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EFFECT OF ORGANIC AND BIO FERTILIZERS ON THE VEGETATIVE TRAITS OF THE SUGARCANE PLANT (*SACCHARUM OFFICINARUM* L.)

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Abstract

In order to study the plant's response of sugarcane crop for organic and biofertilizers, the application date and their effect on improving the growth characteristics and cane yield. A field experiment was carried out on the land of a technology incubator in the fields of College of Agriculture, Diyala University during the year 2019 using the randomized complete block design with three replicates. Treatments included the application of NP chemical fertilizers, Humic acid and *Trichoderma harzianum*. The application was carried out in three different growth rates; the beginning of the tillering stage, the beginning of the elongation stage and the beginning of the ripening stage. The research results showed that the efficiency of the used fertilizer performance varied according to the type of fertilization and their application dates. The application of (1/2 chemical + 1/2 organic) resulted in a significant increase in the average chlorophyll index, which amounted to 80.85 SPAD compared to the control treatment that recorded 71.59 SPAD. Application of (1/2 chemical + 1/2 bio) resulted in a significant increase in the average number of tillers amounting to 33.55 tiller.m^{-2} compared to the control treatment, while the application of chemical fertilizers mixed with organic and biofertilizers has led to a significant increase in the yield of sugarcane stems of 105 tons/ha. Also, the application of fertilizers at the beginning of the ripening stage showed significant superiority in the stem height which reached 197.41 cm and the interaction treatment (1/2 chemical + 1/2 organic) at the beginning of the tillering stage was superior in the number of tillers, which amounted to 38 tiller.m^{-2}. Furthermore, the interaction treatment (1/3 chemical + 3/1 organic + 1/3 bio) was also superior at the beginning of the elongation stage in the stems yield reached 120 ton/ha. It can be concluded from these data that some fertilizers and the date of their application can improve the characteristics of growth and increasing the stems yield in the sugarcane crop by the application of organic and biofertilizers at the beginning of the tillering stage and reducing chemical fertilizers 50% for plants of sugarcane crop.

Key words: Sugarcane, Biofertiliser, Vegetative traits.

Introduction

Sugarcane (*Saccharum officinarum* L.) is an industrial crop that is globally important and is a major source of sucrose extraction (Afifi, 1999). The sugarcane crop is cultivated in the tropical and sub-tropical areas between 37° north latitude and 31° south latitude, which are important crops in the world. Sugarcane is one of the largest sources of sucrose in the world and sugar production depends mainly on the cultivation and development of this crop. Furthermore, its the largest crop in the world in terms of production as the global production of sugarcane in 2015 amounted to 1807.8 million tons (Al-Saeedi, 2018). Several studies have referred to the negative effects of chemical fertilizers and their results and because of this, interests in many countries of the world have tended to encourage organic production, which is characterized by its low percentage of nitrates and oxalates. As well as, the high economic returns of organic products, especially in developed countries (Abu Rayyan, 2010). Biofertilizers are one of the modern techniques used to reduce the excessive use of chemical fertilizers and the use of alternatives to chemical fertilizers such as biological fertilization is of great importance in obtaining high-yield crops and free from chemical pollutants (Bin Mahmoud, 2019). Studies differed about the response of sugarcane plant to fertilizers, their application date and the effect of these fertilizers on vegetative growth characteristics, including plant height, number of stems and stems yield (Babar *et al*., 2011). Moreover, (Soomro *et al*., 2013) obtained the same result that mentioned previously, while a study on sugarcane plant in China using different levels of nitrogen, added at the end of the elongation stage showed the superiority of fertilization treatment 675 $kg.ha^{-1}$ in the average chlorophyll index (Yang *et al*., 2019). Besides, (Civiero *et al*., 2013) on studying sugarcane plants in protected fields using different levels of humic acid that added at the elongation stage showed that there were no significant differences in the average leaf area. The (Oliveira *et al*., 2018) results on cane plant using Humic acid 20 $mg.l^{-1}$, added at the beginning of the tillering stage showed the superiority of Humic fertilization treatment in the number of leaves in the plant. Finally, Due to the importance of choosing fertilizer and the appropriate date of application and the lack of studies and researches on this crop in Iraq, this study was carried out to raise the productivity of this crop.

Materials and Methods

A field experiment was carried out during the year 2019 on the land of the technology incubator of the College of Agriculture, the University of Diyala on the sugarcane crop *Saccharum officinarum* L. according to RCBD with three replicates. Once the plowing and harrowing of the soil were completed, the experiment land was divided into plots and the waterways were opened. Furthermore, the cuttings of sugarcane were planted on 3/14/2019 with a depth of 5 cm and were covered with a slight layer of soil and the stem cuttings were cultivated manually and each cutting contains three buds. However, the experiment included eighteen treatments, where the area of the experimental unit was 6 m^2 included 4 lines with a length of 2 m, while the distance between them 1 m, the distance between an experimental unit to another 1 m. Besides, the distance between a replicate and another 2 m, where the soil analyzes were conducted before planting on the land of technology incubator at the College of Agriculture - University of Diyala.

The experiment was fertilized according to the quantities recommended by the company that is added to all fields by adding 200 kg/ha N of urea fertilizer (46%) in the first three batches at the beginning of the tillering stage on 8/4/2019. As well as, the second one at the beginning of the elongation stage on 10/6/2019 and the third at the beginning of the ripening stage on 15/9/2019 and 200 kg/ha P_2O_5 of triple superphosphate fertilizer (46%) was added at one batch after plowing. In the role of the organic fertilizer, the Humic acid fertilizer was used by 10 g / m-L in three planting dates and *Trichoderma* harzianum was used as a source of the biofertilizer and was added as a water-suspension at a ratio of 2 g / 100 $ml.m^{-2}$ in three planting dates. Measurement of the following characteristics was recorded at the harvest of the two middle lines (Mubarak, 2004):

Table 1: Some physical and chemical properties of study soil.

Physical properties				Chemical properties					
Clay%	Sand%	Silt%	EC	pH	OM	$CaCO_3$	N	P	K
46.2	184.3	769.5	10.01	7.3	10.8	201.8	47.6	72.3	207.1
$g.kg^{-1}$			ds/m		$g.kg^{-1}$		$mg.kg^{-1}$		

1. Stem height (cm): The height of ten sugarcane plants was recorded using a tape measure from the soil surface up to the last node of each experimental unit.

2. Number of tillers: ($tiller.m^{-2}$): It was calculated for the total number of plants within one square meter.

3. Leaf area (cm^2): It was calculated by multiplying the length and width of leaf per square meter (Mary and Anitha, 2019).

$$L.A. = WL \times 0.65$$

4. Chlorophyll index in leaves (SPAD unit): Chlorophyll was measured in leaves using the SPAD-502 meter-measuring instrument in the field directly (Dinh *et al*., 2017).

5. The number of total leaves: ($leaf.m^{-2}$): The total number of leaves per square meter was calculated from the same plants that were chosen to measure the above growth characteristics.

6. Cane yield ($ton.ha^{-1}$): The harvest was carried out on 10/12/2019 after removing the leaves and shoot tips from the sugarcane plants of each experimental unit. Stems were cut from the area near the soil surface with a large knife, then the harvested stems were collected and were measured they weigh with a special scale, then the sugarcane yield was calculated and was converted to tons/ha.

The data obtained were analyzed for all studied traits according to the method of statistical analysis of the design used and a less significant difference (LSD) test was used at the 5% probability level to compare the arithmetic mean of different treatments.

Results and Discussion

Stem height (cm)

The results in table 2 indicated that there were significant differences between the fertilizing type averages in the plant height, as the control treatment gave the highest average of plant height reached 210 cm. The reason may be due to that the addition of chemical fertilizer has led to the

Table 2: Effect of fertilization type and application date on the average stem height of sugarcane plant (cm).

Fertilization type	Application date			Fertilization averages
	Tillering stage	Elongation stage	Ripening stage	
Chemical fertilization (control)	210.00	210.00	210.00	210.00
Organic fertilization	194.66	183.46	188.93	189.02
Bio fertilization	200.06	196.50	187.73	194.76
1/2 chemical + 1/2 organic	155.00	200.80	229.33	195.04
2/1 chemical + 1/2 bio	177.93	181.06	179.28	179.42
1/3 chemical+1/3 organic+1/3 bio	202.80	188.13	189.20	193.37
5% L.S.D for interaction (fertilization type × application date) = 14.97				5% LSD =8.64 for fertilization
Application date averages	190.07	193.32	197.41	
5% LSD = 6.11 for application date				

availability of nutrients from N, P and K in sufficient amounts to stimulate vital processes throughout the plant's growth period. An increase in growth occurs because of faster cell division and increased elongation (Wiedenfeld and Enciso, 2008 and Gana, 2008), which is reflected positively in increased the stem elongation; this is consistent with (Parajuli, 2016 and Sakina and El-Bakry, 2018) findings, which they confirmed that the addition of chemical fertilizer increases the plant height.

It was observed from the results of table 2 that there were significant differences between the averages of application date, as the application date at the beginning of ripening stage was significantly superior and gave the highest average of plant height reached 197.41 cm, which did not differ significantly from the application date in the elongation stage. The reason may be due to that the application date in the elongation stage in which the plant height increased is characterized by high temperatures, a long time and high lighting, in which the vegetative growth increases and reaches its maximum. However, the nutrients are exploited in the cell division and elongation and at high temperatures, the amounts of absorbed nutrients increases and thus the vegetative growth increased. It was observed from the results shown in table 2 that the interaction between the fertilization type averages and the application date affected significantly the plant height. The highest average in this trait was 229.33 cm at the interaction treatment (1/2 chemical + 1/2 organic) at the beginning of the ripening stage, with an increasing percentage of 9% compared to the control treatment, which gave the lowest average of this trait reached 210 cm. The reason for an increase in stem height may be due to the occurrence of a complementary role between the organic humic fertilizer and the chemical fertilizer added to the soil. Humic acid encouraged the action of stimulating hormones in cell division and stem elongation, as well as the role of the acid that works on the formation of chelating compounds that hold the element and covers it from more than one side and prevents it dissolves to the soil solution (Phelps, 2000). This shows the role of the acid in the early stages more than in the later stages in improving the soil properties, which was reflected in the growth characteristics including stem height. Chemical fertilizer action has an important role in encouraging photosynthesis and increasing energy formation ATP in the ripening stage, this is consistent with (Soomro *et al*., 2013 and Sukla *et al*., 2015). This indicates that it can reduce the amount of chemical fertilizer to a half and replace it with organic fertilizer and thus it will work to reduce environmental pollution, whether in the soil or the plant and at the same time obtain the same results.

Number of tillers (tiller.m^{-2})

The results of table 3 showed significant differences occurred between the fertilization type averages in the number of tillers, as the treatment (1/2 chemical + 1/2 bio) gave the highest average of this trait reached 33.55 tiller.m^{-2}, compared to the control treatment, which amounted to 29 tiller.m^{-2}, with an increasing percentage of 15.6%. The increase in the number of tillers in sugarcane plants because of the application of (1/2 chemists + 1/2 bio) may be due to that this treatment gave the lowest value for the stem height as shown in table 2, this means that there is a negative correlation between the number of tillers and the stem height. Moreover, the reason may be due to that the application

Table 3: Effect of fertilization type and application date on the average number of tillers of sugarcane plant (tiller.m^{-2}).

Fertilization type	Application date			Fertilization averages
	Tillering stage	Elongation stage	Ripening stage	
Chemical fertilization (control)	28.00	30.00	29.00	29.00
Organic fertilization	28.33	29.66	29.33	29.11
Bio fertilization	29.33	30.00	30.33	29.88
1/2 chemical + 1/2 organic	29.00	21.00	27.00	26.00
2/1 chemical + 1/2 bio	38.00	33.00	29.66	33.55
1/3 chemical+1/3 organic+1/3 bio	27.00	30.33	28.33	18.55
5% L.S.D for interaction (fertilization type × application date) = 14.97				5% LSD =2.39 for fertilization
Application date averages	30.05	29.11	29.05	
5% LSD = NS for application date				

of chemical fertilizer has led to the availability of nutrients of N, P and K in quantities sufficient to stimulate the biological processes throughout plant growth from the production of tillers and the beginning of stem elongation and the evolution and division of cells. Also, biofertilizers have a complementary role in the chemical fertilizer application reflected on the increase in the number of tillers in the sugarcane crop (Nashio *et al*., 2001). Since the first batch of chemical fertilizer may have an active role in the first stages of plant growth and works to stimulate it and followed by the role of biofertilizer in supplying the plant with the required nutrient in the next growth stages.

The application of *T. harzianum* fertilizer also contributes to improving the mineral nutrition of the plant by its penetrating the roots and forming fungal compositions in it that increases the efficiency of nutrient absorption reflected on increase the average of this trait (Kleifield and Chet, 1992). In addition, the formation of tillers is considered one of the distinguishing features of the sugarcane crop and is considered one of the most closely related traits to the yield is the number of healthy stems. This treatment (1/2 chemical + 1/2 bio) is economically feasible, as it provided 50% of the chemical fertilizer amount, in addition to that the bio fertilizer application leading to reducing environmental pollution and rationalizing the consumption of chemical fertilizers (Bashan and Levaneny, 1991). These results are consistent with (Bokhtiar *et al*., 2015) findings, which they observed that the application of chemical and biofertilizer *T. harzianum* has led to an increase in the number of tillers in the sugarcane crop. It was observed from the results of table 3 that there were no significant differences between the averages at the application date for the number of tillers. It is evident from table 3 that the interaction between the fertilizer type averages and the application date has significantly affected the number of tillers. The highest average in this trait was 38 tiller.m^{-2} at the interaction treatment (1/2 chemical + 1/2 bio) at the tillering stage with an increasing percentage of 35.7% compared to the control treatment, which recorded an average of 28 tiller.m^{-2}. The reason for an increase in the number of tillers per unit area at this date of application dates may be due to the fact that the tillering stage in which the sugarcane crop needs moderate temperatures that are compatible with a short lighting period and low moisture. Therefore, the temperature has an important role in the growth of sugarcane crop, as the number of tillers increases gradually with increasing temperature until it reaches its maximum at approximately 30°C (Muhammad Ali, 1990).

Leaf area (cm^2)

It was observed from the results of table 4 that there were significant differences between the fertilizing type averages in the leaf area. Treatment (1/2 chemical + 1/2 bio) gave the highest average for this trait reached 200.56 cm^2, compared to the control treatment that reached 183.73 cm^2 with an increasing percentage of 9% and the reason is due to that the application of chemical and biofertilizers has led to increasing the readiness of the nutrients in the soil solution. Furthermore, bio-fertilizer contains microorganisms that increase the readiness of the nutrients in the soil and their ability to secrete stimulants and growth regulators that lead to the formation of a dense root. Then, increase the absorption of the nutrients, which was positively reflected on the surface area of the leaves and from table 3, it can be observed that this treatment (1/2 chemical + 1/2 bio) gave the highest value for the number of tillers reached 33.55 tiller.m^{-2}. However, the increase in the number of tillers is directly proportional to the leaf area as shown in table 3 and possessed a high leaf area with a large coverage that led to increased competition between plants on growth factors through biological benefiting that added mixed with the chemical. Thus main benefiting from the light factor, which reflected positively in increasing the leaf area, this contrasts with what (Sahuki *et al*., 1988) mentioned in that the increasing leaf area leads to increased competition between plants on the main growth factors and Nitrate reductase activity (NRA) and consequently the efficiency of photosynthesis decreases. Similarly, the leaf area depends on the number of leaves, their emergence rapidity and their surface area (Charles-Edwards *et al*., 1986), where the results in table 4

Table 4: Effect of fertilization type and application date on the average leaf area of sugarcane plant (cm^{-2}).

Fertilization type	Application date: Tillering stage	Elongation stage	Ripening stage	Fertilization averages
Chemical fertilization (control)	200.00	162.53	188.66	183.73
Organic fertilization	186.13	142.86	184.26	171.08
Bio fertilization	204.56	173.10	188.53	188.73
1/2 chemical + 1/2 organic	120.00	180.00	149.56	149.85
2/1 chemical + 1/2 bio	200.00	200.00	201.70	200.56
1/3 chemical+1/3 organic+1/3 bio	225.66	139.26	156.10	173.67
5% L.S.D for interaction (fertilization type × application date) = 14.97				5% LSD =9.89 for fertilization
Application date averages	189.39	166.29	178.13	
5% LSD = 6.99 for application date				

indicated that there was a significant effect between the averages of leaf area at the application date. The application date exceeded at the beginning of the tillering stage significantly, as it gave the highest average of leaf area reached 189.39 cm^2, due to that the fertilizer application at the beginning of the tillering stage.

The nutrients absorbed by the plant roots invested in the vegetative growth of tillers and leaves and are stored in the leaves, as ideal temperatures help in storing large quantities of nutrients. (Rizic and Abdel Ali, 1981; Al-Mubarak, 2009), which is reflected in increasing leaf area for the crop. The results in table 4 showed that the interaction between the fertilization type averages and the application date has effected significantly on the leaf area. Besides, the highest average in this trait was 225.66 cm^2 at the interaction treatment (1/3 chemical + 1/1 organic + 3/1 bio) at the beginning of tillering stage, with an increase percentage of 13% compared to the control treatment, which amounted to 200 cm^2. Possibly the reason is due to the superiority of the fertilizers application date at the beginning of tillering stage for the leaf area trait, as well as that whenever increasing the number of tillers, the leaf area increases. That is, there is a direct relationship between the number of tillers and the leaf area at the fertilizer application date, despite the absence of significant differences between the averages as shown in table 3.

Chlorophyll index in leaves (SPAD)

The results of table 5 showed that there was a significant effect among the fertilization type averages on the chlorophyll index in sugarcane plant leaves. Treatment (1/2 chemical + 1/2 organic) gave the highest average chlorophyll index reached 80.85 SPAD, compared to the control treatment that recorded 71.59 SPAD, with an increasing percentage of 13% and the reason for this may be due to the complementary role of chemical fertilizer and Humic acid. The reason for increasing the content of chlorophyll in the leaves is due to the role of chemical fertilizer, as it activates the microelements that work to maintain an amount of iron to form chlorophyll and activate the enzymes Phospho Enol Pyruvate Carboxylase and Hexokinase. In addition to increasing the proportion of nitrogen in the leaf and as it is known, nitrogen is involved in chlorophyll synthesis (Issa, 1984). As for the role of Humic acid when added to the soil, it increases the levels of nitrogen released in the soil, which results in an increase in nitrogen accumulation in the plant. Furthermore, improving the physical and chemical properties of the soil and then increasing the leaf content of chlorophyll (Pang and Letey, 2000). Humic acid has a direct effect in increasing the permeability of the cell membrane, resulting in an increase in the permeability of nutrients in the plant and leading to improved photosynthesis, thus increase the chlorophyll content of the leaves (Nardi *et al*., 2002; Anonymous, 2010). As well as, the effect of Humic acid on some of the plant's metabolic processes such as respiration and photosynthesis and its role in increasing the antioxidants, thereby preserving the leaf content of chlorophyll from the catabolism process (Gallant, 2004 and Asik *et al*., 2009).

These results are consistent with (Bokhtiar and Sakurai, 2005) results, that confirmed the addition of chemical and organic fertilizers increases the percentage of chlorophyll in the leaves of the sugarcane plant. It is evident from this result that the treatment (1/2 chemical + 1/2 organic) reduced (50%) from the percentage of chemical fertilizer. It was observed from the results of table 5 that there were no significant differences between the averages of the chlorophyll index in the leaves of the sugarcane plant at the fertilizer application date. The results of table 5 showed that the interaction between the fertilization type averages and the application date has effected significantly on the chlorophyll index in sugarcane plant leaves. The highest average in this trait was 93.33 SPAD at the interaction treatment (1/2 chemical + 2/1 bio) at the beginning of the ripening stage, with an increasing percentage of 27% compared to the control treatment of 73.33 SPAD. Possibly the reason is due to the superiority of the treatment (1/2 chemical + 1/2 bio) over the rest of the fertilizers application treatments in the chlorophyll index in sugarcane plant leaves and gave the highest value

Table 5: Effect of fertilization type and application date on the average chlorophyll index of sugarcane plant (SPAD).

Fertilization type	Application date			Fertili-zation averages
	Tillering stage	Elongation stage	Ripening stage	
Chemical fertilization (control)	71.44	70.00	73.33	71.59
Organic fertilization	70.16	70.00	73.02	71.06
Bio fertilization	82.55	65.00	71.61	73.05
1/2 chemical + 1/2 organic	74.22	75.00	93.33	80.85
2/1 chemical + 1/2 bio	63.89	70.22	68.87	67.66
1/3 chemical+1/3 organic+1/3 bio	56.66	70.00	29.00	51.88
5% L.S.D for interaction (fertilization type × application date) = 14.97				5% LSD =4.16 for fertilization
Application date averages	69.82	70.03	68.19	
5% LSD = NS for application date				

Table 6: Effect of fertilization type and application date on the average number of leaves of sugarcane plant (leaf.m^{-2}).

Fertilization type	Application date			Fertili-zation averages
	Tillering stage	Elongation stage	Ripening stage	
Chemical fertilization (control)	336.00	360.00	348.00	348.00
Organic fertilization	340.00	356.00	352.00	349.33
Bio fertilization	352.00	360.00	364.00	358.67
1/2 chemical + 1/2 organic	303.67	260.00	332.00	398.56
2/1 chemical + 1/2 bio	456.00	396.00	356.00	402.67
1/3 chemical+1/3 organic+1/3 bio	324.00	364.00	340.00	342.67
5% L.S.D for interaction (fertilization type × application date) = 38.18				5% LSD =22.04 for fertilization
Application date averages	351.94	349.33	348.66	
5% LSD = NS for application date				

reached 80.85 SPAD, as well as the fertilization application date despite the absence of significant differences between averages.

Number of leaves (leaf.m^{-2})

It was observed from the results of table 6 that there was a significant effect between the fertilization type averages on the total number of leaves of the sugarcane plant. Treatment (1/2 chemical + 1/2 bio) gave the highest average number of leaves reached 402.67 leaf.m^{-2} compared with the control treatment, which amounted to 348 leaf.m^{-2} with an increasing percentage of 15.7% and the reason for this may be due to the complementary role between chemical and biofertilizers. However, the application of chemical fertilizers to the soil has led to the supply of the soil with the macronutrients, which was reflected in vegetative growth and an increase in the number of leaves.

In addition, the biofertilizer contains microorganisms that secrete organic acids and a number of enzymes that increase the readiness of the nutrients, which in turn reflected positively on vegetative growth and an increase in the number of leaves (NIIR, 2007). The *Trichoderma* Spp. secretes a specific growth-regulating substance that causes an increase in some plant growth criteria (Windham *et al*., 1986), or the ability of this fungus to increase the readiness of nutrients in the soil (Al-Shaibani, 2005). This result showed that the application of organic and biofertilizers has resulted in a 50% reduction in the use of chemical fertilizers. The results of table 6 showed that there was no significant effect among the averages number of leaves in the sugarcane plant at the fertilizer application date, where the results also indicated that the interaction between the fertilization type averages and the application date has significantly affected the number of leaves. Furthermore, the highest average for this trait was 456 leaf.m^{-2} at the interaction treatment (1/2 chemical + 1/2 bio) at the beginning of the tillering stage and with an increasing percentage of 36% compared to the control treatment of 336 leaf.m^{-2}. Possibly the reason is due to the superiority of the fertilization treatment (1/2 chemical + 1/2 bio) at the application of the fertilizer, in addition to that the date of fertilizers application at the beginning of the tillering stage gave the highest value in the number of leaves, which reached 351.94 leaf.m^{-2}, while there were no significant differences between the averages.

Cane yield: (ton.ha^{-1})

The results of table 7 showed that there was a significant increase between the fertilization type averages in the cane yield. Treatment (1/3 chemical + 1/3 organic + 1/3 bio) exceeded in giving the highest average for this trait reached 105 ton.ha^{-1}, compared with the control treatment, which amounted to 88.88 ton.ha^{-1} with an increasing percentage of 18%. The reason is probably due to the role of chemical, organic and bio-fertilizers that worked together in increasing nutrients and forming a shoot that reflected positively on increasing the yield of sugarcane stems. In addition to the complementary role of fertilizers represented for this treatment in increasing the readiness of important elements present in the soil and increasing their ability to retain water, which provided an appropriate environment for the plant to perform its physiological activity in the best way. Especially photosynthesis, which led to an increase in the plant size and its leaf

Table 7: Effect of fertilization type and application date on the average cane yield of sugarcane plant (ton.ha^{-1}).

Fertilization type	Application date			Fertili-zation averages
	Tillering stage	Elongation stage	Ripening stage	
Chemical fertilization (control)	86.00	90.00	90.00	88.88
Organic fertilization	85.00	60.00	40.00	61.66
Bio fertilization	90.00	78.00	90.00	86.11
1/2 chemical + 1/2 organic	80.00	80.00	80.00	80.00
2/1 chemical + 1/2 bio	90.00	75.00	90.00	85.00
1/3 chemical+1/3 organic+1/3 bio	90.00	120.00	105.00	105.00
5% L.S.D for interaction (fertilization type × application date) = 1.84				5% LSD =10.67 for fertilization
Application date averages	86.94	83.88	82.50	
5% LSD = NS for application date				

area as shown in table 4, thus, the increase of nutrients represented in the source and its transfer to the sink, which caused an increase in the cane yield. These results were consistent with (Shukla *et al*., 2008; Shukla *et al*., 2015) results. Moreover, the increase in the yield of sugarcane cane yield resulting from the addition of a combination of chemical, organic and biofertilizers may be due to the role of these fertilizers in increasing the average number of squeezable stems per unit area as shown in table 7. Besides, the decrease in the number of stems that are non-squeezable, as it found positive and significant correlations among the attributes mentioned, as the decrease in the number of non-squeezable stems has caused a positive effect on the yield. Therefore, the increase in the number of tillers from the beginning of the growth stage for the crop resulted in the storage of more photosynthesis products in those tillers, which resulted in produced squeezable stems. In addition, the application of biofertilizers leads to the accumulation of dry matter in a way that reduces part of the photosynthesis products of the plant part located above the soil surface and directing it to the ground part of the plant by producing dense roots, which leads to an increase in the surface area. Besides, an increase in the production of dry matter for the roots and then increases their absorption to the nutrients and these changes have been positively reflected by the cane yield. This result reduced chemical fertilization (66%) and replaced it with organic and biofertilizers. Thus, it will work to reduce environmental pollution, whether in the soil or the plant and at the same time obtain the same amount of yield. It was observed from the results of table 7 that there were no significant differences between the averages of the sugarcane cane yield at the fertilizer application date. The results also indicated that the interaction between the fertilization type averages and the application date has significantly affected the stems yield of the sugarcane plant.

The interaction treatment (1/3 chemical + 1/3 organic + 1/3 bio) was superior at the beginning of the elongation stage began by giving the highest average of the cane yield reached 120 $ton.ha^{-1}$ compared with the control treatment, that recorded an average of 90 $ton.ha^{-1}$ with an increasing percentage of 33%. The reason may be due to the complementary role of chemical, organic and biofertilizers that worked together when added and as a result, led to an increase in the cane yield, or perhaps because of the superiority of this treatment by giving the highest value of the stems yield when adding fertilizers, which amounted to 105 $ton.ha^{-1}$. Moreover, this treatment exceeded at the beginning of the elongation stage at the application date, although there were no significant differences between the averages at the application date.

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