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EFFECTS OF ORGANIC AND CHEMICAL FERTILIZERS ON GROWTH AND YIELD ATTRIBUTES OF CHILI (*CAPSICUM ANNUUM* L.)

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ABSTRACT

A field experiment was conducted at the experimental station of the Institute of Agricultural sciences, University of the Punjab Lahore, to assess the impact of natural and chemical fertilizers on development and yield attributes of a local germplasm of chili (*Capsicum annuum L.*) in the kharif season of 2019 using Randomized Complete Block Design (RCBD) with five replications. There were seven treatments with various sources and levels of natural and inorganic supplements and treatments i.e. T1 (control), T2 (1kg farm yard manure), T3 (250g humic acid), T4 (800g compost), T5 (RD) recommended dose i.e. 440g, 270g, 160g $NPK_{50\%}$ + 1kg FYM), T6 (440g, 270g, 160g $NPK_{50\%}$ + 800g compost), and T7 (440g, 270g, 160g $NPK_{50\%}$ + 250g humic acid). Plant height, number of leaves, number of primary branches, average leaf area, total yield, total chlorophyll content and total carotenoid content was estimated. Amongst the different treatments, the T7 (440g, 270g, 160g $NPK_{50\%}$ + 250g humic acid) was recorded as the best treatment in terms of plant height, number of leaves, total chlorophyll content, total carotenoid content and T5 (440g, 270g, 160g $NPK_{50\%}$ + 1kg FYM) was found to be the second-best treatment in terms of number of primary branches, average leaf area and yield. The study provides the information to the other researchers for the germplasm enhancement, desirable traits and high yield potential of the chili.

Key-words: Chili, growth, chemical and organic fertilizers.

INTRODUCTION

The broadly developed pepper, *Capsicum spp*., imperative as a vegetable and spice crop world-wide, is one of the foremost assorted crops (Hill *et al.*, 2013). Chili (*Capsicum annum L.*) is well known financially imperative crop in country and universally. In Pakistan, Sindh province is the major cultivator of chili crop followed by the Punjab and Balochistan (Arain, 2019). Chili has green color and achieves red color on aging (Pundir *et al.*, 2016). Islam *et al*. 2018 reported that the joined use of 140 kg/h Nitrogen with 60 kg/h Phosphorus and Potash with 40 kg per hectare increased plant development as well as fruit yield of chili.

Nitrogen treatment on *Capsicum* having impact on fruit flavor extending the parameter estimated as titratable acidity (TA) and lessening the association of TSS. On the other hand, the antioxidant activity and polyphenols are not influenced by any nitrogen estimation association (Núñez-Ramírez *et al.*, 2011).

Potassium application is fundamental to exploit the potential of vegetable crops, for most crop variety tried, the prescribed K dosage should be returned to, as well as the total fertilization hone, to maintain an adjusted nourishment status. The positive reaction to the part of K dosage may demonstrate that it is beneficial to convey K application along the cropping season (Kumar *et al.*, 2015). Effect of phosphorus and nitrogen, the best plant stature is noticed from (100kg nitrogen + 60kg phosphorus per hectare). Meanwhile, the nitrogen and phosphorus combination (150kg nitrogen + 30kg phosphorus per hectare) is very beneficial for the estimation total number of fruits/plant (Khan *et al*. 2010). It is revealed that amount of N at 155 kg per hectare, P_2O_5 at 55 kg per hectare and potassium at 45 kg/ha demonstrated to be the foremost appropriate combination of nitrogen, phosphorus and potassium in connection to crop development, quality and financial returns for development of *Capsicum* (Dubey *et al.*, 2017).

Earlier findings reveal that application of humic acid might effectively be utilized to improve yield potential and can fundamentally improve fruit quality in organic production of *Capsicum* (Karakurt *et al.*, 2009). Singh *et al*. 2017 described that higher *Capsicum* yields and greater measured fruits with treatment i.e. (phosphorus at 80 kg/ha, nitrogen at 120 kg/ha, and potassium at 80 kg/h) + (humic acid at 10 kg/ha as soil treatment + humic acid at 0.1 % as foliar treatment + micronutrient as foliar application (0.5% Mn, 0.2% Boron, 0.5% Zn) for supporting the higher development, fruit yield and quality beneath polyhouse condition. It is found that application of humic acid at 100

mg/kg results most noteworthy lycopene and capsaicin substance, and lower values have recorded in control treatments. Total soluble solids (TSS) and Titratable acidity (TA) enhanced in terms of humic acid application, and the higher values have observed from the humic acid treatment (250 mg/kg) (Aminifard *et al.*, 2012). Dorji, 2011 reported that the most outside source of plant supplements is farm yard manure (FYM), but the sum of supplements provided through FYM isn't satisfactory to fulfill the requirements of crop. (Murillo-Amador *et al.*, 2015) stated that lower organic matter content is one of the foremost imperative contributing components for poor fertility status of Pakistani soils. The combination of inorganic and natural fertilizers (fluid slurry) is very useful and very successful for high yield in comparison with other combinations. Shabir *et al*. 2017 reported the information regarding combined application of RDF 75% + Farm yard manure + Sheep fertilizer + Poultry fertilizer + Vermi compost + Bio-fertilizers that induce more red ripe, dry chili surrender, net returns and (BC) benefit cost ratio. Setyowati *et al*. 2014 revealed that application of composts individually or in combination with nitrogen fertilizer resulted in crop improvement and development of *Capsicum*. The present study was attempted with taking after goals, to assess morphophysiological characters, yield, and quality of local chili germplasm and to look at the impact of chemical and natural fertilizers as basal applications on local chili germplasm.

MATERIALS AND METHODS

During kharif season 2019 a field experiment was conducted at experimental location of Institute of Agricultural sciences, University of the Punjab Lahore, to analyze the impact of organic and chemical supplements on growth and yield attributes of chili (*Capsicum annuum* L.). The experiment was conducted with a point of comparison between cheap and locally accessible natural manures with chemical fertilizer as sources of supplements. There were seven treatments with various sources and levels of natural and inorganic manures and the subtleties are as pursues: T1 (control), T2 (1kg/plot farm yard manure), T3 (250g/plot humic acid), T4 (800g/plot compost), T5 (RD $NPK_{50\%+}$ 1kg FYM) /plot, T6 (RD $NPK_{50\%+}$ 800g compost) /plot, T7 (RD $NPK_{50\%+}$ 250g humic acid) /plot. NPK requirements of chili crop are 40:25:15 kg per acre. Humic acid was applied as humic acid granules. All the inorganic fertilizers furthermore, natural fertilizers were applied before planting with the exception of urea which was applied in two split portions. Half portion of the amount of nitrogen was applied as a basal portion previously planting and the rest was top dressed 60 days after planting. Treatments were weighed and assigned to five blocks according to the layout; in each block treatments were randomly assigned. The research trial was carried out in RCBD design with five replications. Among morphological attributes number of leaves per plant, number of primary branches per plant, plant height (cm), leaf area (cm^2), and fresh fruit weight (g) were recorded per plant. Total chlorophyll substance (mg per 100g), total carotenoids (mg per 100g) were estimated in matured green chili fruit selected at random.

The number of Leaves per plant was assessed by checking tagged plant leaves and all out numbers of leaves per plant were determined. Number of Primary Branches of individual plants was calculated from randomly chosen plants and the mean values were evaluated. Shoot of three randomly chosen plants in each plot was estimated starting from the ground level of plant to the highest point of the stem by using meter rod. The entire leaf area was estimated with the help of LICOR Photoelectric area meter. The breadth of selected healthy fruits was estimated with the help of Vernier calipers selected from each treatment and circumference of the fruit was noted. The mature fruit were harvested and weight of the fresh fruit per plant was recorded using digital weighing balance. Total carotenoids (TC) was estimated through the method introduced by Kuti (2004) . Chlorophyll substance in chilies was estimated through the method introduced by Ranganna (1986). The data of various physio-morphological traits were recorded and analyzed by using statistical analysis SAS version 9.2.

RESULTS AND DISCUSSION

Analysis of variance of chili genotype showed significant differences along with the desired traits at 5% level of significance. The results were discussed in the following figures along with important traits.

Plant height (cm)

The information with regard to plant height recorded at the time of harvesting and displayed through Fig 1. T7 treatment which is RD $NPK_{50\%+}$ 250gHA shows noticeably the plant height is higher among in all other treatments. T5 RD $NPK_{50\%+}$ 1kg FYM found to be the second-best treatment in terms of heights of plant. To differ this noticeably the less height was recorded in T1 (Control) that was 17.72 cm. T3 (250g/plot humic acid), and T4 (800g/plot compost), respectively 20.69 and 20.67 cm was recorded lower result after T5, T6 and T7. The development incitement by humic acid may be because of the impact on prolonged cell prolongation. In common,

cell prolongation is stopped by a quick addition in wall bound hydroxy proline by complexing iron inside the plant, which empties the iron from a key biochemical reaction including hydroxy proline synthesis (Vaughan and Malcolm, 1979). T7 realized in essentially higher plant tallness when contrast with the rest of the treatments. (Dileep and Sasikala, 2009) revealed that development properties of chili were altogether impacted by application of 75% RDF together with humic acid at 30 kg/ha was prevalent in expanding the development characters like plant height (79.30 cm).

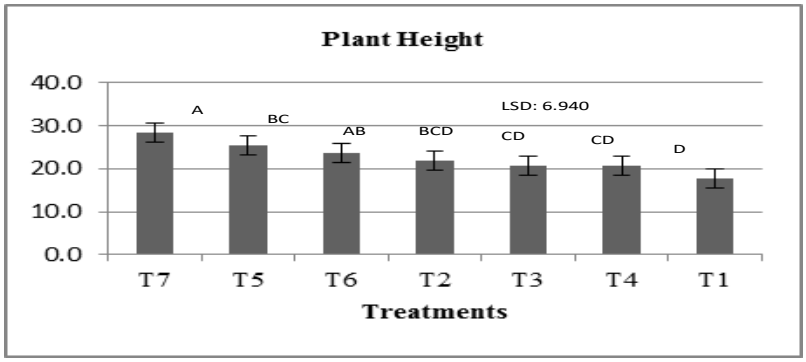

Fig. 1. Effect of different treatments application on average plant height of chili. Means with the same letters are not significantly different at the 0.05 probability level.
T1 (control), T2 (1kg/plot farm yard manure), T3 (250g/plot humic acid), T4 (800g/plot compost), T5 (RD $NPK_{50\%+}$ 1kg FYM) /plot, T6 (RD $NPK_{50\%+}$ 800g compost) /plot, T7 (RD $NPK_{50\%+}$ 250g humic acid) /plot.

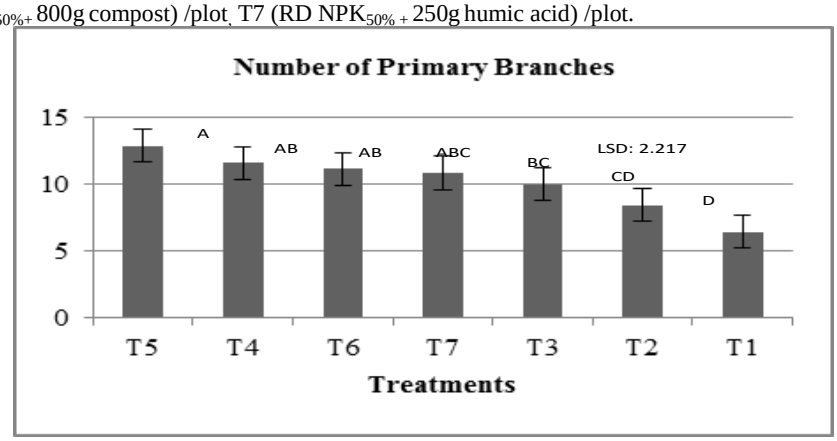

Fig. 2. Effect of different treatments application on average number of primary branches/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

Number of primary branches

The diverse treatments applied significant affect beyond this attribute at each developmental stage. Higher number of primary branches was estimated significantly in T5 (RD $NPK_{50\%+}$ 1kg FYM) at each developmental stage in contrast with remaining treatments. T4 (800g/plot compost) recorded second best treatment in estimation of this parameter. Treatments T6, T7, T3, and T2 relatively recorded relatively less number of primary branches (Fig 2). Furthermore, significantly lower number of primary branches was recorded in T1 (control) 6.43 braches per plant. The significance response to the treatments may be due to the inherent hereditary characteristics of the crop which invigorates vine number early in buds instead of the amount of fertilizer applied (Mukhtar *et al.*, 2010). Combined use of natural and chemical supplements enhances the quantity of primary branches individually than sole utilize of inorganic fertilizer. As natural fertilizers offer assistance to improve the soil condition and chemical fertilizers guarantee fast accessibility of basic supplements, the combination of two demonstrated superior than single utilize of the each. Typically in similarity with (Dorji, 2011) examined the impact of rates of farm yard manure and chemical supplements on the quality and measure of chili, to look at the impact of the incorporated use of natural and chemical supplements on chili yield and to characterize an ideal enhancement prerequisite for chili.

Number of leaves

The number of leaves / plant was counted in each treatment and the information so acquired was exposed to factual calculation. The mean information are included and laid out through Fig 3. This parameter was affected fundamentally because of different treatments of organic and chemical fertilizers. T7 RD $NPK_{50\%}$ + 250gHA delivered significantly most noteworthy number of leafs (427.45/plant) though T6 and T5 enlisted more number of leafs 376.3 and 364.28/plant relatively noteworthy prevalent to left over treatments. One of the foremost imperative variables influencing development, advancement, and function of plants is mineral nutrition. Macro and micronutrients play a noteworthy part in all perspectives of plant metabolism, and their accessibility in satisfactory levels is required for ideal physiological execution. Mineral supplements had a great impact on development of chilies. As nitrogen is a basic portion of chlorophyll, makes a difference in protein synthesis. Increment in number of leaves per plant might be because of sufficient aggregate of nitrogen given an ideal domain and balanced sustenance to plants. (Abdel-Mawgoud *et al.*, 2007) considered the reaction of tomato (*Lycopersicon esculentum L*) to different humic based fertilizers along with NPK fertilizer.

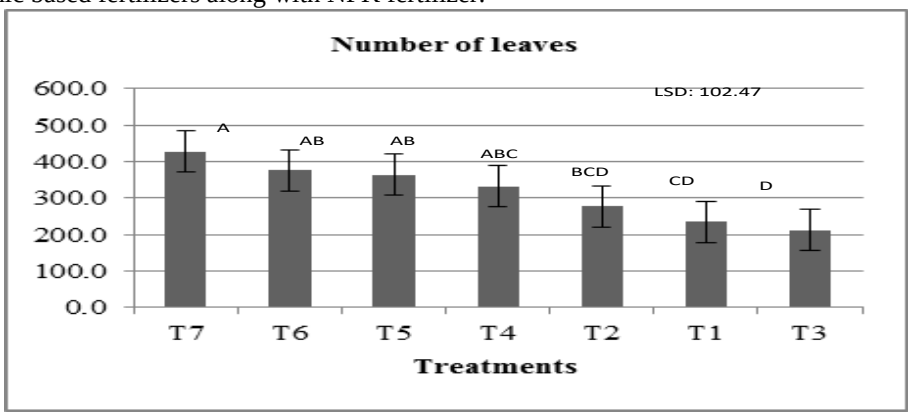

Fig. 3. Effect of different treatments application on average number of leaves/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

Average Leaf Area (cm^2)

The leaf area was resolved treatment wise and the information so gotten was exposed to factual calculation. The mean information is displayed in Fig 4. The distinctive fertility levels applied noteworthy deviation in this parameter. The finest fertility treatment was T5 RD $NPK_{50\%}$ + 1kgFYM which brought about in essentially higher leaf area (25.54 cm^2) over rest of the treatments. T6 (RD $NPK_{50\%}$+ 800g compost) is characterized as second-best treatment in term of leaf area i.e. 23.31 cm^2 followed by T7 (RD $NPK_{50\%}$ + 250g humic acid) with measurement of 22.35 cm^2. The significantly lower leaf area (15.23 cm^2) was gotten from T1. Leaf area like other development parameters was recorded greatest with the application of T5 (RD $NPK_{50\%}$ + 1kg FYM) at all stages of perception. This may be due to moderate leaf area development at beginning development stages when diverse soil supplements are however to be retained by the plant. The findings are relate to (Singh *et al.*, 2016) who explore the impact of diverse sources of manuring on development yield and quality of capsicum beneath low fetched poly-house conditions.

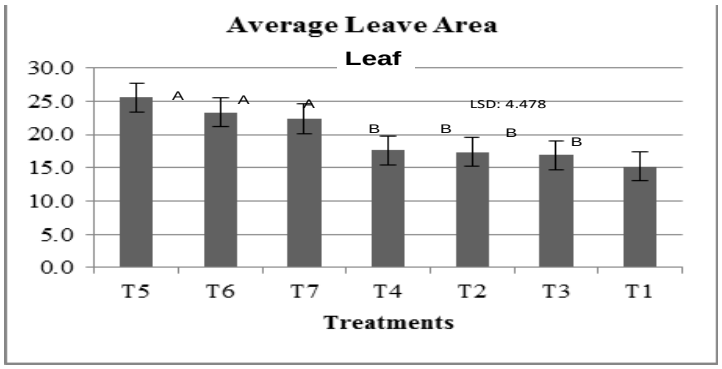

Fig. 4. Effect of different treatments application on average leaf area/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

Total Yield (g/plot)

Yield was estimated per plot of each treatment. The information in this way got were exposed to factual calculation. Furthermore, mean information are featured and laid out through Fig 5. The different treatments applied critical impact upon this productivity parameter. The leading treatment T5 RD $NPK_{50\%}$ + 1kgFYM was found essentially prevalent chili yield as regards (550.63 g) as compared to other treatments. T7 and T6 moreover found the second-best treatment predominant over the remaining treatments. This was closely taken after by T2, T1 and T3 (386.98, 331.33, and 319.69 g/plot chili yield respectively). Essentially least chili yield (305.22 g/plot) was accomplished from treatment T4 800g/plot compost. The yield was affected altogether due to distinctive fertility treatments. The critical variations in yield due to treatments having applied natural sources of supplements alone or with chemical might be owing to varieties in their supplement composition, decay of organic buildups, supplement release pattern and carbon-nitrogen proportion. As a substitute to inorganic manure the solitary use of FYM isn't sufficient to save the present degrees of harvest proficiency of high yielding assortments (Efthimiadou *et al.*, 2010). Findings are similar to (Melese, 2018) who survey the impact of NP fertilizer application and Farmyard Manure on efficiency and economic achievability of Marako Fana pepper assortment.

Total chlorophyll content (mg/L)

The total chlorophyll content was evaluated beneath each treatment. The cruel information so obtained are displayed and diagrammatically outlined through Fig 6. Among the different fertilizer treatments, T7 RD $NPK_{50\%}$ + 250g HA performed higher in term of total chlorophyll content followed by T6 RD $NPK_{50\%+}$ 800gcompost with 37.06 mg/l. Furthermore, T4 800g/plot compost and T5 RD $NPK_{50\%}$ + 1kgFYM were recorded relatively equal chlorophyll content with 35.76 and 35.03 mg/l. The significantly lower chlorophyll content was estimated in T2 1kg/plot FYM with 32.89 mg/l. Chlorophyll content of fruit is considered as a significant quality attribute of chili fruit, being for the most part liable for the green shade of the fruit influencing their appearance and buyer acknowledgment (Lightbourn, 2016). All out chlorophyll content fundamentally expanded in light of both NPK and HA treatment, recommending a critical improvement in the green shade of chili fruit. The presence of Nitrogen in overabundance advances improvement of the over the ground organs with respectably inadequate root development. Proteins synthesis and course of action of modern tissues are invigorated, coming almost in plenteous dull green (high chlorophyll) tissues of sensitive consistency (Bernstein *et al.*, 2019).

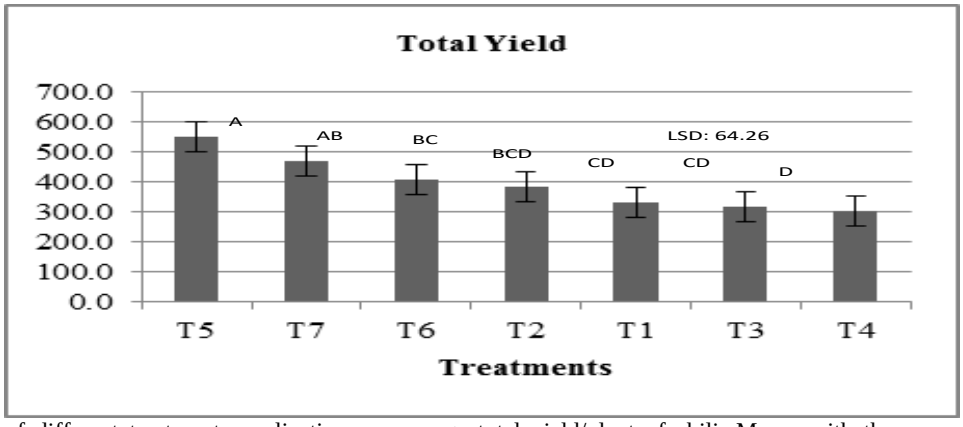

Fig. 5. Effect of different treatments application on average total yield/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

Total Carotenoid content (mg/100g)

Wide difference was observed among Capsicum entries for total carotenoids substance of fresh fruit. Distinction between treatments was non significant for total carotenoids substance in fresh fruit. Treatment T7 having RD $NPK_{50\%}$ + 250gHA recorded significantly higher carotenoids content (6.53 mg/100g) over reaming treatments, followed by T6 RD $NPK_{50\%+}$ 800gcompost and T3 250g/plot humic acid recorded (6.24 and 6.18 mg/100g). On the other hand, T1 brought about significantly most reduced carotenoids content (4.85mg/100g) Fig 7. In plant tissue Carotenoid accumulation was formed by the physiological, hereditary, and biochemical traits of a plant species due to natural development factors, for example, temperature, fertility and light (Kopsell and Kopsell, 2006). Besides, the chlorophyll and carotenoids substance of chilies can fluctuate in concentration and composition from contrasts in hereditary qualities and development (Howard, 2000). Findings are relate to (Karakurt *et al.*, 2015) who examine the influence of humic acid as foliar as well as soil implementation on antioxidant compounds of cucumber fruit.

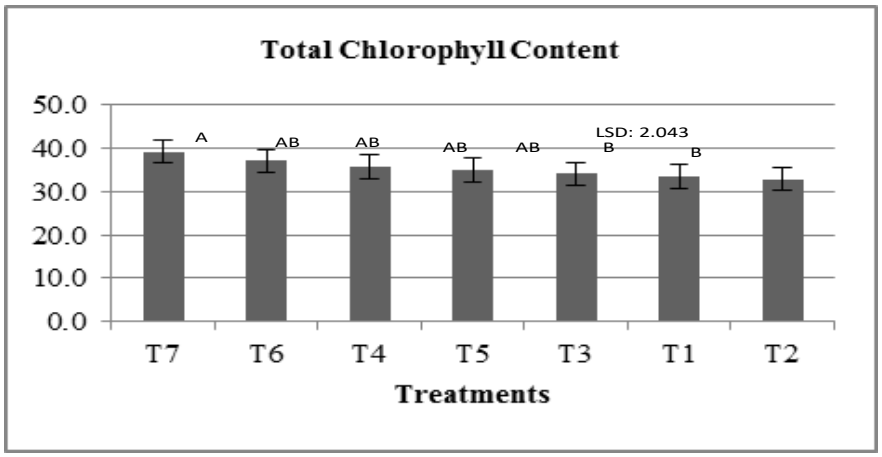

Fig. 6. Effect of different treatments application on total chlorophyll content/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

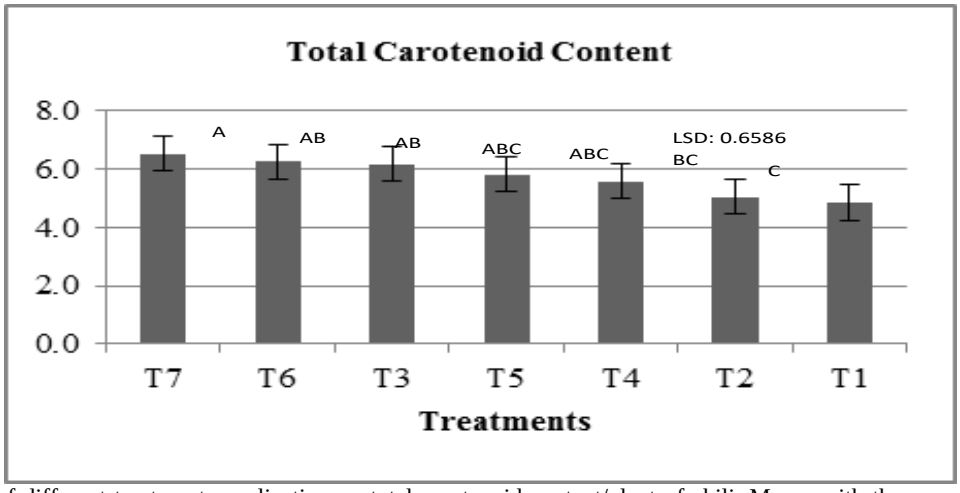

Fig. 7. Effect of different treatments application on total carotenoid content/plant of chili. Means with the same letters are not significantly different at the 0.05 probability level.

T1 (control), T2 (1kg/plot farm yard manure), T3 (250g/plot humic acid), T4 (800g/plot compost), T5 (RD $NPK_{50\%+}$ 1kg FYM) /plot, T6 (RD $NPK_{50\%+}$ 800g compost) /plot, T7 (RD $NPK_{50\%+}$ 250g humic acid) /plot.

CONCLUSION

It was concluded that application of humic acid in combination with recommended dosage of chemical fertilizers play an effective role to boost growth and improves quality attribute of chili crop. According to economic prospective the application of farm yard manure in combination with chemical fertilizers was proved best in term of overall yield. The outcome of the current findings reveals that the impact of different treatments of organic and synthetic supplements on various developmental factors, fruit quality characters, and the overall yield of local variety of chili was significant. The present study will be equally beneficial both for scientists and farmers community.

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