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ANALYTICAL GROWTH STUDY OF COTTON CULTIVARS IN SUPPLEMENT OF ANIMAL MANURE AND SYNTHETIC FERTILIZERS IN SOIL

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ABSTRACT

Cotton is an important cash crop. In developing countries like Pakistan, cotton is a major source of economics to many farmers. The soils of Pakistan are generally low in organic matter, firstly because of arid climate resulting in a rapid decomposition of organic matter and secondly because very little organic matter is added to the soil. Soil nutrients deficiency fulfilled by the application of phosphorus as well as nitrogenous fertilizers. Experiment was carried out in the wire house of Botany Department, Ghazi University Dera Ghazi Khan. 60 earthen pots were used to test the vegetative growth parameters of two cotton cultivars. i.e. *BT 886* and *BT 905* of cotton species having 5 replicates and 3 treatments for each cultivar. Two-way ANOVA was carried out to determine the differences among treatment groups and growth and development variables of cotton by using a statistical software MINITAB version 14. From this trial experiment it was concluded that the application of synthetic fertilizers showed highly significant difference at the different levels of vegetative growth of two cotton cultivars than the application of animal manure. Among the cultivars, Cultivar 2 i.e. *BT 905* showed maximum growth at various harvesting intervals under the significantly increase the treatments levels than the cultivar 1 i.e. *BT 886*. The concluded annotations of this trail were that the Synthetic fertilizers were more appropriate to obtain the good quality and quantity of fiber crops than the animal manure.

Keywords: cotton cultivars, manure, fertilizers, fiber crops, farmer economy.

INTRODUCTION

Cotton is an important economic crop that provides fibers to large number of human population for clothing in world. In developing countries cotton is a major source of wealth to many farmers (Tagne *et al.*, 2008). In Pakistan the potential of crop is not being exploited satisfactorily due to many constraints. Among those, inappropriate nutrients supply is important (Oad *et al.*, 2004). The soils of Pakistan are generally low in organic matter, firstly because of arid climate resulting in a rapid decomposition of organic matter and secondly because very little organic matter is added to the soil.

In spite of substantial fertilizer use in Pakistan, the crop yields are not increasing correspondingly, which reflect low fertilizer use efficiency (FUE). Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients. In contrast to chemical fertilizer, it adds organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa *et al*., 2008). It was also indicated that poultry manure more readily supplies P to plants than other organic manure sources (Garg and Bahla, 2008).

Potential for crop production under extensive irrigation system in the Punjab is high, because of its favorable environmental and edaphic factors. However, increased crop yields through intensive cropping will require large amount of plant nutrients to sustain high production level. Cotton growers face major problem of increase in production cost. There is a constant increase in prices of many inputs; raising production costs and wiping out profit margins. Fertilizer is one of many inputs, which raises production cost.

Survey of various districts of the Punjab has shown that almost all cotton growers use nitrogenous fertilizer; however 85 % farmers use phosphatic fertilizer to increase crop production. Fertilizer costs were second largest variable costs and accounted for 22 percent of total production costs (Bickersteth and Walker 1988). Soil tests carried out in Pakistan indicated a general lack of nitrogen, a wide spread deficiency of phosphorus and occasional deficiency of potassium (Wahhab, 1985). Cotton crop in general showed tremendous response to nitrogenous fertilizers in all soil types, but its response to phosphatic fertilizer was erratic and variable in most areas (Malik *et al.,* 1996). However, there are cases where cotton response to phosphorus has been positive and economical (Gill *et al.,* 2000).

Keeping in view the above facts, the present study was therefore, designed to evaluate the comparative effect of different levels of animal manures and synthetic fertilizers on the vegetative growth and development yield of two cotton cultivars under Dera Ghazi Khan environmental conditions.

MATERIALS AND METHODS

Experimental site

Experiment was carried out in the wire house of Botany Department, Ghazi University (Government Postgraduate College), Dera Ghazi Khan from 10-05-2012 to 10-08-2012. 60 earthen pots were used to test the vegetative growth parameters of cotton. The size of each

earthen pot was 10 inches deep and 8 inches width and filled with 7kg loam texture soil checked by Soil and Water Testing Laboratory (SWTL) Dera Ghazi Khan having characteristics pH 8.4, EC 4.2mmhos, Organic matter 0.52, available P 10ppm, soil saturation 44% and K 205 ppm which was used for growth trail. The seeds of species were collected from Punjab Seed department Corporation Zonal office Dera Ghazi Khan. Two cultivars of cotton were selected to explore the comparative effect of animal manure and synthetic fertilizer on the vegetative growth of cotton species.

Rising of seedlings

At the time of sowing 5 seeds were proliferated in each pot. After germination only one healthy seedling were selected for further examination, while remaining plants were thinned out.

Applications of treatment

The experiment comprised 60 earthen pots with two cultivars i.e. *BT 886* and *BT 905* of cotton species having 5 replicates and 3 treatments for each cultivar:

T1: Control (No add animal manure and synthetic fertilizer)
T2: (125:7) 125 gm animal manure with 7 kg soil
T3: Synthetic fertilizer (Mixture of Urea + Super Phosphate)

The first harvest was taken after 15 days of germination, the duration of each harvest is 15 days, and total 6 harvests were taken within 3 month, the plants were carefully dig out with roots from the pots kept into paper envelope, labeled into treatment wise separately then taken into laboratory for different growth parameters, the soil used in the pots was loam in texture.

Measurements of growth parameters

At each harvest following parameters were recorded; Shoot length (cm), Root length (cm), Number of leaves, Leaf area (mm^2), Shoot Fresh weight (gm), Root Fresh weight (gm), Shoot Dry weight (gm) and Root Dry weight (gm).

Statistical analysis

Two-way ANOVA was carried out to determine the differences among treatment groups and growth and development variables of cotton by using a statistical software MINITAB version 14.

RESULTS

Effects of treatments at the levels (harvests) of growth of cotton cultivars

The growth and development of two cotton cultivars showed significant difference (≥ 0.017***) at the different harvesting levels of growth under the different treatments. The interaction between the species and treatments showed highly significant effects of treatments (0.394) on the different levels of growth of both the cultivars of cotton. It was also observed that during this trail experiment the large affects of treatments (≥ 0.079**) were found between the cultivars (Table-1). From the two way analysis of variance it was observed that the growth of two cultivars of cotton enhance rapidly due the application of synthetic fertilizers (T_3) than the animal manure and control. In between the species BT 905 cultivar showed more positive response at the different growth parameters towards the treatments (Table-1).

Effects of treatments on the root length of two cotton cultivars

The growth and development of root length of cotton cultivars were slightly effected by the treatments. The interaction between the species and treatments showed a little degree effects (≥ 0.259) on the different levels of root length growth of both the cultivars of cotton. There was no significant affects were noted of different treatments (≥ 0.221) between the cultivars (Table-1 and Figure-1).

Effects of treatments on the shoot length of two cotton cultivars

The substantial effects of treatments on the growth and development of shoot length of the two cultivars of cotton. The level of significance (0.058***) showed that the positively strong effects of treatments on the shoot length of two cultivars of cotton. The more interaction (≥ 0.251) was found between the species and treatments on the different levels of shoot length of both the cultivars of cotton. There was no significant affects were noted of different treatments (≥ 0.182) between the cultivars (Table-1 and Figure-2).

Effects of treatments on the fresh weight root of two cotton cultivars

The no effects of treatments were found on the fresh weight of root of the two cultivars of cotton. The level of non significance (0.923) showed that there were no effects of treatments on the root fresh weight of two cultivars of cotton. There was no interaction (≥ 0.145) was found between the species and treatments on the different levels of fresh weight of root of both the cultivars of cotton. There was no significant affects were noted of different treatments (≥ 0.844) between the cultivars (Table-1 and Figure-3).

Effects of treatments on the fresh weight of stem of two cotton cultivars

The considerable effects was noted of treatments (≥ 0.022***) on the fresh weight of stem of the two cultivars of cotton. The more significant interaction (≥ 0.024***) was found between the species and treatments on the different levels of fresh weight of stem of both the cultivars of cotton. There was no significant affects were noted of different treatments (≥ 0.355) between the cultivars (Table-1 and Figure-4).

Effects of treatments on the number of leaves of two cotton cultivars

From the two way of analysis of variance, it was noted that there was no effects of treatments (0.288) on the number of leaves of the two cultivars of cotton. The interaction (0.286) was found between the species and treatments on the number of leaves of both the cultivars of cotton at different levels of growth. It was interestingly found that both the cultivars produced and develops variable number of leaves and observed the significant difference (0.010***) in the number of leaves between the two cultivars at the different levels (Table-1 and Figure-5).

Effects of treatments on the dry weight of stem of two cotton cultivars

The present analysis of variance was revealed that there was no significant difference of treatments (0.683) on dry weight of stem of the two cultivars of cotton. The interaction (0.387) between the species and treatments showed non significant effects on the dry weight of stem of both the cultivars of cotton at different levels of growth. But it was found that the dry weight of stem of both the cultivars showed the significant difference (0.015***) between the two cultivars of cotton at the different levels (Table-1 and Figure-6).

Effects of treatments on the dry weight of root of two cotton cultivars

The analysis of variance was elucidated that there was no significant difference of treatments (0.112) on dry weight of root of the two cultivars of cotton. The interaction (0.242) between the species and treatments showed non significant effects on the dry weight of root of both the cultivars of cotton at different levels of growth. But it was clearly found that the dry weight of roots of both the cultivars showed the more significant difference (0.006***) between the two cultivars of cotton at the different levels (Table-1 and Figure-7).

Effects of treatments on the leaf area index of two cotton cultivars

The two way analysis of variance was showed that there was strong significant difference of treatments (0.056***) on leaf area index of the two investigated cultivars of cotton. The highest significant interaction (0.405) was observed in the leaf area index of both the cultivars of cotton at different levels of growth. The leaf area index of both the investigated cultivars showed the significant difference (0.020***) between the two cultivars of cotton at the different levels (Table-1 and Figure-8).

Table-1. Two-way analysis of variance among the growth variables of cultivars × treatments.

Source	DF	MS	F-Value	P-Value
Treatments	2	1.167	7.481	0.017***
Cultivar	1	1.245	7.981	0.079**
T x cultivars	2	0.168	1.077	0.394
T x RL	2	0.898	0.777	0.259
T x SL	2	0.980	0.810	0.251
T x RFW	2	0.814	2.16	0.145
T x SFW	2	30.44	3.76	0.024***
T x NL	2	0.167	1.36	0.286
T x SDW	2	0.159	1.00	0.387
T x RDW	2	0.174	1.53	0.242
T x LAI	2	3750	0.271	0.405
Error	18	0.156		
Total	23			

Abbreviations: T= treatments; RL= root length; SL= shoot length; RFW= root fresh weight; SFW= shoot fresh weight; NL= number of leaves; SDW= shoot dry weight; RDW= root dry weight; LAI= leaf area index

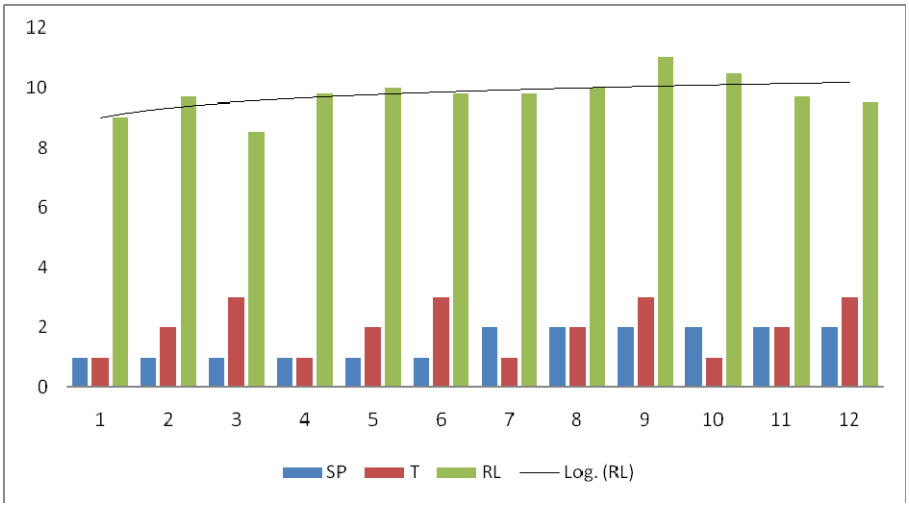

Figure-1. Graph represents effects of treatments on the root length of two cultivars.

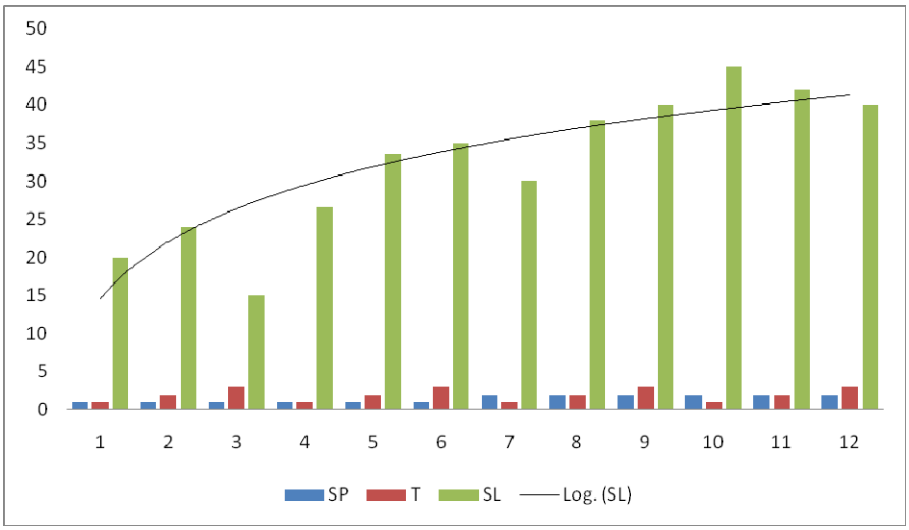

Figure-2. Graph represents effects of treatments on the shoot length of two cultivars.

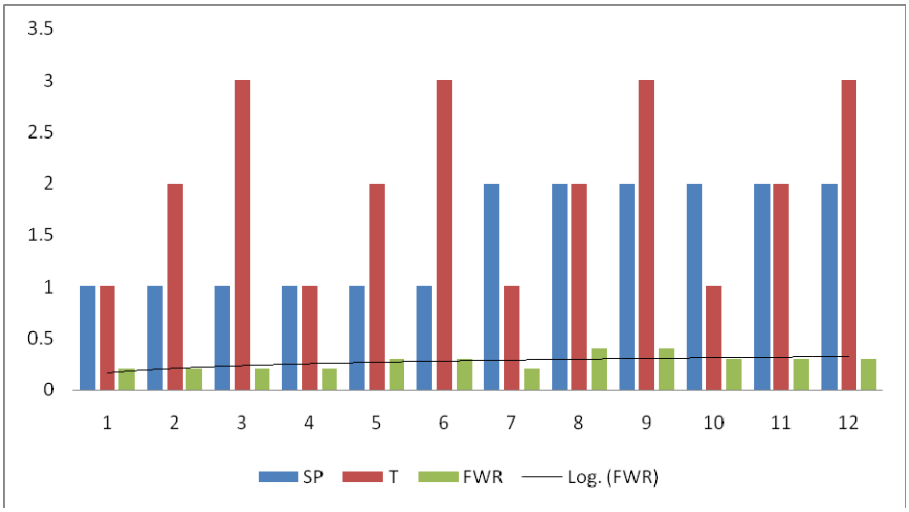

Figure-3. Graph represents effects of treatments on the species fresh weight of root.

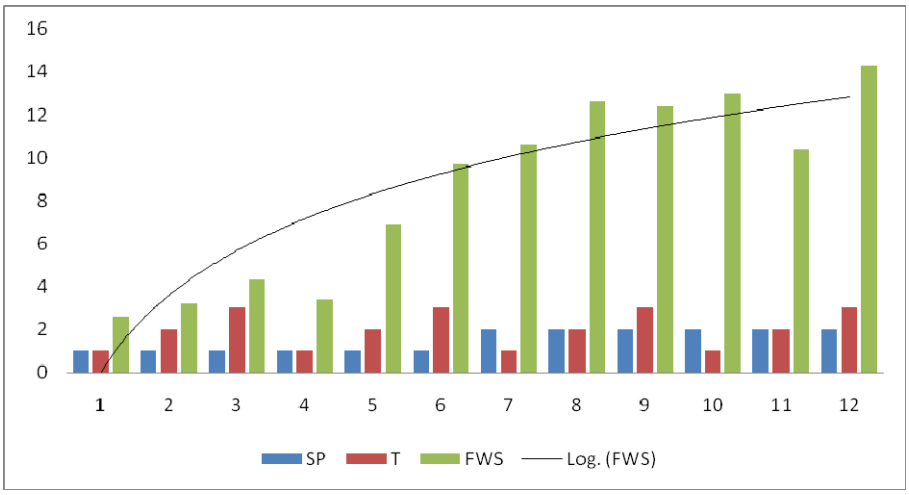

Figure-4. Graph represents effects of treatments on the species fresh weight of stem.

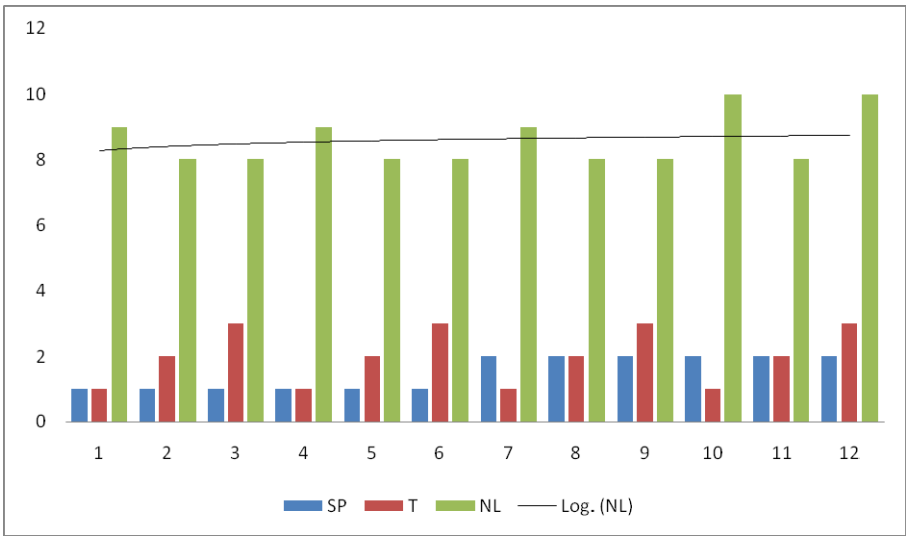

Figure-5. Graph represents effects of treatments on the species number of leaves.

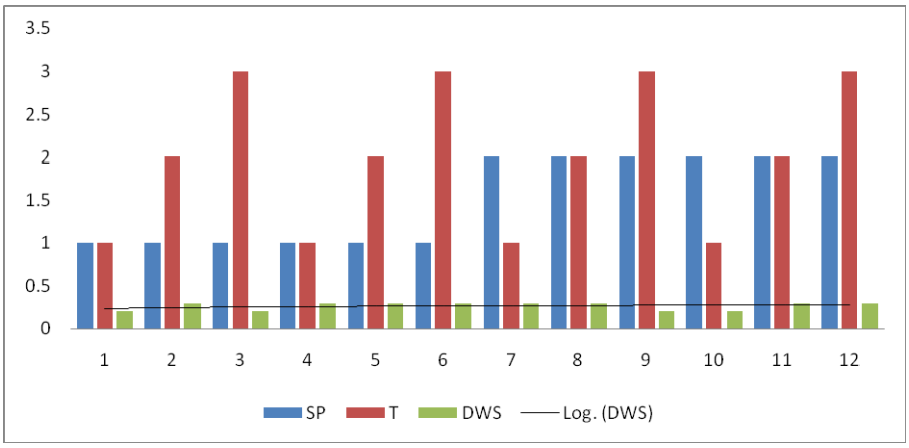

Figure-6. Graph represents effects of treatments on the species dry weight of stem.

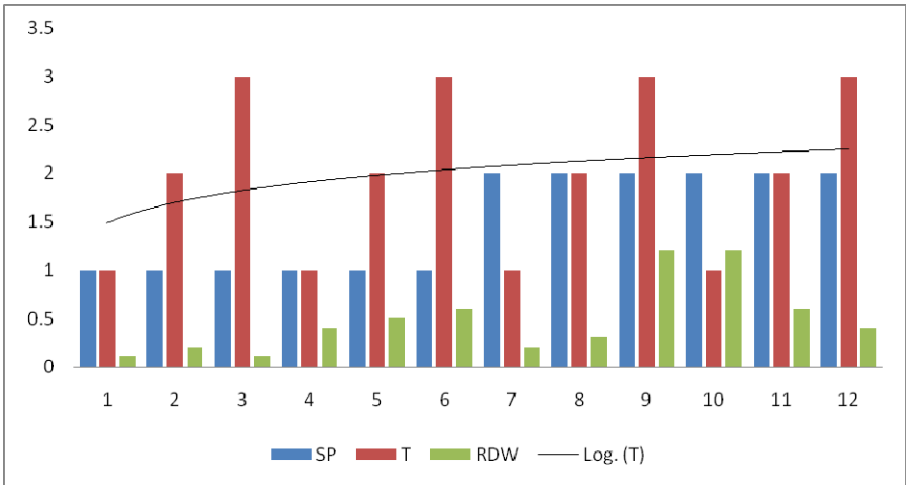

Figure-7. Graph represents effects of treatments on the species root dry weight.

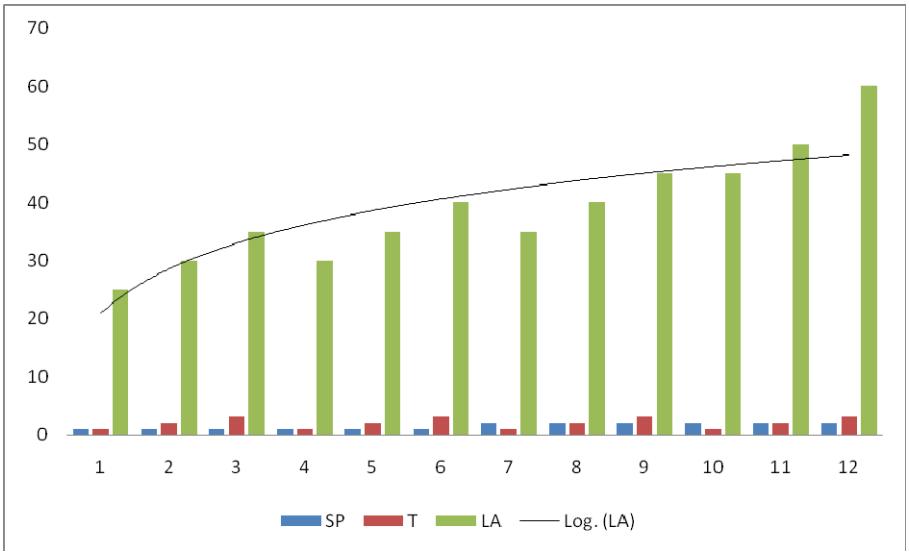

Figure-8. Graph represents effects of treatments on the species leaf area index.

DISCUSSION AND CONCLUSIONS

Growth parameters of cotton cultivars

Cotton producers use products intended to enhance plant growth and yields. However, research data concerning the effect of fertilizer additives or plant growth regulators on cotton is limited and, in many instances, conflicting. Previous research indicates inconsistent plant response to some plant growth regulators applied either in-furrow at planting or foliar-applied at pinhead or bloom. Although plant response also is inconsistent with in-furrow fertilizer applications, research data indicate in furrow fertilizer applications appear to be more effective than plant growth regulators.

The present research evaluated various growth parameters of two cotton cultivars were studied by the application of different treatments of synthetic as well as animal manures. The responses of two cultivars in connection to treatments were variables. The growth and development of both the species was different at different harvesting intervals. Results of the pot experiment indicated that the contrasting application of animal manure and synthetic fertilizer more or less significantly increased the chemical properties of soil. Irrespective of the animal manure, the synthetic application of nitrogen and phosphorus fertilizers increased soil fertility with the increasing of rates of application.

The results depicted in this investigation revealed that the significant variation was found between the cultivars due to application of different treatments. Similar trends were observed of other vegetative attributes namely root and shoot length of plant individuals, fresh and dry weights of species, number of leaves and leaf area index. Theses responses could largely be due to initial differences in treatments.

Effects of treatments on the shoot and root length of cotton cultivars

The effects of treatments on the root length growth of both the cultivars of cotton were not obviously significant. But the shoot length growth showed positively significant effects under the various treatments at different harvesting intervals. The growth of stem of both the cultivars of cotton showed maximum growth in T_3 (synthetic fertilizer). In between the cultivars *BT, 905* showed highly significant growth in synthetic fertilizers than the cultivar *BT. 886.* Similar results were reported by Wright *et al*., 1995, they observed that the maximum root growth with application of animal manure and synthetic fertilizers.

Effects of treatments on the shoot and root dry and fresh weights of cotton cultivars

The no clear cut differences were observed among the biomass attributes of cotton cultivars. The treatments of animals manure and synthetic fertilizers showed no significant differences in the fresh dry weights of both the cultivars of cotton at different harvesting stages of growth. But the small differences were noted in between the two cultivars. The cotton cultivar *BT, 905* showed more vigour vegetative growth in the variable treatments than the cotton cultivar *BT, 886*. Thus primarily variety was suggested to grow in the fields to obtain the better quality and quantity of the fibers of cotton under various applications of fertilizers. These results are agreed with the findings of Massomo and Rweyemamu, 1989.

In the previous literature among the organic manure the application of Farm Yard Manure (FYM) performed better than the other treatments through improved plant attributes, like plant height, number of leaves and flowers. Though the organic manure as well as synthetic manure treatments showed positive effects on growth and yield parameters, these results are agreed with the findings of (Wright *et al*., 1995; Blaise *et al*., 2005; Gulshan *et al*., 2013). Application of organic and inorganic fertilizers helped in the plant metabolic activity through the supply of such micronutrients in the early vigorous growth.

Effects of treatments on the number of leaves of cotton cultivars

The highly significant differences were observed in producing the number of leaves of both the cultivars of cotton at different harvesting levels due to application of animal manure as well as synthetic fertilizers. These differences were also noted in between the two cultivars of investigation. The *BT, 905* produced maximum number of leaves than the cultivar, *BT, 886*. From over all analysis of variance, it was observed that the cultivar *BT, 905* showed maximum vegetative growth than *BT, 886* of cotton under the application of different treatments of organic and inorganic fertilizers.

Effects of treatments on the leaf area index (LAI) of cotton cultivars

The noticeable significant effects of treatments were found in the leaf area index of the two cultivars of cotton. When the application of treatments increased, then the leaf area index of the cotton varieties two folds positively increased. In between the two cultivars of cotton the BT, 905 had more significant effects in the treatment T_3 (synthetic fertilizer). But the cultivar BT, 886 showed less growth and development in connection to treatments. However the animal manure also rich source of organic matter but the application of synthetic fertilizers showed maximum and vigorous growth and development of the plant body. The cultivars produced more number of leaves due to application of nitrogenous and phosphorus fertilizers, it was the clear cut observation that more development of leaves per plant caused more leaf area index during the time of data observation.

CONCLUSIONS

The present results indicate that manures had less significant affected the growth, yield and photosynthesis of cotton cultivars. The most significant impact was observed when synthetic fertilizers were applied to soil. The lowest dry weight, height and leaf area index and soil organic matter were measured in the control treatment. Organic soil amendments increased the levels of soil organic matter. Overall, cow, poultry manure and barley mulch increased soil organic matter in comparison to inorganic fertilizer and control (no treatment). High correlation between cotton cultivars yield and organic matter was registered. Final, the choice of suitable amounts of organic fertilizers can also affect the yield of sweet corn.

The significant differences recorded in plant growth and biomass yield suggest that comparative placement of synthetic as well as animal manure probably affected nutrient release pattern and the eventual quantity of nutrients available to plant roots for absorption and utilization for growth. An earlier study by (Karkanis *et al*., 2007) on the effect of placement of composted and non-composted manure on corn yield and N uptake showed significant treatment effects on biomass yield, grain yield and N uptake.

The over all analysis of variance it was finally concluded that from this experimental trail the application of synthetic fertilizers was more beneficial to obtain the better quality and quantity of fiber crop cotton than the local type of animal manure. Moreover the animal excreta contains various number of weeds seeds. When the animal manure was applied in agricultural farms, then the various numbers of troublesome weeds appeared and created a big problem with crop plants in acquiring more rapidly major and beneficial minerals from the soil and occupied a space. This problem was faced by the farmers and often the farmers regularly weeding the field's manually in different intervals of times and it caused a huge wastage of energy and times of the farmers. Although the tremendously increased the price of synthetic fertilizers day by day and reached far beyond the buying capacity of

the poor farmers of most of the developing nations of the world. But it is fact information and suggestion from this experimental hypothesis, that due to application of various types of synthetic fertilizers, the farmers save their energy and time due to bother of weed problems in the fields. Various types of synthetic fertilizers are available in the market and recommended the doses for various regions of the country for the cotton growers. Now it is the prime duty of the farmers that good and better quality of the cultivar grown in their fields and application of synthetic fertilizers at the proper time to obtain the better quality and quantity of the fiber crops and played and shared a major role in the economy of the country.

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