EFFECT OF DIFFERENT MANURES ON THE GROWTH, YIELD AND QUALITY OF TWO BRUSSELS SPROUTS (*Brassica oleracea* var. gemmifera L.) HYBRIDS

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ABSTRACT
The study was conducted during 2014-2015 at Bakrajo Agricultural Research Station, Bakrajo, Sulaimani, Iraq to investigate the effect of different organic manures (cow 10 and 20 t.ha^{-1}, sheep10 and 20 t.ha^{-1} and chicken 4 and 8 t.ha^{-1}) on the yield and quality of two Brussels sprouts hybrid "Topline F1" and "Attwood F1". The results showed that "Topline F1" increased plant height, leaf weight, leaf area, bud size, yield. plant^{-1}, yield.ha^{-1} and Ascorbic acid . "Attwood F1" took shorter time to harvest days. The highest yield.plant^{-1}, yield.ha^{-1}and bud number obtained from cow manure 20 t.ha^{-1}, highest plant height and bud fresh weight obtained from sheep manure 20 t.ha^{-1} , while the highest leaf number, leaf weight , leaf area and bud size recorded for chicken manure 8 t.ha^{-1}.. NPK gave highest protein and nitrate content values. The highest ascorbic acid obtained from the control treatment. Shorter period to harvest was recorded for cow and sheep manure 20t.ha^{-1} .

Key words: Brussels sprouts, hybrids, organic manure, growth, yield, protein, nitrate, ascorbic acid.

INTRODUCTION

Brussels sprouts (*Brassica oleracea* var. gemmifera) is a member of Brassicaceae family, is an important vegetable crop and has high nutrition and good commercial value. The edible part of the Brussels Sprouts are buds (sprouts) that develop under the armpit of every leaf. The leaves are positioned along the stalk, so the number of formed leaves and buds on the height of the stalk, hence the yield [9]. Brussels Sprouts contain plant phytochemicals which enhance the activity of the body's natural defense system to protect disease especially cancer due to reduction of oxidative DNA damage, it is rich source of sulforaphane which has been shown to display potent and carcinogenic properties and its high contents of vitamins (A, C, B6 and K), minerals (K, Fe, S) and Folic acid [7], [26].

It is an established fact that use of inorganic fertilizer for the crops is not good for health because of its residual effects, but in the case of organic fertilizer such problem does not arise and on the

other hand it increases the productivity of soil as well as quality and yield [24].

Subhan [21)] carried out an experiment on cabbage cv. “Gloria Osena” and applied 15, 20, 25 and 30 t.ha^{-1} of cattle manure, composted maize straw or composted rice straw, he observed that application of organic manure increased head diameter at 60 days after planting and the average number of leaves.plant^{-1} and reduced the number of days to crop maturity, while application of 25 or 30 t cattle manure.ha^{-1} gave the largest cabbage and the highest yield/plot. Stoorvogel [20] recorded that low use efficiencies of inorganic fertilizers coupled with their rising costs and the need for organically produced foods has directed the attention of farmers towards organic sources. Njoroge and Manu [12] found that organic fertilization important for providing plant with their nutritional requirements without having undesirable impact on the environment

Organically grown crops are believed to be healthier and contain more minerals and vitamins than that of the conventional counterparts [27]. Levy and Taylor [8] reported that application of organic fertilizer increases the populations of micro-organisms in the soil that helps the soil to release various nutrients. These micro-organisms also produce plant growth regulators that are important for plant growth and photosynthetic activity. Abou El-Mged *et al.* [2] indicated that the highest vegetative growth parameters (plant height, and leaf number) were recorded by broccoli plants supplied with 100% of cattle manure. Organic fertilizers improve soil structure, thereby allowing root development into deeper soil layers. Citak and Sonme [6] reported that because of some problem arising from the consumption of the unhealthy foods grown under chemical fertilizers, growing foods organically has gained popularity around the world. Tawfiq (23) recorded that poultry 8% manure increased total yield of spinach, while poultry12% caused an increase in cabbage yield. Omar *et al*. [15] showed that combination of farm yard manure, Homobacter and NPK increased broccoli yield, while they found the great effectiveness of organic fertilizer application in reducing of nitrate content in broccoli heads. Rowell and Robert [19] found that animal manures contribute more to the soil than just nitrogen, phosphorus and potassium. Use of manure builds organic matter in soils and improve soil structure

Since there are little or no studies or experimental works on using organic manure on Brussels sprouts, for this reason this investigation was selected. The main objectives of the current study were to:

1) Evaluate the effect of different kind and rates of organic manures on growth, yield and some chemical components of Brussels sprouts under Sulaimani conditions.
2) Produce healthy product of Brussels sprouts with high nutrient values for the human consumption, having more vitamins and minerals and less nitrate content.

MATERIALS AND METHODS

The study was conducted during 2014-2015 at Bakrajo Agricultural Research Station, Bakrajo, Sulaimani, Iraq. The field is located on latitude (34^{o},35.134N) longitude(45,22.879 E) and altitude (741 meters above sea level) to study the effect of different organic manures (Cow, sheep and chicken) on the yield and quality of two Brussels sprouts hybrids “Topline F1” and “Attwood F1”.

Soil samples were taken from the depth of (0-30) cm at the location and analyzed in Agriculture Research Center of Bakrajo. Some physical and chemical properties of the soil and analysis of different composted manures shown in table (1) and table (2), respectively.

The organic manure was collected from the local sources on 1st March 2014. They were transferred into holes of 6 m^3 (3 m long, 2 m wide and 1 m depth). Two layers of polyethylene were laid into the hole. After adding the manure into the hole, it was covered with a layer of polyethylene at the surface level of the soil.

Table (1): Some physical and chemical properties of the experiment soil during the study seasons in field of Bakrajo Agricultural Research Station, Bakrajo.

Soil properties	Sand %	Silt %	Clay %	Soil texture	E.C ds. m^{-1}	pH	O.M %	$CaCO_3$ %	Total N mg/100 g	Available P mg/100 g	Available K mg/100 g
	09.2	46.0	44.8	Silty clay	0.4	7.4	10.33	25.1	10.4	8.0	20.1

Manure was mixed up every two weeks for four months for the better uniformity of the moisture content and ventilation till only 20 day before setting the experiment (Chapman and Pratk, 1961). Analysis of composted manures is shown in (Table 2).

Table (2): Analysis of different composted manures

Variable Manure	N%	P%	K%	Fe%	Mg%	pH	C:N ratio	Moisture %
Sheep	2.0	1.1	1.6	0.5	0.8	7.3	13.3	20.0
Cow	1.5	0.9	2.4	0.7	0.4	7.1	11.5	17.0
Chicken	2.3	1.8	3.0	1.0	0.9	6.8	13.0	16.1

Experimental design and treatments:

The experiments were designed as a split- plot system embedded in a randomized complete block design (RCBD) with three replicates. Each block consisted of 8 experimental units and treatments were arranged randomly.

The factorial experiment included 2factors as follow:

1. Factor of hybrids (V) which assigned in the main plots.
   V1="Topline F1" V2="Attwood F1"
2. Factor of fertilizers (F) assigned in sub-plots.

F4= Sheep manure 10t.ha^{-1} 3.5 kg.$plot^{-1}$ F0= Control
F5= Sheep manure 20t.ha^{-1} 7.0 kg.$plot^{-1}$ F1=NPK (10-10-5) 450kg.ha^{-1} 157.5g.$plot^{-1}$
F6= Chicken manure 4t.ha^{-1} 1.4 kg.$plot^{-1}$ F2= Cow manure 10t.ha^{-1} 3.5 kg.$plot^{-1}$

F3= Cow manure 20t.ha^{-1} 7.0 kg.plot^{-1} F7=Chicken manure 8t.ha^{-1} 2.8 kg.plot^{-1}

The field was prepared through cultivating by rotivator and the rows were prepared mechanically. An area of 17 m × 12.5 m was divided into two main plots consists three equal blocks (each main plot represents one hybrid), each block was divided into 8 sub-plots represents 8 fertilizers putted at random. There were 48 plots and the size of the each one was 3.5 m × 0.6 m. The distance between two blocks 1.0m and between two plots was 0.4 m. The media which was used for sowing the seeds was prepared previously, containing a mixture of sand and ordinary fine field soil (1:1). Boxes of 30 X 60 X 20 cm were filled with media for seed sowing. Brussels sprouts seeds ("Topline F1" and "Attwood F1".) were sown in a semi-shaded wooden canopy using cooler instruments to obtain temperature about (24-27^{o}C) at 15-8-2014. Seedling emergence occurred 12-16 days after sowing, and the seedling were transferred to the field after (40 days) of seed sowing and having 3-4 leaves. The seedling was planted in one side of the rows (0.6 m widths) at 50 cm distance between the plants with seven plants in each row (plot). Different manures were broadcasted and incorporated into 0-30 cm of soil surface for each plot. The application was performed at 20 days before transplanting of Brussels sprouts plants, while chemical fertilizers were applied after a week from transplanting. Because Brussels sprouts like other brassica crops need more boron, 3 Kg.ha^{-1} (1.05g.plot^{-1}) B (as Borax) was applied to all treatments [25]. Drip irrigation system was used in both seasons. Weeding was repeated manually as required. The results were analyzed statistically and the comparisons among means were carried out by Duncan's multiple range tests (0.05) which analyzed by a computer JMP7 program statistical social science.

The following parameters were taken from three plants (except the yield took from seven plants) and the means were recorded: Plant height (cm), Leaf number, Leaf area (cm^2), Leaf weight (g), Total yield. $Plant^{-1}$(g.), Total yield ($t.ha^{-1}$), harvest (days), bud number, Bud size (cm^3), bud fresh weight (g.), bud dry matter%, Protein%, Vitamin C content ($mg.100g^{-1}$)and Nitrate content in buds ($mg.kg^{-1}$ dry weight).

RESULTS AND DISCUSSIONS

Vegetative growth characteristics, Yield and time to harvest:

Vegetative growth was differed between the two Brussels sprouts hybrids. Data in table (3) shows that leaf $weight.plant^{-1}$ (796.71 g) and leaf area (116.61 cm^2) were recorded by ("Topline-F1"). These results may be due to differences between the hybrids in adaptation to environments and their ontogenetic [22]. The increased in plant height and leaf area and weight as the plant aged revealed the existence of genotypic differences among the hybrids tested. This reconfirmed the report of Abey *et al*. [1] that vegetable crops performance could be linked to both genetic and environmental influences. Results in same table shows that total yield and time to harvest were significantly affected by hybrids. The highest $yield.plant^{-1}$ (197.03 g) and total $yield.ha^{-1}$ (6.504t) obtained from "Topline-F1" cv.. The shortest period to harvest was (161.16 days) for "Attwood-F1". Similar results with other hybrids reported by [7]

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Table 3: Vegetative growth and yield of Brussels sprouts affected by different hybrids

Hybrids	Plant height (cm)	Leaf No. $plant^{-1}$	Leaf weight. $plant^{-1}$ (g)	Leaf area . $plant^{-1}$ (^{cm2})	Total $yield.plant^{-1}$ (g)	Total yield ($t.ha^{-1}$)	harvest (days)
Topline-F1	85.96 a	36.42 a	796.71 a	116.61 a	197.03 a	6.504 a	170.83 b
Attwood-F1	81.33 a	35.58 a	671.38 b	99.63 b	178.15 b	5.879 b	161.16 a

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

Results in table (4) shows that, the highest plant height (89.17 cm) recorded by (sheep manure 20 $t.ha^{-1}$), whereas the highest leaf number (39.67), leaf weight

(842 g) and leaf area (124.74 cm^2) were recorded by (chicken manure 8 $t.ha^{-1}$). Maximum plant yield (292.18 g) and total yield.$ha.^{-1}$ (9.651 t) were obtained from (Cow manure 20$t.ha^{-1}$). In all the parameters, the minimum values were recorded by unfertilized (control) treatment. The higher plant height, leaf weight and leaf area as results of organic fertilizer application may be associated with the fact that organic manures releases considerable amount of nutrients for plant use [14]. Agbede *et al*. [4] reported that organic manure improved soil physical properties by reducing soil bulk density. In a study carried out by Okonwa and Mensah [13], results showed that the poultry manure increased the nutrient content (N, P, K) of the soil and these increased vegetative growth. Our results in harmony with [23] finding on cabbage and [15] and [16] on Broccoli. Data presented in table (4) indicated that application of Cow manure 20$t.ha^{-1}$ increased the yield of Brussels sprouts. The increase in total yield resulting by organic manure may be due to that organic matter enhanced soil aggregation, soil aeration and increasing water holding capacity and offers good environmental conditions for the root system of Brussels sprouts plants [2].This study had also established that inorganic fertilizers and control treatment performed inferiorly as compared to the organic manures in the production of Brussels sprouts can be attributed to the lower esteem in retention of moisture that is exhibited by inorganic fertilizers as reported by [17]. The shortest time to harvest obtained from cow 20$t.ha^{-1}$ and sheep20$t.ha^{-1}$ manure which was (163.50 days) in all cases.

The obtained data in table (5) shows that the interaction of hybrids and fertilizers significantly affected all growth parameters. The highest plant height (91.67 cm) recorded with “Topline-F1” cv. combined with Sheep manure 20$t.ha^{-1}$, while the higher number of leaves (40.33) obtained from “Attwood” cv. combined with chicken manure 8 $t.ha^{-1}$ .Maximum leaf weight (931.67 g) and leaf area (144.16 cm^2) recorded by “Topline-F1” cv. combined with Chicken manure 8$t.ha^{-1}$. Our results agree with [2] finding. Interaction within Brussels sprout hybrids and manures significantly affected total yield and time to harvest. “Topline–F1” cv. Fertilized by Sheep manure 20$t.ha^{-1}$ gave higher yield (321.10$g.plant^{-1}$) and (10.596 $t.ha^{-1}$). The shortest time to harvest (158.33 days) recorded from “Attwood–

F1" cv. Fertilized by Cow manure 20t.ha^{-1} .

Table 4: Vegetative growth and yield of Brussels sprouts affected by different fertilizers

Treat.	Plant height (cm)	Leaf No. plant^{-1}	Leaf weight. plant^{-1} (g)	Leaf area . plant^{-1} (cm^2)	Total yield.plant^{-1} (g)	Total yield(t.ha^{-1})	harvest (days)
Control	70.33 b	26.67 b	594.33 c	78.20 b	103.32 g	3.410 g	171.16 b
NPK	88.50 a	36.33 a	811.50 ab	116.31 ab	133.90 f	4.419 f	166.50 ab
Cow-10	79.83 ab	34.67 ab	637.17 bc	93.87 ab	149.13 e	4.921 e	165.50 a
Cow-20	87.17 ab	38.00 a	753.50 abc	119.52 a	292.18 a	9.651 a	163.50 a
Sheep-10	81.83 ab	37.17 a	696.67 abc	105.79 ab	163.23 d	5.387 d	165.83 a
Sheep-20	89.17 a	39.17 a	816.00 ab	116.20 ab	258.18 b	8.520 b	163.50 a
Chicken-4	84.17 ab	36.33 a	721.17 abc	110.32 ab	167.77 d	5.536 d	166.17 ab
Chicken-8	88.17 ab	39.67 a	842.00 a	124.74 a	233.03 c	7.690 c	165.33 a

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

It is clear from the results mentioned above that the effect of treatment combinations depended on the individual factors, sometimes both have the same and sometimes they have the opposite effects.

Table 5: Vegetative growth and yield of Brussels sprouts affected by fertilizer and hybrid interaction

Treat.	Plant height (cm)	Leaf No. plant^{-1}	Leaf weight. plant^{-1} (g)	Leaf area . plant^{-1} (cm^2)	Total yield.plant^{-1} (g)	Total yield(t.ha^{-1})	harvest (days)
Top X Cont.	73.33 de	26.33 c	648.67 bcd	90.81 ab	107.03 ij	3.532 ij	175.67 f
Top X NPK	90.00 a	37.67 ab	880.00 ab	123.200 a	125.00 hi	4.125 hi	171.33 ef
Top X C10	82.00 cd	33.67 abc	658.67 bcd	92.21 ab	139.93 h	4.618 h	171.00 ef
Top X C20	90.00 a	38.00 ab	814.33 abc	124.82 a	299.17 b	9.889 b	168.67 def
Top X S10	83.33 bcd	35.67 abc	760.33 a-d	110.50 ab	159.03 fg	5.248 fg	170.33 ef
Top X S20	91.67 a	40.00 a	863.33 abc	128.73 a	321.10 a	10.596 a	167.67 cde
Top X Ch 4	86.33 ab	39.00 a	816.67 abc	118.42 ab	205.17 de	6.770 de	171.67 ef
Top X Ch 8	91.00 a	39.00 a	931.67 a	144.16 a	219.83 d	7.255 d	170.33 ef
Att X Cont.	67.33 e	27.00 bc	540.00 d	65.60 b	99.60 j	3.287 j	166.67b cde
Att X NPK	87.00 ab	35.00 abc	743.00 a-d	109.41 ab	142.80 gh	4.713 gh	161.67 a-d
Att X C10	77.67 cde	33.67 abc	752.33 a-d	95.52 ab	158.33 fg	5.225 fg	160.00 ab
Att X C20	84.33 bc	38.00 ab	692.67 a-d	114.21 ab	285.20 b	9.412 b	158.33 a
Att X S10	80.33 cd	38.67 a	633.00 bcd	101.08 ab	167.43 f	5.525 f	161.33 a-d
Att X S20	86.67 ab	38.33 a	768.67 a-d	103.67 ab	195.27 e	6.444 e	159.33 ab
Att X Ch 4	82.00 bcd	33.67 abc	625.67 bcd	102.20 ab	130.37 h	4.302 h	161.67 a-d
Att X Ch 8	85.33 bc	40.33 a	752.33 a-d	105.33 ab	246.23 c	8.126 c	160.33 abc

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

Physical and Chemical properties:

Hybrids has no response regard to physical properties except bud size (table 6).”Topline-F1 was significantly superior and gave maximum bud size (13.29) cm^3.

Differences between hybrids may be due to environmental and genetic factor interaction. Genotype-environmental interactions are extremely important in the development and evaluation of plant hybrids because they reduce the genotypic stability [18].Results given in table (6) reflected significant differences in the amount of Ascorbic acid. On the other hand, bud dry matter%, protein and nitrate content did not reflect significant differences. However the highest amount of Ascorbic acid were (85.78 mg.100g^{-1}) recorded by "Topline-F1" cv.. These results may be referred to the differences in hybrid characters and genetic diversity and it's ontogenetic [3].

Table 6: Physical and chemical properties of Brussels sprouts affected by different hybrids

Hybrids	Bud number	Bud size (cm^3)	Bud fresh weight (g)	Bud dry matter%	Protein %	Ascorbic acid content (mg/100g)	Nitrate ($mg.kg^{-1}$)
Topline-F1	27.67 a	13.29 a	7.15 a	11.20 a	3.87 a	85.78 a	88.92 a
Attwood-F1	27.50 a	12.35 b	6.78 a	11.13 a	3.76 a	84.18 b	78.64 a

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

Data presented in table (7) indicated that application of manure fertilizers significantly affected physical properties. Maximum bud number (38.67), bud size (15.12 cm^3) and bud fresh weight (7.95g) recorded by cow manure 20 $t.ha^{-1}$, chicken manure 8$t.ha^{-1}$ and sheep manure 20$t.ha^{-1}$, respectively. These results might be attributed to that manures provide a source of all necessary macro- and micro nutrients in available forms, thereby improving the physical, chemical and biological properties of the soil [2].

There are significant differences in protein%, Ascorbic acid and nitrate content by using different organic manure treatments. The highest protein% (4.80%and highest nitrate (131.33$mg.kg^{-1}$) obtained from NPK treatment. While, highest Ascorbic acid content (87.92) mg.100g^{-1} were observed in the unfertilized (control) treatment and no

significantly differ from other fertilizers especially NPK and chicken manures because of excess nitrogen contents in these two fertilizers. Zahradnik and Petrikova [28] also obtained the same results who recorded that the unfertilized control had the highest levels of ascorbic acid; it was significantly higher than in case of farmyard manure which, in turn, had significantly higher values than compost. Augustien *et al.* [5] reported that response of Ascorbic acid to nitrogen fertilization can depend on variety. However, nitrogen fertilization has been shown generally to decrease Ascorbic acid values. In contrast, Mondy *et al*. [10] found that Ascorbic acid increased significantly with increasing nitrogen levels. Worthington [27] further stressed that the observed decrease in **vitamin C** content resulted from the increase in protein production and decrease in carbohydrate production following the application of nitrogen fertilizer. Because vitamin C is formed from carbohydrates, its synthesis is also reduced. If there is more nitrogen than the plant can handle through increased protein production, the excess is accumulated as nitrates and stored predominately in the green leafy part of the plant [11]. Because organically managed soils generally present plants with lower amounts of nitrogen than chemically fertilized soils, it would be expected that organic crops would have more vitamin C, less nitrates and less protein but of a higher quality than comparable conventional crops, moreover, the increased protein that is produced in response to high nitrogen levels contains lower amounts of certain essential amino acids such as lysine and consequently has a lower quality in terms of human and animal nutrition [27].

Table 7: Physical and chemical properties of Brussels sprouts affected by different fertilizers

Treatments	Bud number	Bud size (cm^3)	Bud fresh weight (g)	Bud dry matter%	Protein %	Ascorbic acid content (mg/100g)	Nitrate ($mg.kg^{-1}$)
Control	18.33 f	9.53 c	5.64 b	9.80 a	2.91 d	87.92 a	36.88 c
NPK	21.00 ef	11.79 b	6.71 ab	12.24 a	4.80 a	82.15 b	131.33 a
Cow-10	23.83 de	11.75 b	6.37 ab	10.65 a	3.22 d	86.12 a	75.38 bc
Cow-20	38.67 a	14.77 a	7.89 ab	11.50 a	3.57 bcd	86.22 a	72.10 bc
Sheep-10	27.17 cd	12.02 b	6.56 ab	11.54 a	3.34 cd	86.63 a	75.18 bc
Sheep-20	34.83 ab	15.12 a	7.95 a	11.18 a	3.62 bcd	86.47 a	64.30 bc
Chicken-4	27.00 cd	12.71 b	6.82 ab	11.12 a	4.59 ab	82.48 b	111.13 ab
Chicken-8	29.83 bc	14.90 a	7.77 ab	11.32 a	4.50 abc	81.83 b	103.92 ab

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

The interaction effect within Brussels sprouts hybrids and manure fertilizers (table 8) shows significant differences among bud number, bud size, protein, Ascorbic acid and nitrate values. Greatest values in bud number (40) was obtained from combination of "Topline-F1" cv. and Cow manure 20t.ha^{-1}. On the contrary, the lowest bud numbers was (17.33) recorder for unfertilized with "Atwood-F1: cv.. The greatest bud size (16.36) cm^3 were obtained from combination of "Topline-F1" cv. with Sheep manure 20t.ha^{-1}. Maximum values of protein%, Ascorbic acid and nitrate were 4.85%, 88.93 $mg.100g^{-1}$ and 134.00 $mg.kg^{-1}$ obtained from combination of "Topline-F1" cv. with Chicken manure 4t.ha^{-1}, "Topline-F1" cv. with control and "Topline-F1" cv. with NPK fertilizer, respectively. These results show clearly that the treatments of organic manures and hybrids of Brussels sprouts act in cooperating pattern.

Table 8: Physical and chemical properties of Brussels sprouts affected by fertilizer and hybrid interaction

Treatments	Bud number	Bud size (cm^3)	Bud fresh weight (g)	Bud dry matter %	Protein %	Ascorbic acid content (mg/100g)	Nitrate ($mg.kg^{-1}$)
Top X Cont.	19.33 gh	9.67 h	5.50 a	9.45 a	2.86 d	88.93 a	38.13 c
Top X NPK	19.67 fgh	11.80 fg	7.00 a	12.60 a	4.84 a	83.10 de	134.00 a
Top X C10	21.67 fgh	12.04 fg	6.50 a	10.68 a	3.11 bcd	86.87 ab	82.37 ab
Top X C20	40.00 a	15.16 abc	8.10 a	11.43 a	3.52 a-d	87.47 ab	75.53 ab
Top X S10	23.33 e-h	12.20 efg	6.90 a	11.78 a	3.32 a-d	87.13 ab	83.87 ab
Top X S20	39.00 a	16.36 a	8.13 a	11.68 a	3.89 a-d	86.03 bc	70.03 b
Top X Ch 4	30.00 b-e	13.44 def	7.11 a	10.81` a	4.85 a	83.57 cde	117.17 a
Top X Ch 8	27.00 c-f	15.69 ab	7.94 a	11.20 a	4.59 abc	83.13 de	110.27 ab
Att X Cont.	17.33 h	9.39 h	5.77 a	10.16 a	2.96 cd	86.90 ab	35.63 c
Att X NPK	22.33 fgh	11.79fg	6.43 a	11.88 a	4.75 ab	81.20 e	128.67 a
Att X C10	26.00 c-f	11.45 g	6.25 a	10.61 a	3.32 a-d	85.37 bcd	68.40 bc
Att X C20	37.33 ab	14.38 bcd	7.68 a	11.56 a	3.61 a-d	84.97 bcd	68.67 bc
Att X S10	31.00 bcd	11.84 fg	6.54 a	11.30 a	3.36 a-d	87.13 ab	66.50 bc
Att X S20	30.67 b-e	13.88 cde	7.77 a	10.67 a	3.35 a-d	86.90 ab	58.57 bc
Att X Ch 4	24.00 d-g	11.58 fg	6.54 a	11.43 a	4.34 a-d	81.40 e	105.10 ab
Att X Ch 8	32.67 abc	14.11 bcd	7.61 a	11.44 a	4.40 a-d	80.53 e	97.57 ab

Numbers within a column carrying the same letters are not different significantly at Test ($P \leq 0.05$).

Conclusions: Based on the results in our experiment for this environmental, the following conclusions can be drawn: "Topline-F1" cv. gave the higher vegetative growth, bud size, yield and Ascorbic acid content. "Atwood-F1" cv.

took the shorter period to maturity. Different FYM gave higher vegetative growth and increased bud number, bud size, bud weight and yield and shorter time to maturity. The highest level of Ascorbic acid was recorded in the unfertilized control, while the larger levels of protein and nitrate recorded in NPK fertilizer.

R NEFERENCES

1. Abey,L., D.CJoyce, ,J. Akad, and B.Smith (2002).Genotype, sulpher and nutrition and soil types effects on growth and dry matter production of spring onion. J. of Hort. Sci. and Technl. 77: 340-345.
2. Abou El-Maged, M. M., A. M. El-Bassiony and Z. F. Fawzy (2006) "Effect of organic manure with or without chemical fertilizer on growth quality of some varieties of broccoli plants", *J. Appl. Sci. Res* 2(10):791-798.
3. Al-Obadi, H.S.h.(1999).Effects of gibberellin, Cycocyl, potassium nitrate, vernalization and sowing date on yield of Curds and seeds of cauliflower. College of agriculture, University of Baghdad.Ph.D. Dissertation (in Arabic).
4. Agbede, T. M., S. O. Ojeniyi and A. J. Adeyemo (2008) "Effect of poultry manure on soil physical and chemical properties ،growth and grain yield of sorghum in southern Nijeria ,"American-Eurasian Journal of Sustainable Agric. 2:72 – 77.
5. Augustin,J., R.E. McDole, , G.M. McMaster, C.G. Pamter, and W.C. Sparks, (1975). Ascorbic acid content in Russet Burbank potatoes. J. Food Sci. 40: 415-416.
6. Citak,S. and S.Sonmez (2010). Influence of organic and conventional growing conditions on the nutrient contents of white head cabbage (*Brassica oleracea* var. capitata) during two successive seasons,J.Agric.Food Chem. 58:1788-1793.
7. Kurtar, E.S.(2006).The effect of planting times on some vegetable characters and yield components, in Brussels sprouts (*Brassica oleracea* var.gemmifera). Journal of Agronomy, 5:186-190.
8. Levy, J. S. and B. R. Taylor (2003) "Effects of pulp mill solids and three composts on early growth of tomatoes", Bioresource Technology 89(3): 297 – 305.
9. Mirecki, N. (2005). The influence of planting date on the rate of Brussels Sprouts (*Brassica oleracea* var.gemmifera) in Agro-Ecological Conditions of the Zeta Plain. Acta Agriculturae Sebrica Vol. X, 20: 47-57.
10. Mondy, N.I., R.L. Koch, and S. Chandra (1979). Influence of nitrogen fertilization on potato discoloration in relation to chemical composition. 2. Phenol and Ascorbic acid. J.Agric. Food Chem. 27: 418-420.

11. Mozafar A. Nitrogen fertilizers and the amount of vitamins in plants (1993) A review. J Plant Nutr.16: 2479–2506.
12. Njoroge, W.J. and C.Manu (1999). Organic farming. A Textbook for Post. Secondary Education. Kenya Institute of organic farming, Nairobi, Kenya.
13. Okonwu, K. and S. I. Mensah (2012) "Studies on soil amended with poultry manure and its effects on yield and yield components of Pumpkin", *Scientia Africana* 11 (1): 84-91.
14. Olaniyi, J. O. and A. E. Ojetayo (2011) "Effect of fertilizer types on the growth and yield of two cabbage varieties", Journal of Animal & Plant Sciences 12(2): 1573-1582.
15. Omar,S.J.; M.S.Salam, G.K.Luqman, and A.A.Ahmad, 2015). Effect of different fertilizers on growth, yield and chemical component of Broccoli (*Brassica oleracea* var. italica) (CorvetF1).J.Garmyan.Vol.(1):500-512.
16. Omar,S.J. (2010). Effect of planting dates, apical removal, IAA application, Boron fertilizer and growing conditions on the growth and yield of some hybrids of Broccoli (Brassica oleracea var.italica Plenk).Ph.D. Disseration submitted to the college of agriculture. University of Sulaimani. P: 182.
17. Owen,P.2008. Origin and Distribution of lettuce.http://www.ca lettuce research board.org/Origin.html accessed on:(14/02/2010).
18. Pooni,H. and M.Kearsey (2002).Plant quantitative traits. Encyclopedia of life sciences (www.els.net).
19. Rowell,B. and H.Robert.(2016).Organic manures and fertilizers for vegetable crops.University of Kentucky, College of agriculture, Food and Environment. Academic web pages.
20. Stoorvogel, J.J.; E.M.A. Smaling and B.H. janksen(1993). Calculating soil nutrient balaces in Africa at different scales: 1. Supra-national scale. Fert. Res.
21. Subhan. 1988. Effect of organic materials on growth and production of cabbage (*Brassica oleracea* L.). Bull. Peletitian Hort., 16(4): 37--11.
22. Svec,L.V. (1997). Soybean variety selection, Nebraska cooperative Extention. Institute of Agriculture and Natural Resources, University of Nabraska, Lincoln,File G 445: Field crops A.%,Soyabean (C.F. Abdulkaiq, D.A. 2006).
23. Tawfiq,Ch.K.(2014).The effect of application rates of some animal manures on growth, yield and quality of cabbage and spinach in Sulaimani Governorate.A Disseration submitted to the council of the Faculty of Agricultural Science/Univesity of Sulaimani.pp:119.
24. Tindall, M. (20000. Mineral and organic fertilizing in cabbage.

conventional fruits, vegetables and grains. J.Altern.Complement Med. 7: 161-173.

28. Zahradnik , A. and K. Petrikova. (2007). Effect of alternative organic fertilizers on the nutritional value and yield of head cabbage. *Hort. Sci.* (PRAGUE) 34 (2): 65-71

Residual effect for commercial cultivation on yield and quality performance with organic farming. Hort. Bras. 6: 15-20.

25. Turan,M.,N.Ataoglu , A.Gunes and T. Oztas (2009). Yield and chemical composition of Brussels sprout (*Brassica oleracea* var.gemmifera) as affected by boron management. Hort.Science 44 (1): 176-182.

26. Ware,M. and Natalie,B.(2016). Brussels Sprouts: Health benefits and Nutritional Information. http://www.medicalnewstoday.com/articles/284765.php.

27. Worthington,V. (2001). Nutritional quality of organic versus

تاثير الأسمدة العضوية المختلفة في نمو و انتاج و نوعية صنفين من كرنب بروكسـل

(*Brassica oleracea* var. gemmifera L.)

ســامال جلال عمر

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الملخص

انجزت هذه التجربة خلال 2014-2015 في محطة بكرجو للابحاث الزراعية في بكرجو/ السليمانية / العراق لدراسة تاثير الأسمدة العضوية المختلفة (الأبقار 10 و 20 طن. هكتار$^{-1}$ و الأغنام10 و 20 طن. هكتار$^{-1}$ والدواجن 4 و 8 طن. هكتار$^{-1}$) في انتاج ونوعية هجينين من كرنب بروكسل (Topline-F1“) و (”Attwood-F1‘‘) . بينت النتائج بان (Topline-F1“)كان متقدما في طول النبات ووزن الأوراق والمساحة الورقية وحجم البراعم وحاصل االنبات الواحد والحاصل الكلي للهكتار وحامض الأسكوريك. بينما كان للصنف(”Attwood-F1‘‘) اقل فترة للحصاد. اعلى حاصل للنبات والحاصل الكلي للهكتار وعدد البراعم سجلت من سماد الأبقار(20 طنزهكتار$^{-1}$) . بينما اعطى سماد الأغنام (20 طنزهكتار$^{-1}$) اعلى معدلات طول النبات والوزن الطري للبراعم . سجل سماد الدواجن (8 طن. هكتار$^{-1}$) اكبر عدد للاوراق ووزن الأوراق والمساحة الورقية وحجم البرعم . اعطى سماد ال NPK اكبر نسبة للبروتين والنترات ، اما اكبر قيمة لحامض الأسكوربيك سـجلت من نباتات المقارنة. اقصر وقت للحصاد سجلت للسمادين الأبقار و الأغنام (20 طن. هكتار$^{-1}$).

كلمات مفتاحية: كرنب بروكسل ,الهجن، الأسمدة العضوية ,النمو، الأنتاج، البروتين، النترات، حامض الأسكوربيك.