding was given by Manjunath and Panchal (1988) and Kandasamy et al (1998).

Table 22: Relative growth rate (g g^{-1} day^{-1}) for dry matter as influenced by different treatments

Treatments	Relative growth rate (g g^{-1} day^{-1})			
	30-60 DAS	60-90 DAS	90-120 DAS	120 DAS-at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	0.0895	0.0225	0.0015	-0.0120
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	0.0854	0.0244	0.0018	-0.0122
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	0.0939	0.0226	0.0014	-0.0122
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	0.0854	0.0248	0.0020	-0.0130
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	0.0904	0.0179	0.0013	-0.0123
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	0.0910	0.0185	0.0026	-0.0125
T_7- Weed free check	0.0915	0.0194	0.0020	-0.0126
T_8- Weedy check	0.0867	0.0275	0.0009	-0.0134
GM	0.0892	0.0221	0.0016	-0.0124

Net assimilation rate (g dm^{-2} day^{-1}):-Data related to net assimilation growth rate are presented in Table 23, it is recorded from 30 DAS up to harvest of crop. Mean net assimilation growth rate from 30-60 DAS, 60-90 DAS, 90-120 DAS and 120 DAS- at harvest recorded as 0.0871 g dm^{-2} day-1, 0.0226 g dm^{-2} day^{-1}, -0.0024 g dm^{-2} day^{-1} and -0.0264 g dm^{-2} day^{-1}. Net assimilation was rate higher in weed free check and lowest in weedy check (T_8) during crop growth period. Similar finding was reported by Manjunath

and Panchal (1988) and Kandasamy et al (1998).

Table 23: Net assimilation rate (g dm^{-2} day^{-1}) for dry matter as influenced by different treatments

Treatments	Net assimilation rate (g dm^{-2} day^{-1})			
	30-60 DAS	60-90 DAS	90-120 DAS	120 DAS-at harvest
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	0.0891	0.0222	0.0035	-0.0244
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	0.0794	0.0239	0.0023	-0.0246
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	0.0883	0.0225	0.0017	-0.0265
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	0.0799	0.0249	0.0027	-0.0294
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	0.0945	0.0185	0.0018	-0.0236
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	0.0908	0.0188	0.0034	-0.0259
T_7- Weed free check	0.0995	0.0214	0.0025	-0.0268
T_8- Weedy check	0.0750	0.0283	0.0012	-0.0296
GM	0.0871	0.0226	0.0024	-0.0264

Yield contributing characters:-Number of bolls picked per plant and weight of seed cotton (g) $plant^{-1}$ as influenced by different treatments are presented in Table 24.

Number of bolls picked per plant:-Data revealed that various treatments of weed management practices showed significant influence on the number of bolls picked per plant. The average number of bolls picked per plant during the investigation was 16.07. Weed free check was recorded the highest number of bolls picked per plant (20.71) and was found at par with T_6, T_3 and T_1. Treatment T_2, T_4 and T_5 was at par with each other. Among the herbicidal treatments glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS was recorded maximum number of bolls $plant^{-1}$ (18.61). Significantly lowest number (9.90) of picked bolls $plant^{-1}$ was in weedy check. Significant increase in number of bolls per plant in weed free check (T_7) might be because of significant increase in growth parameters like plant height, number of branches $plant^{-1}$, number of functional leaves $plant^{-1}$ and dry matter accumulation $plant^{-1}$. Least competition for moisture and nutrients by weed favoured more number of bolls retention in weed free check. The similar finding was noted by Hussain *et al.* (1989), Pawar *et al.* (2000), Detroja *et al.* (1992) and Kakade (1996).

Table 24: Number of bolls picked $plant^{-1}$and weight of seed (g) $plant^{-1}$ as influenced by different treatments

Treatments	Number of bolls $plant^{-1}$
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	16.61
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	14.91
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	17.07

T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	14.51
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	15.30
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	18.61
T_7- Weed free check	20.71
T_8- Weedy check	9.90
SE(m) ±	0.95
CD at 5 %	3.89
GM	16.07

Yield studies:-Seed cotton yield, stalk yield, biological yield (kg ha^{-1}) harvest index (%) and seed index (g) as influenced by different treatments.

Seed cotton yield (kg ha^{-1}):-Data regarding seed cotton yield are presented in Table 25. The mean seed cotton yield was 991 kg ha^{-1}. Among the weed management treatments, weed free check recorded significantly higher seed cotton yield (1250 kg ha^{-1}) which was statistically at par with T_6, T_1,T_3 and T_5. The lowest seed cotton yield of cotton (567 kg ha^{-1}) was recorded with weedy check (T_8). Among the herbicidal treatment glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS seed cotton recorded significantly highest yield (1190 kg ha^{-1}) followed by T_1 due to reduction in weed competition in early growth of cotton crop, which favoured more growth and retention of bolls and higher yields. These results are in conformity with the findings of Panwar *et al*. (1991), Sreenivas (2000) and Detroja *et al*. (1992).

Table: 27-Seed cotton yield, stalk yield, biological yield (kg ha^{-1}), harvest index (%) and seed index (g) as influenced by different treatments

Treatments	Seed cotton yield (kg ha^{-1})	Stalk Yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Seed index (100 seed) (g)
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	1110	1869	3051	35.17	10.16
T_2-Quizlofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	964	2089	2908	29.65	9.81
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	1002	2057	2956	31.87	9.89
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	937	1856	2619	31.71	10.25
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	910	2067	2877	29.89	9.91
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	1190	2067	3150	34.91	10.49
T_7- Weed free check	1250	2112	3271	36.45	10.67
T_8- Weedy check	567	1319	1798	26.57	9.19
SE(m) ±	51.30	125	166	1.07	0.47
CD at 5 %	159	375	491	3.20	NS

GM	991	1929	2828	32	10.04

Cotton stalk yield (kg ha^{-1}):-Cotton stalk yield is presented in Table 27 recorded at harvest. Mean stalk yield was (1909 kg ha^{-1}).Results were no significant in respect of stalk yield (kg ha^{-1}). Numerically highest stalk yields with weed free checks (1929 kg ha^{-1}) followed by T_2 (Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing) and lowest was weed check.

Biological yield of cotton (kg ha^{-1}):-Biological yield of cotton (seed cotton yield + cotton stalk yield) was significantly influenced by various treatments. Mean biological yield was 2828 kg ha^{-1}. Weed free check recorded significantly highest biological yield. This might be due to maximum growth of cotton and least competition of weeds for resources like moisture, nutrients and light. The T_6, T_5, T_3, T_2 and T_1 were at par with weed free check (3269 kg ha^{-1}). Lowest biological yield was recorded in the weedy check (1798 kg ha^{-1}). These results are in conformity with the findings of Patil *et al*. (1998), Panwar *et al.* (2001), Kakade (1996) and Detroja *et al.* (1992).

Harvest index (%):-Harvest index of cotton are presented in Table 27. Mean of harvest index was recorded 32.00 %. Highest harvest index was recorded in weed free check (36.45 %) which was at par with T_1 and T_6. Lowest harvest index recorded in weedy check (26.57 %). It indicates the source sink relation was better in weed free check followed by glyphosate spray in cotton rows.

Seed index (g):-Seed index of cotton are presented in Table 27. Mean of seed index was recorded 9.95 (g). The highest seed index was recorded in weed free check10.04 (g) followed by T_6, T_2 and T_4. Lowest seed index recorded in weedy check 9.19 (g).It indicates poor development of seed in bolls due to competition for moisture and nutrients in weedy check. These results are in conformity with the findings of Patil *et al*. (1998), Panwar *et al*. (2001), Kakade (1996) and Detroja *et al.* (1992).

Economic studies:-Data related to gross monetary returns, net monetary return, cost of treatment (Rs. ha^{-1}) and B: C ratios are presented in Table 26.

GMR (Rs. ha^{-1}):-Data related to gross monetary returns were significantly influenced due to different treatments. Mean gross monetary return was recorded Rs. 39362 ha^{-1}. The maximum gross monetary return (Rs. 44560 ha^{-1}) was recorded with weed free check followed by T_6, T_1 and T_3. Lowest GMR was recorded in weedy check (Rs. 30512 ha^{-1}). As highest seed cotton yield was recorded in weed free check followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS.

NMR (Rs. ha^{-1}):-The net monetary returns were significantly influenced due to various treatments. Mean net monetary return was recorded Rs.10105 ha^{-1}. The maximum NMR recorded in T_6 (Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS) (Rs. 15466 ha^{-1}) followed by T_7, T_1 and T_3 and lowest with weedy check (Rs. 6000 ha^{-1}) where no weeding was done. Among herbicidal spraying glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS found best which were controlled weeds at critical growth stages of cotton i.e. boll development stage. Least competition diverted more photosynthates to boll development and seed cotton yield.

Table 28: GMR, NMR, cost of cultivation (Rs. ha^{-1}) B: C ratio and ICBR ratio as influenced by different treatments

Treatments	GMR (Rs.ha^{-1})	NMR (Rs.ha^{-1})	Cost of Cultivation (Rs.ha^{-1})	B:C ratio
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	42312	13739	28523	1.48
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	37894	8713	29121	1.30
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	39785	11455	28340	1.40
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	36895	4152	30258	1.21
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	38962	6820	32142	1.21
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	43978	15466	28512	1.54
T_7- Weed free check	44560	14498	29562	1.50

T_8- Weedy check	30512	6000	24512	1.02
SE(m) ±	2234	2453	-	-
CD at 5 %	6385	6380	-	-
GM	39362	8251	28169	1.33

Cost of Cultivation (Rs. ha^{-1}):-Extra cost over cost of cultivation after implementation of treatments. The highest cost of treatment was recorded under weed free check (T_5) (Rs. 32142 ha^{-1}) and lowest in T_8 (Rs. 24512 ha^{-1}) weedy check. B:C ratio:-Mean B:C ratio was 1.33. Higher B:C ratio (1.54) was obtained under when glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS, followed by weed free check (1.50).The higher GMR in weed free check and NMR in glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS was found due to proper and timely weed control in cotton. Among the herbicide treatment glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS recorded the highest GMR, NMR and B:C ratio. Similar results were recorded by Nimbole (1990), Arun (1992), Pawar (1998), Bhol *et al.* (2007) and Manickam and Gnanamoorty (1994).

Quality studies:-Oil content (%) and oil yield (kg ha^{-1}):- Oil content (%):-Data related to oil content (%) and oil yield (kg ha^{-1}) are presented in Table 31. The oil content in seed was no significant. Mean oil content of cotton seed 14.25 %. Oil yield (kg ha^{-1}):-Mean oil yield was 155 kg ha^{-1}. The highest oil yield (183 kg ha^{-1}) was recorded under weed free check kg ha^{-1} and lowest in weedy check (124 kg ha^{-1}) due to low seed cotton yield kg ha^{-1}.

Ginning percentage (%):-Average ginning percentage was 37.01% and highest with weed free checks followed by quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing (T_2).

Table 27: Oil content (%), oil yield (kg ha^{-1}) and ginning percentage as influenced by different treatments

Treatments	Oil content (%)	Oil yield (kg ha^{-1})	Ginning %
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	15.21	164	37.2
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	14.87	165	37.3
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	15.60	146	36.6
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	15.68	142	36.7
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	15.02	146	36.9
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	15.25	174	37.0
T_7- Weed free check	15.89	183	37.7
T_8- Weedy check	15.57	124	36.7
SE(m) ±	0.49	-	0.53
CD at 5 %	NS	-	NS
GM	14.25	155	37.01

Available nutrient status of soil before sowing and after harvest:-Fertility status of soil before sowing and after harvest of cotton crop, regarding available nitrogen, phosphorus and potassium data are presented in Table 30. Negative results were obtained of nitrogen and potassium but phosphorus show positive result due to its low uptake by cotton and weed. Available nitrogen (kg ha^{-1}):-

Initial available nitrogen status of soil before sowing was 212.21 kg ha^{-1}. The higher value of available nitrogen was recorded with T_7 (Weed free check) followed by T_6 (Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS). The lowest available nitrogen was recorded in weedy check, where maximum uptake of nitrogen by weeds. These findings are in close accordance with Pawar *et al.* (2000), Kandasamy et al (1998) and Mehta *et al.* (1996). Available phosphorus (kg ha^{-1}):-Initial available phosphorus status of soil was 18.2 kg ha^{-1}. The highest available phosphorus in T_7 (Weed free check), which is closely followed in T_6 (Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS) recorded significantly higher values of available phosphorus. The lowest value of phosphorus was recorded in weedy check. It might be due highest uptake of phosphorus by weeds. Similar types of finding were also reported by Pawar *et al.* (2000), Kandasamy et al (1998) and Josan et al (1994).

Table 28: Nutrient status of soil (NPK kg ha^{-1}) at initial and after harvesting of cotton as influenced by different treatments

Treatments	Nutrient status of soil (kg ha^{-1})		
	N	P	K
T_1-Pendimethalin 1.5 Kg a.i.ha^{-1} PE + Hoeing	216.08	17.44	373.25
T_2-Quizalofop-ethyl 0.50 Kg a.i.ha^{-1}PoE + Hoeing	218.31	18.34	375.56
T_3-Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.050 kg a. i. ha^{-1} PoE + Hoeing	214.69	17.35	373.40
T_4-Pyrithiobacsodium 0.62 Kg a.i.ha^{-1}PoE + Hoeing	219.34	19.38	376.45
T_5-Pyrithiobac sodium 0.50 Kg a.i.ha^{-1}PoE + Quizalofop-ethyl 0.050Kg a.i.ha^{-1}PoE + Hoeing	218.45	19.08	373.67
T_6-Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS	220.44	19.47	377.09
T_7- Weed free check	224.65	20.67	377.45
T_8- Weedy check	169.45	16.15	326.37
SE(m) ±	0.57	0.53	0.55
CD at 5 %	1.71	1.57	1.67
Initial status	212	18.2	314

Available potassium (kg ha^{-1}):-Initial available potassium status of soil was 314.00 kg ha^{-1}. Data recorded higher values of potassium with weed free check followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS. The lowest value of potassium was recorded in weedy check. It might be due to highest uptake of potassium by weeds.

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Fig. 4 Total dry matter accumulation (g) plant^{-1} as influenced by different treatments

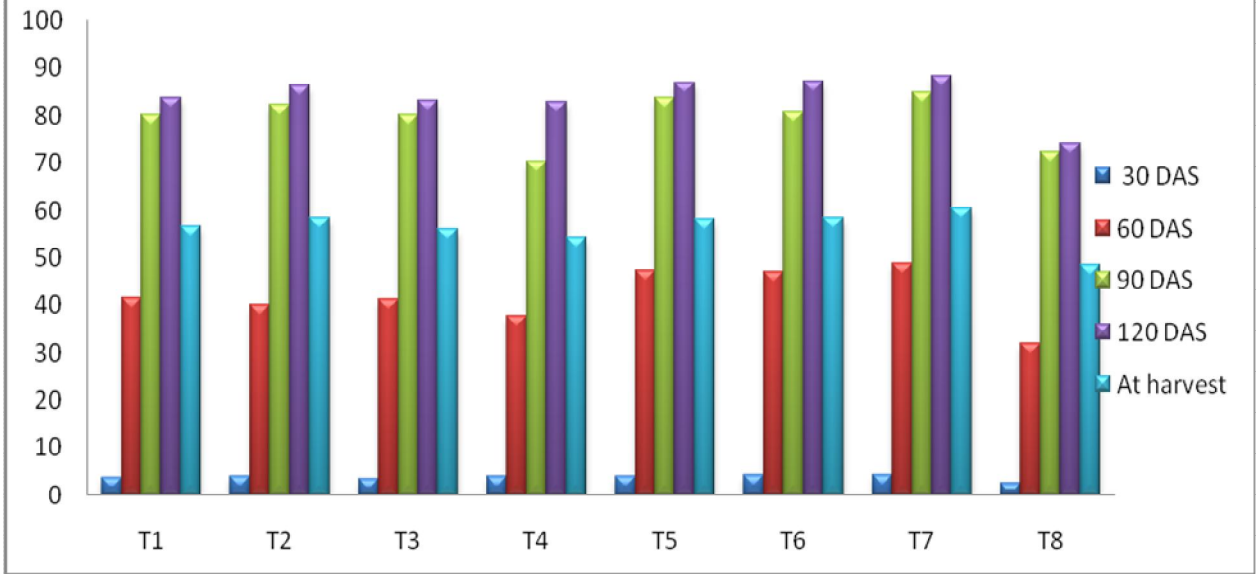
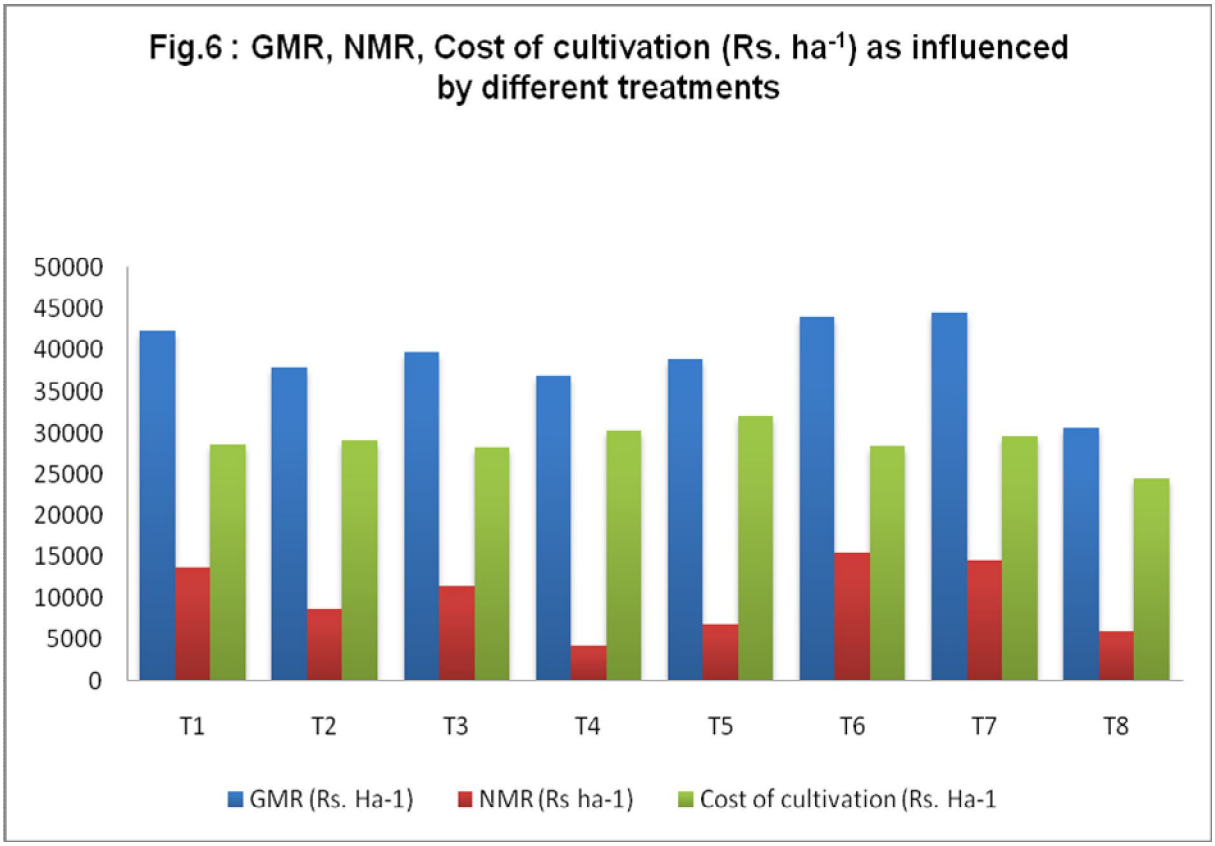


Fig.6 : GMR, NMR, Cost of cultivation (Rs. ha^{-1}) as influenced by different treatments



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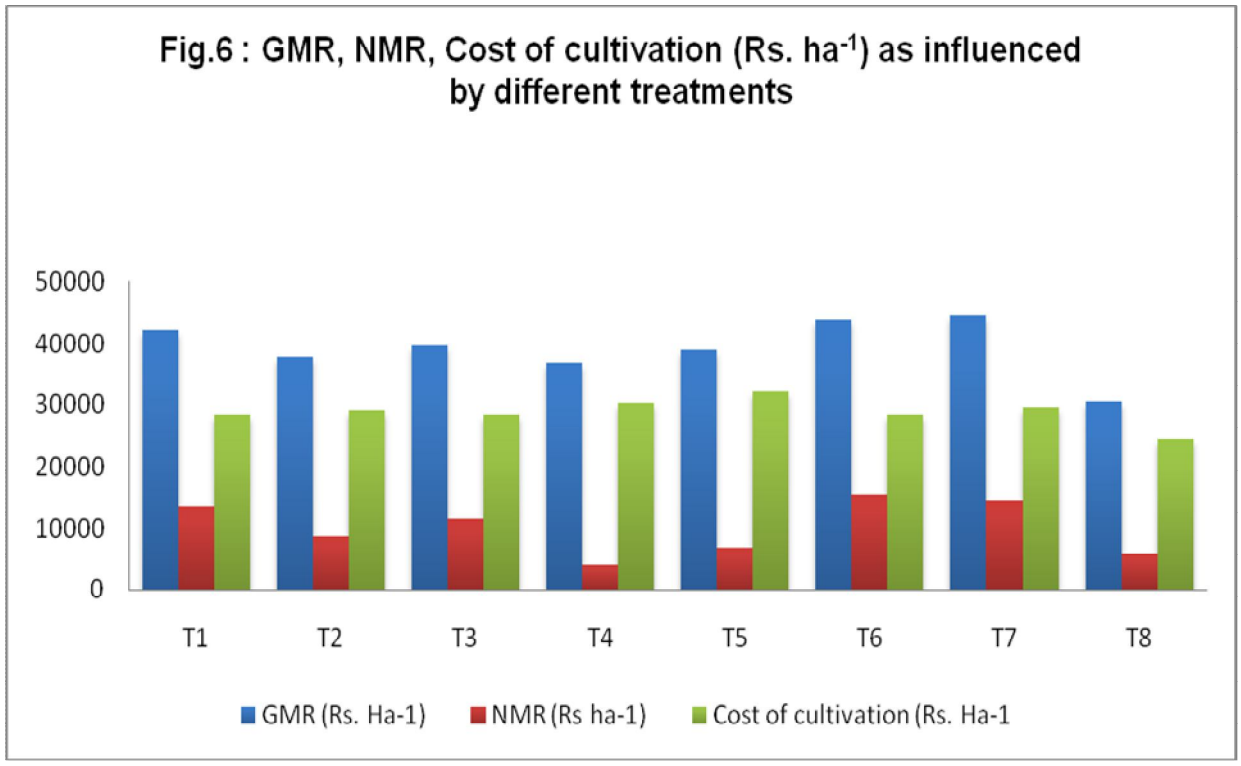

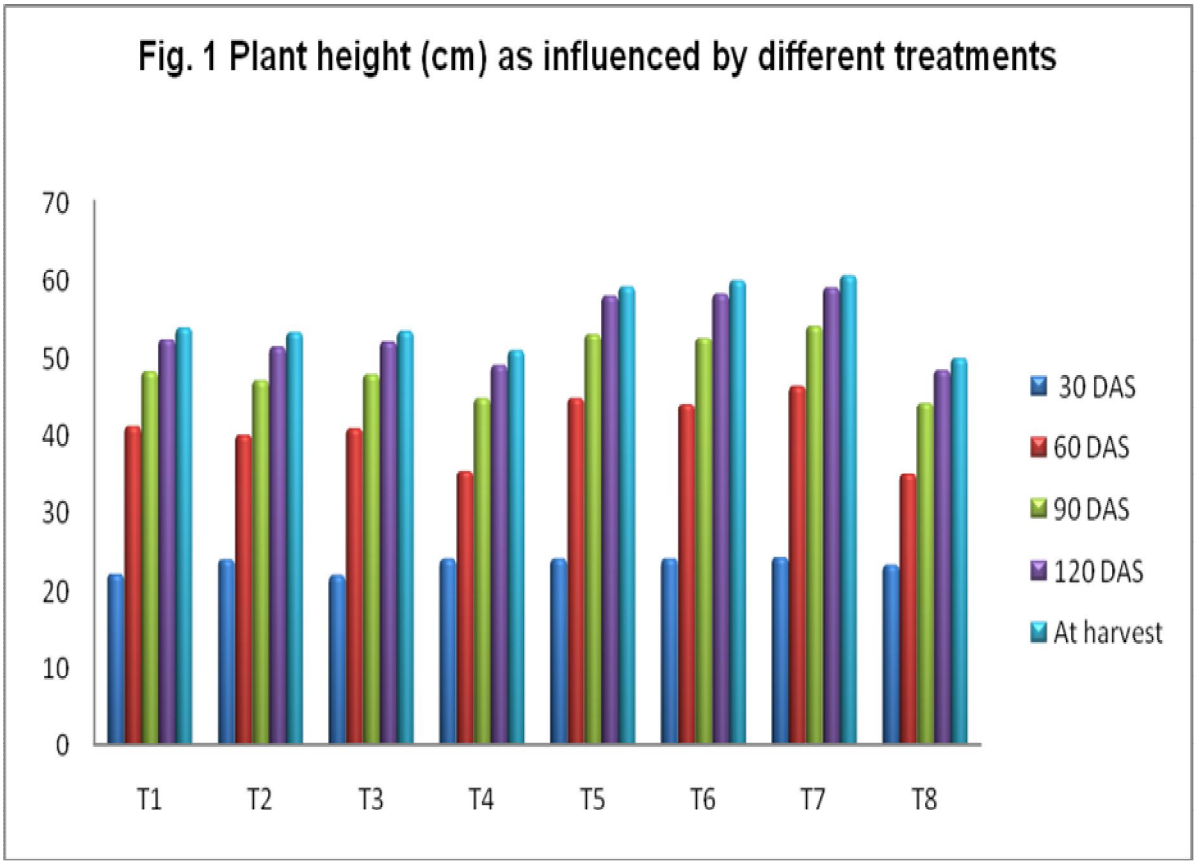

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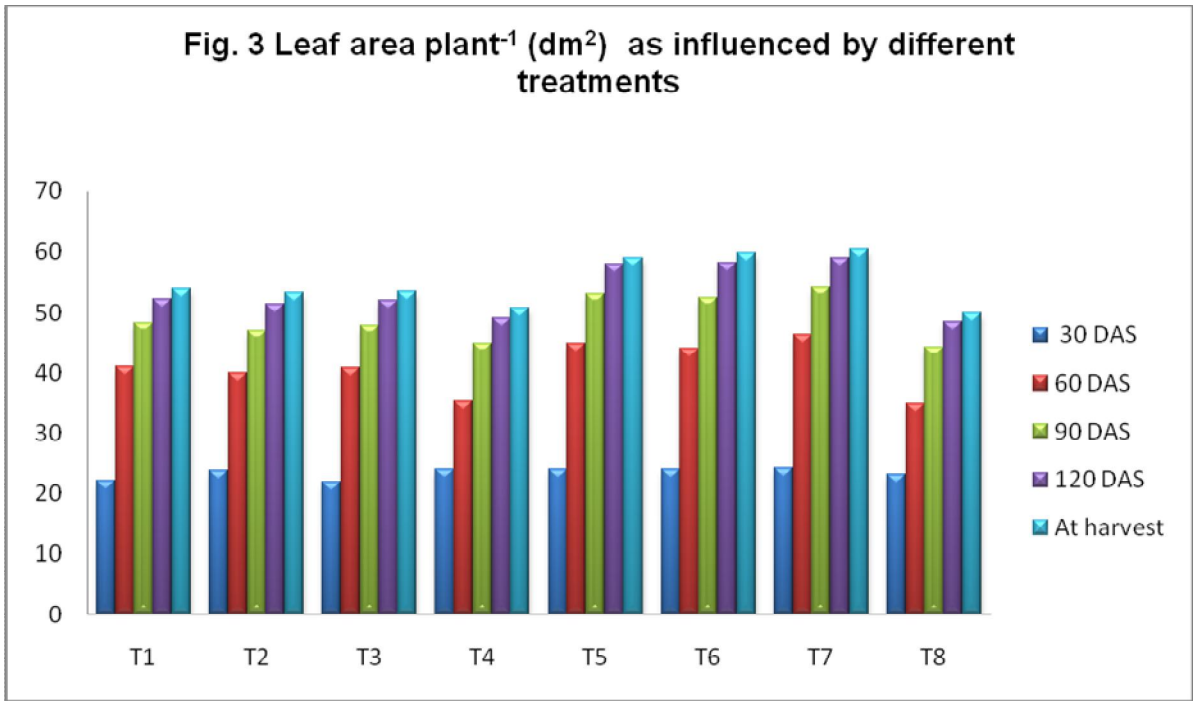
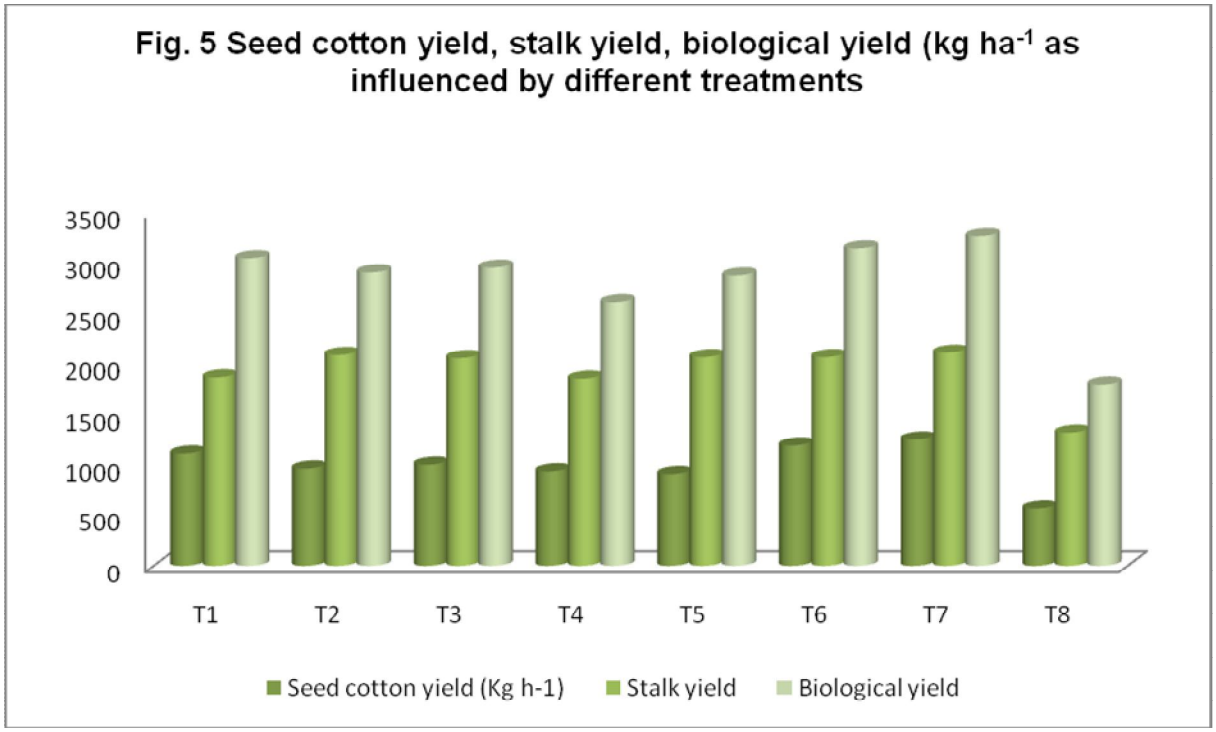




VI. CONCLUSION

The results of the field experiment entitled "Performance of Various Herbicides on bt. Cotton under rainfed condition" conducted at Agriculture Farm, in Bhagwant University Ajmer during *Kharif* 2015 are presented in the preceeding chapter. The significant findings of investigation presented and discussed in preceding chapter are summarized as below.

A. In this trial weedicides were used. One pre emergence weedicides and three post emergence weedicides were used for testing.

The treatments consist of Pendimethalin 1.5 kg a. i.ha^{-1} PE + Hoeing, Quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing, Pendimethalin @ 2.0 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.50 kg a. i. ha^{-1} PoE + Hoeing, Pyrithiobac sodium 0.62 kg a. i.ha^{-1} PoE +Hoeing, Pyrithiobac sodium 0.062 kg a. i. ha^{-1} + Quizalofop-ethyl 0.50 kg a. i. ha^{-1} + Hoeing , Glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS, Weed free check and Weedy check (No was weed control).

B. The effect of treatments on weed population, dry matter production by weed and their effect on plant height, number of branches, AGR, RGR and NAR, dry matter per plant, number of boll per plant, weight of seed cotton per plant, seed cotton yield, biological yield, GMR, NMR, nutrient uptake by weed and crop and stage of crop. Results of the various experimental findings on weed control are summarized as under.

C. During the crop growth periods weed population of monocot weeds was higher than that of dicot weeds at all the growth stages of crop. Dominant weed present in experimental field were *Commelina benghalensis*, *Cynodon dactylon*, *Cyperus rotundus*, *Digera arvensis*, *Parthenium hysterophorus* and *Celosia argentea*. Monocot weeds were effectively controlled in weed free check followed by in quizalofop-ethyl 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_2). Among herbicidal treatments quizalofop-ethyl 0.50 Kg a.i. ha^{-1} PoE + Hoeing (T_2) effectively controlled monocot weeds. Whereas dicot weed were controlled in glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS.

D. Total weeds were effectively controlled under weed free check followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and pendimethalin @ 1.5 kg a. i. ha^{-1} PE Fb Quizalofop-ethyl @ 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_3). Highest total weeds were observed in weedy check (T_8).

E. Dry matter accumulation (g) by weed was significantly highest in Weedy check and lowest in glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) followed by weed free check (T_7) and pendimethalin @ 1.5 kg a. i. ha^{-1} PE Fb quizalofop-ethyl @ 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_3).

F. Maximum weed control efficiency at 30 DAS was recorded under treatment weed free check followed by pendimethalin @ 1.5 kg a. i. ha^{-1} PE Fb quizalofop-ethyl @ 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_3) and quizalofop- ethyl 0.50 kg a.i. ha^{-1} PoE + hoeing (T_2) and at harvest was recorded under treatment glyphosate @ 1.5kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) followed by weed free check (T_7) and pendimethalin @ 1.5 kg a. i. ha^{-1} PE Fb quizalofop-ethyl @ 0.50 kg a. i. ha^{-1} PoE + Hoeing (T_3). Lowest weed control efficiency both at 30 DAS was recorded in glyphosate @ 1.0 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and harvest was recorded in pyrithiobac sodium 0.62 kg a. i.ha^{-1} PoE +Hoeing (T_4).

G. Lowest weed index (%) among various treatments was recorded (7.56%) under glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS and highest under weedy check (59.93%).

H. Weed free check with controlled condition recorded the maximum plant height (60.47cm), number of sympodial branches (14.76), number of functional leaves , leaf area per plant , leaf area index and chlorophyll content index followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and lowest under weedy check (T_8).

I. Weed free check recorded the highest dry matter accumulation per pant (88.20 g) and leaf and root biomass plant^{-1} followed by glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and quizalofop- ethyl 0.50 kg a.i. ha^{-1} PoE + Hoeing (T_2) and lowest under weedy check (T_8).

J. Growth indices like AGR recorded highest under glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and RGR and NAR recorded highest under weed free check (T_7) and lowest under weedy check (T_8).

K. Yield contributory characters like number of bolls per plant^{-1} were recorded significantly higher under weed free check 20.71, followed by T_6 and T_3, minimum bolls plant^{-1} was under treatment weedy check (T_8).

L. Seed cotton yield (kg ha^{-1}), biological yield, harvest index and seed index was highest under weed free check 1250 kg ha^{-1}, 3271 kg ha^{-1}, 36.45 % and 10.67 g respectively, followed by glyphosate @ 1.5kg a. i. ha^{-1} as directed spray at 45 DAS (T_6) and pendimethalin 1.5 kg a. i.ha^{-1} PE + Hoeing (T_1) and lowest values under weedy check (T_8).

M. Highest GMR recorded under weed free check followed by T_6 and T_1 and NMR recorded under glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS Rs. 44560 ha^{-1} and Rs. 15466 ha^{-1} respectively followed by T_7 and T_1, but B:C ratio was recorded highest under glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS (T_6). Lowest GMR, NMR and B:C ratio was found in weedy check (T_8).

N. Quality parameters like winning percentage, and oil content was found no significant among various treatments. Oil yield kg ha^{-1} was recorded highest under weed free check.

O. Uptake of nutrients (NPK kg ha^{-1}) by weeds was highest under weedy check (T_8) and lowest under the treatment weed free check

(T_7). Whereas highest uptake of nutrients (NPK kg ha^{-1}) by cotton 244.15 kg N ha^{-1}, 20.67 kg P ha^{-1} and 377.45 kg K ha^{-1} with weed free check and lowest in weedy check (T_8). NPK status after harvest was found decreasing trend in respect of nitrogen, phosphorus and potassium.

P. The highest reduction in weed density and highest weed control efficiency was found in glyphosate @ 1.5 kg a. i. ha^{-1} as directed spray at 45 DAS.

Q. The highest number of functional leaves, leaf area of cotton and number of bolls and seed cotton yield was highest withT_7 -weed free check as directed spray at 45 DAS was found better than other herbicides.

R. The highest GMR, NMR was recorded with weed free check and B:C ratio was maximum with withT_7 -weed free check as directed spray at 45 DAS.

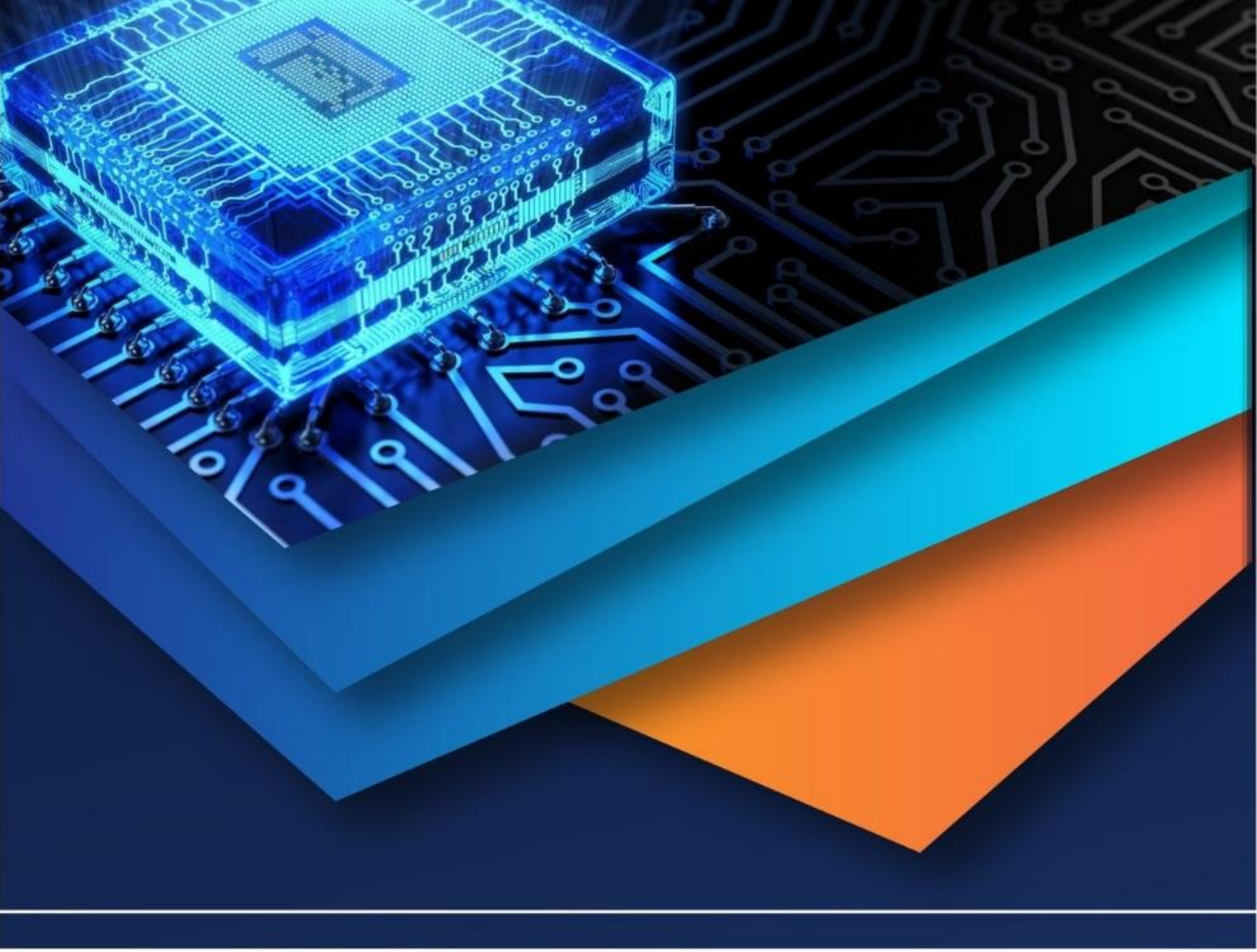
S. The NPK uptake by cotton was highest with glyphosate @ 1.0 kg a. i. ha^{-1} as directed spray at 45 DAS. However, NPK uptake by weeds in unweeded withT_7 -weed free check.

REFERENCES

[1] Akhtar,M.Y.,M.S.Hassan Nasir and Z.A. Cheema, 1986. Seed cotton yield and weed population in response to pre and post emergence application of herbicide.
[2] Almeida, J.C. V. leite,C.R.F. Planta Daninha, 1999. Efficiency of the herbicide pyrithiobac applied in post emergence to control weeds in cotton (Portuguse) J. Article. 17(1): 131-138.F
[3] Anonymous, 1989. Studies of Cyperus rotundus in inceptisols of Varanasi. Indian J. Weed Sci.I (1&2):92-94.
[4] Anonymous, 2001: All India co-ordinated cotton improvement project. Coimbator.3.
[5] Anonymous, 2005. RRC report of the research work done in agronomy April 2005.Dr.PDcKV. Alola. 78-96.
[6] Arun M. N. 1992. Studies on integrated weed management in cotton. Karnataka J. Agric. Res. 5: 288.
[7] Balyan R. S., V. M. Bhan and R. K. Malik, 1980. Crop weed competition studies in cotton (Gossypium hirsutum) Var. H-17. Abst. of papers. Annual conf. Indian Soc. of weed science held at Jabalpur pp: 18.
[8] Beaudin, X. and M. Brochard, 1986.Quizalofop ethyl a new weed killer for flax. Weed abstract. 1988. Vol. 37 (11):462.
[9] Bhattacharya, S.P.,Latikar Mandal, D. Pal and M. Saha, 2004. Bioefficiency of quizalofop ethyl in controlling weed of jute. Pestology .28 (4):32-35.
[10]Bhol,S., R. Lakpale, H.C. Nanda and G.K. Shrivastava, 2007. Effect of weed management practices on productivity and economics of hybrid cotton in vertisols of Chhattisgarh plains. J. April. Issues 12 (2):118-121.
[11]Blackman Y.H. 1919. The compound interest law and plant growth, Ann. Bot. (London), 33: 353-360.
[12]Brar, H.S. 1980. Studies with pre and post-emergence herbicides as well as their combination for weed control in cotton. Ann. Conf Indian Soc. Weed Sci. held at Bhuvaneshwar, July, 80: 21.
[13]Chandrasingh, D. J., P. Nageshwar Rao K. Narayan Rao and J. Prabhakar Rao, 1976. Studies on chemical weed control in irrigated cotton.Indian J. Weed Sci.8 (2): 88-94.
[14]Chandrasingh, D. J.,P.Nageshwar Rao and K. Narayan Rao, 1973. Herbicidal control of weeds in cotton. Pesticides. 7(1): 19-20.
[15]Charles, S. 1998. Sorting out cotton weed controloptions. Australian cotton grower 19 (4): 13-17.
[16]Chaugule, B. A., and B. G. Khare, 1961. Interculture and weeding in relation to the quantitative losses by weeds in rainfed cotton. Indian J. Agron. 6 (1): 1-8.
[17]Chokey Singh, G. V. Katti and O. P. Tiwari, 1971. Effect of weed competition on rainfed cotton in black cotton soil. Indian J. Argon. 16(1) : 137-138.
[18]Deshmukh, R. K. and N. J. Mudholkar, 1988. Control of weeds in cotton. Indian Fmg. July – 1988. pp : 17-19.
[19]Deshpande, R. M., V. S. Thakare, M. B. Patil and B. P. Gomase.1987. Effect of weed removal of different times on the yield of rainfed American cotton. PKV Res J. 11(2): 174-175.
[20]Detroja, K. S., O. M. Damore, J. C. Patil, B. S. Patil and D. D. Malvia, 1992. Effect of chemical and cultural methods of weed control on yield and nutrient uptake in upland cotton. Indian J. Agron. 37(4): 874-875.
[21]Fisher R. A. 1921. Some remarks on methods formulated in recent article on quantitative analysis of plant growth. Ann. Appld. Biol. 7 : 367-372.
[22]Foloni, L.L. 1997. Evaluation of pre plant and pre and post emergence herbicides for no-till cotton in cerrados areas. 1997. Brighton crop protection conference: weeds. Vol. 2. 863-868.
[23]Gautam, K. C., V. S. Mani and R.K. Sharma, 1975. A note on efficiency, selectivity and residual toxicity of some soil applied herbicide in soybean. Indian J. Weed Sci. 7 (10): 72-76.
[24]Gill, H. S. and Vijay Kumar, 1969. Weed index a new method for reporting wheat weed control trial Indian J. Agron. 14 (1): 96-98.
[25]Gomase, B. P., R. T. Kharkar, R. M. Deshpande, 1989. Effect of cultural practices and herbicides on weed control and yield of cotton. PKV. Res.J 13 (1): 11-14.
[26]Gregory F. G. 1917. Physiological condition in cucumber houses. Exp. Res. Stn., Turners Hill, Chestnut, Hort. Ann. Rep. 3 : 19-29.
[27]Heller, K. 1995. Chemical weed control in flax cultivation. Chemiczne metody odch wdiszceupia upraw inu waloknstego. Materiaty sisji Instuta ochrony Reslin. 33 (2) :198-201.
[28]Hunsigi, G., B. H. Katarki and S. B. Hunikri, 1969. Chemical weed control in cotton. Indian J. Weed Sci. 1(2): 119-122.
[29]Hussain, M. R., T. M. Piracha, M. N. Akhtar and S. Nair, 1989. Effect of pre and post emergence application of herbicides on weed growth, seed cotton yield of American cotton, Pak. J. Scientific and industrial Res.32 (5):336-338.
[30]Jacksan H. S. 1973. Influence of date of sowing and weed control method on yield of cotton. Hariyana Agri. Univ. J.Res. 223:215-219.
[31]Jain, H. C., S. C. Jain and S. C. Deshmukh, 1985. Cultural and chemical weed control in cotton in Nimar Region of M.P. Indian J. Weed Sci. 17 (4): 1-8.
[32]Jain, S. C. and K. S. Yadav, 1982. Weed regimes and their impact on the growth and yield of upland cotton in medium black soils. Abst.of Papers. Conf. Indian Society of weed Science. (undated) 17 (En.) Deptt. of Agron. J.N.K. Vishwa Vidyalaya, Indore, MP.

[33]Jalis, A. and S. M. L. Shah, 1982. Weed control in cotton a resume Pak. cotton. 26 (3):141-148.
[34]Josan, T. S., S. K. Thatai, P. K. Monja, T. N. Sharma, 1994. Effect of various herbicides on weed control in Citrus. J. Res., Panjab Agriculture University. 31 (4) : 402-406
[35]Kakade, S. U., B. M. Patil., A. P. Karunakar, H. N. Sethi and P. D. Thakare, 1999. Effect of sequential application of pre emergence and post emergence herbicide on weeds and yield of cotton. Crop- Research-Hissar 17(2):175-178.
[36]Kalsy, H. S., Paramjit Singh and Jasminder Singh Brar, 1994. Integrated weed management in American Cotton. J. Cotton res. And Development 8 (1): 134-136.
[37]Kandasamy, O. S., D. Raju and C. N. Chandrasekhar, 1998. Chemical control of Bermuda grass under non-cropped situation. Indian J. Weed Sci.: 30 (142): 90-98.
[38]Katkar, R. N., A. B. Turkhede., V. M. Solanke and S. T. Wankahde, (2002): Response of cotton to integrated management of various types of organic manure and Fertilizers. Crop Res. 23(1): 194-197.
[39]Keeling J. W., C. G. Henniger, 1989. Horse Weed control in conservation tillage cotton. Weed Tech. 3(2): 399-401.
[40]Klingman, D. L. 1973. Weed control as science. Willey Eastern Pvt. Ltd. New Delhi.
[41]Kurlekar, V. G. and V. S. Khupse, 1984. Effectiveness of herbicides and economics of weed control in cotton. Pesticides. 18 (2): 11-13.
[42]Makhankova. T. A. and A. V. Voevodin, 1984. The harmfulness of weeds in cotton. Cotton and Tropical Fibres Abst. (1986, 1194): 34.
[43]Malik, A. H.and S. H. Shah, 1987. Effects of herbicides and cultural weed control methods on yield of cotton cultural cultivars B-557. Weed abstract 843(4) Pakistan cotton. 83. 27 (3): 181-185.
[44]Mani, V. S. 1978. Preliminary observations of nutsedge control of arable land. Abs. of papers. ISWS/TANU. Weed Sci. Conf. Coimbatore.
[45]Manickam , G. and P. Gnanamoorthy, 1994. Control of Cyperus rotundus with herbicides. Indian J. Agron. 39 : 514-515
[46]Manjunath, S., and V. C. Panchal, 1988. Study on the influence of herbicides in cotton and cotton intercrops. Indian J.Weed Sci. 20(3) 79-82.
[47]Marikulandai A. and V. B. Morachen, (1965). Result manorial trail in Madras state on cotton. Madras Agric.52: 147-155.
[48]Mehta, H. D. R. P. S. Ahalwat P. P. Choudhary and Y. R. Jadhav, (1996). Effect of green manuring on nitrogen management in low land vice Indian J. Agron 41(1) 38-40.
[49]Mudholkar, N. T., R. K. Deshmuksh and Jagevir Singh, 1981. Studies on weed flora and control methods through chemical and mechanical means in rainfed cotton. Annual Reprot C.I.C.R. Nagpur.Vol. 1981-82,33-39.
[50]Muzik, T. J. 1970. Weed biology and control. Mc- Groups Hill Book. Co., New York 5.
[51]Nadanassababady, T. and O. S. Kandasamy, 2002. Evaluvation of herbicides and cultural methods for weed control in cotton . Indian J. Weed Sci. 34(1&2):143-145.
[52]Nagre, K. T. and M. S. Patil, 1880. Effect of methods and time of weed management on yield of deshi cotton. Abst. of Papers. Ann. Conf. of Indian Soc. of Weed Sci. pp: 72.
[53]Nimbole M. N. 1990. Chemical control of weeds in relation to intercropping rainfed hybrid cotton. Ann. of Agric. Res. 11(1): 106-108.
[54]Pal, V. C., Sekhar, S. N. Khajanji and G. K. Shrivastava, 2005. Planting pattern and weed management studies on cotton and mungbean intercropping system under vertisols of Chhattisgarh plains. J. Agril. Issues Vol.10 (1): 81-86.
[55]Pandenov, K. P.1994. Herbicide on fibre flax.Zaschita Rastenil (Moskova) 1994. No. 11 631-32 (Ru), weed Abst. 44:35-38.
[56]Panse, V. G. and P. V. Sukhatme, 1985. Statistical methods for agricultural workers. ICAR, New Delhi.
[57]Panwar, R. S., R. S. Balyan and R. K. Malik, 2001. Evaluation of gluphosinate for control of weeds in cotton. Indian J. weed sci. 32 (1&2):94-95.
[58]Panwar, R.S., R. K. Malik and R. S. Balyan, 1991. Evaluation of haloxyfopmethyl for weed control in cotton. Annuals of Applied Biology 118 (supplement) :62- 65. Field Crop Abst. 45(11) : 1015.
[59]Patil, B. M., Satao R. N. and G. S. Lohariya, 1998. Integrated weed management in cotton.PKV-Research Journal 21 (2): 220-221.
[60]Pawar, A. K., B. M. Patil., A. P.Karunakar and R. N. Satao, 2000. Effect of pre and post emergence herbicides on weed control and yield of cotton. Pestology.24 (7):35-36.
[61] Piper, C. S. 1966. Soil and Plant Analysis, Hans. Pub. Bombay. Asian Ed. pp. 368-374.
[62]Rai, K. P. (1966): Effect of green manuring and following on soil nitrogen and ortanic carbon and on the succeeding cotton crop in the coastal plain of sudan.J. Ind. Soc. Soilsci. 14 : 1-8.
[63]Rao, V. S, B. Katoky and S. N. Sharma, 1981. Perennial weed control in tea. Proc. 8th Asian Pacific Weed Sci. Conf. Sedney, Australia.
[64]Rao, V. S. 2000. Principle of weed science IInd Edn. Oxford and IBH Publishing Co. New Delhi.
[65]Reddy, C. N., M. D. Reddy and M. P. Devi, 2000. Evaluvation of fenoxyprop-p-ethyl and ethoxysulfuron in transplanted rice. Indian J. Weed Sci. 32(1&2):105-107.
[66]Richard F. I. 1969. The qualitative analysis of growth. Pl. Physiol., Acad. Press, New York, Pp 3-63.
[67]Sandhu, K.S.,J.S.Chandi and Tarlok Sigh, 1996. Crop weed competition in American cotton Indian J. weed sci. 28(3&4): 171-173.
[68]Sankaran, S. and N. Balsubramanium, 1974. Studies on weed control in irrigated cotton. Var. MCU-5. Indian J. Weed Sci. 6(2): 36-37.
[69]Schwerezel, P. J. and P. E. L. Thomas, 1971. Weed competition in cotton. PANS. 17 (1) : 30-34
[70]Shanmugham, K. 1981.Studies on manual weedings in weed control in cotton crop and their residual effect on the subsequent green manure crop Dhaincha (S.aculeata). Annual report CICR Nag: 59-60.
[71]Shelke,D. K., N. S. Jadhav and R. H. Bhosle, 1985. Studies on crop – weed competition in rainfed cotton SRT-1 under Marathwada region. Cotton and tropical fibre Abst. 11(5):54.
[72]Singh Vireshwar, and S. S. Verma, 1989. Studies on growth pattern on weeds in cotton J. Indian Soc. For cotton improvement. 14 (2):136-142.
[73]Singh, G. and M. Singh, 2002. Effects of doses and stages of application of fenoxyprop-p-ethyl on weed control and grain yield of wheat. Indian J. Weed Sci. 34(1&2):112-113.
[74]Spark, D. L. 1997. Advances in Agronomy Publication Academic press. London, New York. 58: 62-63

[75]Sreenivas, G. 2000. Effect of application of glyphosate with or without pre emergence herbicides In rainfed American cotton.Indian J. Weed Sci. 32 (1&2):98-100.
[76]Street, J. E., G. A. Buchanan, R. H. Crowtly and J. A. Micquire, 1981. Influence of cotton (G. hirsutum L.) densities on competitiveness of pig weed (Amaranthus spp.) and sickle pod (Cassia obtusifolia). Weed Sci 29(5): 81.
[77]Subbiah B.V., and G.L.Asija, 1956. A Rapid procedure for determination of Available Nitrogen in soil. Current Sci.25:256-260.
[78]Subramainan V; N.J. Jayanathan R.V. Venkitasramy; P. Premasekhar and S. Purushothaman, (1995). Effect of fast growing leguminous intercrop and nitrogen level on cotton. Madras Agric.J. 82. (1): 40-41.
[79]Thakur, D.R.; C.M. Sharma and C.M. Singh, 1993. Herbicidal control of purple nutsedge (Cyperus esculentus L.). Indian J. Weed Sci. 25(3&4):22-26.
[80]Wagh, V. V. 1981. Effects of two herbicides and cultural methods of weed control in cotton. M.Sc. (Agri). Thesis submitted to PKV Akola.
[81]Walkley A. and C.A. Black, 1934. An examination of the different method for determinig soil organic matter and proposal modification of the chromic and titration method.Soil Sci., 37:29- 38.



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