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EFFECT OF NITROGEN SOURCE ON NO_3_N ACCUMULATION, NITRATE REDUCTASE ACTIVITY, GROWTH AND YIELD IN BRASSICA PLANTS

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Abstract

Afield experiment was implemented to evaluate the effect of nitrogen source on growth, NO_3_N Accumulation, nitrate reductase activity and yield in some Brassica plants. split plots experiment in a Randomized Complete Block Design was adopted in three replicates, two kind of Brassica (Cabbage & Cauliflower) as the main plot while fertilizer treatment (control, Humic acid, Bio Horm, Vegeamino, Huxam and Perl humus) the sub plot. Results showed superiority Cabbage plants and Perl humus in leaves number (56.55, 47.84 leaf plant^{-1}) leaf area (104.32, 93.98 dcm^2 plant^{-1}) and Head wright 1103.38, 1114.8 g head^{-1},total yield 65.81, 45.15 ton ha^{-1} respectively, Cauliflower plants increased most plant growth, Cauliflower curds, Perl humus decreased NO_3_N mg g^{-1} dry weight and increased Nitrate Reeducates activity (0.367 NO_3_N mg g^{-1} dry weight, 3.263 µM NO_2 g fresh weight h^{-1}) respectively, Cauliflower plants in Humic acid decreased NO_3_N in edible organ while Cauliflower plants in Perl humus increased Nitrate Reeducates, it was concluded from the research results that Cauliflower plants in Humic acid decreased NO_3 accumulation and enhanced quality characters.

Key words: plant quality, organic fertilizer, Cruciferae, nitrate accumulation

Introduction

Healthy, safe, high quality, free pesticides and chemical fertilizer residuals that's the Organic produce features which reduced nitrate, oxalate and free radical SO_4^{-2}, Cl^{-1} and $H_2PO_4^{-1}$ which remain in safety concentration in conventional agriculture (Al redhaiman and Al Shanaoe 2005), furthermore pesticides residuals increase in edible parts and there is another problem which is NO_3 accumulation, as a potential transformation of nitrate into nitrite, which can interact with hemoglobin and negatively affect blood oxygen transportation (Smith, 1989). Over growth relative to more nutrients exhaustion for vegetables short life cycle, which effect on nutrient soil content, and need more chemical fertilizer especially nitrogen fertilizer, speed nutrient absorption caused dangerous compounds accumulation for human health so many studies focus their on vegetables crop due to daily human food (Brighton, 2001), In harmful industrial organic nutrients for human, animal and plant fewer latest year was used due to its content of amino acids or organic compounds, that's applied with low concentration by spraying or fertigation to grow up plant growth and improvement yield. Albayrak and Cames (2005) indicated that humic acid treatment at 1200ml h^{-1} has shown significant effects on total yield and leaf dry matter for (*Brassica rapa* L.). AL-Zaidi (2016) found increases in vit. C of red cabbage when vegeamino was used, higher vegetative growth for cauliflower and production increased in Organic cultured in comparing to conventionally cultured (Shehata *et al*., 2011).

The objective of this research was to compare the accumulation of NO_3_N and NR activity in the leaves and edible organs of two species of *Brassica* vegetables.

Very important Minimize nitrate accumulate in the edible part of plants for human health, because of the potential transformation of nitrate into nitrite, which can interact with hemoglobin and negatively affect blood oxygen transportation (Herencia *et al*., 2007).

Materials and Methods

A field experiment was carried out at Horticulture Research station in Baghdad University. The soil is classified as silt clay loam (SCL). Six fertilizer treatments were implemented. The fertilizer components which used shown in Table 1. Seeds of Cauliflower (*Brassica oleracea* var. *botrytis*) REMI F1 Hybrid, and Cabbage (*Brassica oleracea* var. *capitata*) RED ROOKIE F1 hybrid, were sown on 15th Aug. 2014 and at 3-4 true leaves stage were translated on 15th Sep 2014 to the field with 0.30m between plants. A factorial experiment (2×6) in a Randomized Complete Block Design was implemented in three replicates (El-Sahookie and Waheeb, 1990)

At harvest, five random plants from the middle row of each plot of each treatment (ten plant) were taken for the measurements, and divided into edible

organ (The head in Cauliflower, and compacted leaves in Cabbage head), Plant height (cm), stem height (cm) and diameter (mm), leaf number, Leaf area dcm^2 $plant^{-1}$, Leaf chlorophyll content (Goodwin, 1975), N%, P%K%, Head wright mg $head^{-1}$, Total yield (Ton ha^{-1}), Vit. C, nitrate reductase (NR) activity assay was measured in Fresh samples of the leaves and the edible organs were kept in a freezer as following of Andrews *et al*. **(1984)** and expressed as µM NO_2 g^{-1} fresh weight (FWt.) h^{-1}, Nitrate content in dried leaves and edible organs samples was measured by the salicylic acid method Cataldo (1975).

Mineral analysis in plant tissue was determined in acid digest according to (Al-Sahaf, 1989). Analysis of variance (ANOVA) completed by using the GenStat. Least significant differences values were at 5% probability level to indicate significant variations between treatments (El-Sahookie and Waheeb, 1990).

Table 1: research treatment

Treatment	components				Dose
Control	-				-
Hummer (UAD)	HUMIC ACIDS**%86**			K_2O**%6**	1g $plant^{-1}$
Hummer	80%	Hummaic acid	6%	Potassium	
Bio Horm (UAD)	Citric + L-Ascorbic and fulvic acid + L free Amino Acids 20%+ Molybdenum 4%				0.5 ml L^{-1}
Vegeamino (Artal company)	Free amino acids: = 24.80% w/v, Total Nitrogen (N): = 4.83% w/v, amino acids: ASP–VAL–GLU(14.0%)–PHE–SER–ILE–GLY–LEU–THR –LYS–ARG–HIS–ALA–PRO–TYR–HYP–MET**)**				2ml L^{-1}
Humax (Biotech company)	**%80**Humic acid				0.5 ml L^{-1}
Perl humus (Humintech)	Humic acid 60%+ P_2O_5 0.1%+ K_2O 0.2%				400kg ha^{-1}

Results and Discussion

The cauliflower plant height increases 42.13 cm $plant^{-1}$ than cabbage plant 25.36, among the six fertilizer treatments, Humax showed statistical differences in plant height 36.15 as compared control 25.83. Cauliflower plants higher height only with Humax fertilizer 45.96 than cabbage plant in control 19.49.

Cauliflower plant and Humic acid treatment was higher in stem height 12.03 and 12.81 cm $stem^{-1}$ respectively as compared with cabbage and control treatment 11.25 and 9.862 cm $stem^{-1}$ respectively, Humic acid in cauliflower increases stem height 13.84 cm $stem^{-1}$ than cabbage control treatment 9.127 cm $stem^{-1}$.

Stem diameter was higher in Cauliflower plant 3.229 mm as compared with Cabbage plant 2.099 mm, Perl humus treatment increases plant stem diameter 2.833mm than control treatment 2.260 mm, cauliflower in Humax treatment was higher in stem diameter 3.440 mm than control cabbage plant 1.720 mm.

Cabbage plant and Perl humus treatment increases leaves number 56.55 and 47.84 leaf $plant^{-1}$ than cauliflower plant and control 27.91 and 33.76 leaf $plant^{-1}$ respectively, higher number of leaves in Cabbage with Perl humus treatment 61.85 leaf $plant^{-1}$ than cauliflower control treatment 18.43 leaf $plant^{-1}$ (Table 2).

Table 2 indicated that cabbage leaf area increases 104.32 dcm^2 $plant^{-1}$ than cauliflower 63.91 dcm^2 $plant^{-1}$, Perl humus fertilizer gave significantly difference of leaf area 93.98 than control treatment 65.66 dcm^2 $plant^{-1}$, cabbage plant in Humic acid treatment were higher leaf area 116.83 dcm^2 $plant^{-1}$ as compared with control treatment cauliflower plant 55.66 dcm^2 $plant^{-1}$.

Cauliflower leaves Chlorophyll content increases 264.9 mg 100g fresh $weight^{-1}$ as compared with cabbage plant 215.5 mg 100g fresh $weight^{-1}$, among the organic fertilizer Perl humus treatment gave the highest leaves Chlorophyll content 271.2 mg 100g fresh $weight^{-1}$ while the lowest chlorophyll content in control 209.0 mg 100g fresh $weight^{-1}$, Humic acid treatment in cauliflower plant gave highest chlorophyll content 323.1 mg 100g fresh $weight^{-1}$ than control cabbage plant 181.8 mg 100g fresh $weight^{-1}$.

Table 2: Effect of nutrient on some Brassica plants growth parameters

Treatment		Plant height cm	stem height cm	stem diameter cm	Leaf number	Leaf area dcm^2 plant^{-1}	Leaf chlorophyll content mg 100g
Type	Cabbage	25.36	11.25	2.099	56.55	104.32	215.5
	Cauliflower	42.13	12.03	3.229	27.91	63.91	264.9
LSD		0.26	0.0608	0.0231	0.608	1.112	4.38
Fertilizer	Con	25.83	9.862	2.260	33.76	65.66	209.0
	Humic acid	34.21	12.81	2.673	40.60	88.75	264.6
	Bio Horm	34.86	11.48	2.643	41.87	82.82	234.7
	Vegeamino	34.71	11.65	2.706	41.74	77.48	228.2
	Humax	36.15	12.17	2.821	45.86	87.62	262.9
	Perl humus	36.04	12.41	2.833	47.84	93.98	271.2
LSD		0.50	0.1137	0.0432	1.137	2.081	8.19
Type*fertilizer							
Cabbage	con	19.49	9.127	1.720	49.08	75.67	181.8
	Humic acid	26.79	11.78	2.060	55.14	116.83	206.2
	Bio Horm	26.30	11.22	2.110	56.08	101.80	222.7
	Vegeamino	24.75	11.21	2.133	56.75	91.47	217.3
	Humax	26.35	12.04	2.203	59.73	107.43	231.8
	Perl humus	27.52	12.22	2.256	61.85	116.53	239.2
Cauliflower	con	32.18	10.59	2.800	18.43	55.66	236.2
	Humic acid	41.62	13.84	3.286	26.07	60.67	323.1
	Bio Horm	43.42	11.75	3.176	27.67	63.83	246.8
	Vegeamino	44.66	12.08	3.280	26.73	63.50	239.2
	Humax	45.96	12.31	3.440	31.99	67.81	294.0
	Perl humus	44.56	12.61	3.410	33.82	71.43	303.2
LSD 5%		0.70	0.1608	0.0612	1.608	2.942	11.58

Level of N in cabbage highest 2.733% than cauliflower 2.263%, Perl humus were the highest among the fertilizer treatment 2.647% and the lowest 2.282% in control treatment, cabbage treated with Humic acid were the highest 2.929% while control cauliflower treatment gave lowest N% at 2.060 (Table 3).

Cabbage plants data showed significant differences in P% (0.531) than cauliflower (0.419%), among fertilizers treatments Perl humus gave the highest P% (0.551) than others, cabbage plants when treated with Perl humus increases P% 0.582 while cauliflower in control gave lowest P% at 0.333%, cauliflower increases leaves K% 3.389 than cabbage 3.237, Perl humus fertilizer treatment gave highest K% 0.551 compared with control 0.408% and cauliflower treated with Perl humus 3.913% than the same plants in control 2.206%.

Increased N, P and K when organic fertilizer was used has been reported (Herencia *et al*., 2007), and levels of these nutrients were elevated in chard (*Beta vulgaris* var. *cicla*) and tomato leaves. Warman (2005) and Herencia *et al.* (2007) reported higher concentration of K in organically produced vegetables (Herencia et al and Warman, 2005). However, others show that application of organic amendment improves soil nutrient content, but does not always increase plant nutrient concentration (Warman, 2005 and Warman and Havard, 1997). Other studies show that the nutrient content in a plant depends on crop type, nutrient type, climate, and year of study (Maqueda *et al*., 2001).

Cabbage Head weight was significantly highest (1103.38 g) than cauliflower (810.1g), Perl humus of all fertilizer was used in experiment the highest Head weight (1114.8g) than control plant (656.3g), cabbage plants treated with Humic acid shows highest head weight (1226.0g) relative to cauliflower curd with control (543.7g). Cabbage plants total yields were greater (65.81ton ha^{-1}) than cauliflower plants(11.93 ton ha^{-1}), Among the six fertilizer treatments showed statistical differences in total yield, Perl humus was highest yield (45.15ton ha^{-1}) as compared with control plant (30.13ton ha^{-1}), cabbage plant treated with Perl humus organic fertilizer highest total yield (76.16 ton ha^{-1})than cauliflower control plant (8.65ton ha^{-1}).

In this research the Perl humus was superior to control plants and produced heavier edible organs, probably due to the high amount of nutrients which favor the availability and uptake of macro and micronutrients by plant roots improving plant growth and yields of the edible organs.

Level of Vit. C increases in cabbage 27.59 mg $100g^{-1}$ fresh weight than cauliflower 20.25 mg $100g^{-1}$ fresh weight, Perl humus treatment shows highest percentage of Vit. C 27.88 mg $100g^{-1}$ fresh weight than control plant 16.42 mg $100g^{-1}$ fresh weight, cabbage plants treated with Humic acid were the highest 30.66 than cauliflower control plants in Vit. C percentage 13.60 mg $100g^{-1}$ fresh weight.

Edible organ of cauliflower decreased the amount of NO_3_N accumulated 0.367 mg g^{-1} dry weight as compared with cabbage 0.685 mg g^{-1} dry weight, among fertilizer treatments, Perl humus decreased NO_3_N accumulated in the edible organ 0.490 mg g^{-1} dry weight as compared with Humic acid which not difference from control plant 0.493 mg g^{-1} dry weight, cauliflower plants treated with Humic acid decreased NO_3_N accumulated 0.321 mg g^{-1} dry weight as compared with cabbage plants in Humic acid and control plants 0.826 and 0.637 mg g^{-1} dry weight,

The distribution may be that edible organ of cauliflower curd (flowers), and (Ali, 1982) mentioned that low concentration of NO_3 accumulate in flowers and fruits.

The differing NO_3 values in the edible portions may be due to the genotype and the different plant tissues.

In this experiment cauliflower had the highest activity whereas cabbage had the lowest NR activity. Perl humus application increased NR activity in the leaves than other treatments, cauliflower where fertilization with Perl humus increased NR activity compared to the cauliflower control plants.

Edible organs usually have higher metabolic activities than other plant organs (strong sinks). Increased NR activity could be one aspect of higher metabolic activity and may be activated by many factors including raised nitrate content of the tissue. Factors that activate NR in plant cells claimed that environmental factors such as light, CO_2, or oxygen availability would rapidly modulate NR activity. Plant development stages could also affect NR activity. The changes in nitrate reduction sites during plant development have been related to the changes in soluble glutamine in the leaves and roots (Camargos *et al*., 2006).

Table 3: Effect of nutrient on some Brassica plants growth parameters and nutrients percentage

Treatment		**N%**	**P%**	**K%**
Type	Cabbage	2.733	0.531	3.237
	Cauliflower	2.263	0.419	3.389
LSD		0.0413	0.0246	0.0323
Fertlizer				
con		2.282	0.408	2.329
Humic acid		2.626	0.538	3.437
Bio Horm		2.440	0.435	3.211
Vegeamino		2.422	0.458	3.448
Humax		2.613	0.480	3.627
Perl humus		2.647	0.551	3.677
LSD		0.0773	0.0461	0.0605
Type*fertilizer				
Cabbage	con	2.505	0.483	2.452
	Humic acid	2.929	0.570	3.481
	Bio Horm	2.662	0.493	3.139
	Vegeamino	2.660	0.547	3.389
	Humax	2.836	0.537	3.451
	Perl humus	2.870	0.582	3.442
Cauliflower	con	2.060	0.333	2.206
	Humic acid	2.323	0.506	3.393
	Bio Horm	2.218	0.376	3.283
	Vegeamino	2.183	0.370	3.506
	Humax	2.390	0.423	3.803
	Perl humus	2.423	0.520	3.913
LSD		0.1094	0.0652	0.0855

Table 4: Effect of nutrient on some Brassica plants yield parameters, NO_3_N in edible organ and Nitrate Reeducates

Treatment		Head wright g head^{-1}	Total yield	VitC mg 100g^{-1} fresh weight	NO_3_N mg g^{-1} dry weight	Nitrate Reeducates µM NO_2 /fresh weight h^{-1}
Type	Cabbage	1103.38	65.81	27.59	0.685	3.118
	Cauliflower	810.1	11.93	20.25	0.367	3.263
LSD		19.76	0.422	0.494	0.0077	0.052
Fertilizer	Con	656.3	30.13	16.42	0.493	0.688
	Humic acid	1049.3	41.82	26.24	0.573	2.362
	Bio Horm	952.7	38.42	23.82	0.519	3.780
	Vegeamino	914.3	36.52	22.86	0.518	3.327
	Humax	1036.3	41.83	25.91	0.529	4.028
	Perl humus	1114.8	45.15	27.88	0.490	4.182
LSD		36.96	0.789	0.924	0.0145	0.098
Cabbage	Con	769.0	51.61	19.23	0.637	0.900
	Humic acid	1226.0	71.81	30.66	0.826	3.103
	Bio Horm	1137.3	65.50	28.44	0.660	3.890
	Vegeamino	1069.3	60.94	26.74	0.686	3.450
	Humax	1180.7	70.38	29.53	0.670	3.460
	Perl humus	1196.3	76.16	29.92	0.575	3.107
Cauliflower	Con	543.7	8.65	13.60	0.349	0.477
	Humic acid	872.7	11.83	21.82	0.321	1.620
	Bio Horm	768.0	11.35	19.20	0.378	3.670
	Vegeamino	759.3	12.09	18.98	0.350	3.203
	amino acids	801.7	12.17	20.04	0.374	4.017
	Humax	892.0	13.28	22.30	0.389	4.597
	Perl humus	1033.3	14.15	25.83	0.406	5.257
	LSD	52.27	1.116	1.307	0.0205	0.1389

References

Al-redhaiman, K.N. and Al-Shanaoe, M.Z. (2005). Organic agriculture introduction, Sientifc series of Saudi agriculture science society, 8th for 5 year, KSA

Albayrak, S. and Camas, N. (2005). Effect of different level and application times of humic acid on root and leaf yield components of forage turnip (*Brassica rapa* L.). Journal of Agronomy 4(2): 130-133.

Ali, N.S. (1982). Effect of nitrogen fertilizer, calcium carbonate, and water regime on yield, chemical composition, and incidence of cavity spot of carrots (*Daucus carota*). Thesis, Lincoln College, University ofCanterbury, New Zealand. 27-36.

Al-Sahaf, F.H. (1989). Applied plant nutrition. Baytol-Hikmah University of Baghdad. Ministry of Higher Education and Scientific research, Baghdad Iraq.

AL-Zaidi, A.K.N. (2016). Effect of adding wheat peat and spraying with its extract on growth and yield of Red Cabbage, Thesis, College of Agriculture at The University of Baghdad. Iraq

Andrews, M.; Sutherland, J.M. and Sprent, J.I. (1984). Nitrate reduction in *Vicia faba* grown at different temperaturers. in World Crop Series vol 10: *Vicia faba*, Agronomy, physiology and Breeding. 10: 29-36.

Brighton, R. (2001). The Quality and Value of Organic Food. Land Heritage, Wellington, Somerset TA 21 9NU.

Camargos LS, Aguiar LF, and Azevedo RA. 2006. Sites of nitrate reduction in Jack bean (*Canavalia ensiformis*) changes from leaf to root during development. NZ. J. of Crop and Hortic. Sci. 34: 131-137.

Cataldo, D.A.; Haroon, M.; Schrader, L.E. and Young, V.L. (1975). Rapid colorimetric determination of nitrate in plant tissue by nitration of salicylic acid. Communications in Soil Science and Plant Analysis, 6 : 71-80.

El-Sahookie, M. and Kareema, M.W. (1990). Application in Experimental Design and Analysis of Agriculture Experiments. Ministry of Higher Education and Scientific research, Iraq.

GenStat. (2007). A guide to ANOVA and Design in GenStat, 10th ed., VSN International Ltd. UK.

Goodwin, T.W. (1976). Chemistry & Biochemistry of Plant Pigment. 2nd Academic. Press. Landon, New York. San Francisco. p 373.

Herencia, J.F.; Ruiz-Porras, J.C.; Melero, S.; Garcia-Galavis, P.A.; Morillo, E. and Maqueda, M. (2007). Comparison between organic and mineral fertilization for soil fertility levels, crop macronutrient concentrations, and yield. Agron. J.99: 973-983.

Maqueda, C.; Ruiz, J.C.; Morillo, E. and Herencia, J.F. (2001). Effect of an organic amendment on nutrient availability and plant contents. 11th Int. Symp. Environmental Pollution and its Impact on Life in Mediterranean Region. Mesaep & Secotox. Proceedings Limasol (Chipre).

Shehata, S.A.; Gharib, A.A.; El-Mogy, M.M.; Gawad, A.; and Shalaby, E.A. (2011). Influence of compost, amino and humic acids on the growth, yield and chemical parameters of strawberries. Journal of Medicinal Plants Research, 5(11): 2304 – 2308.

Smith, S.R. (1989). A comparison of organic and inorganic nitrogen fertilizers: Their nitrate-N and ammonium-N release characteristics and effects on the growth response of lettuce (*Lactca sativa* L. cv. Fortune). Plant and Soil, 115: 135-144.

Warman, P.R. and Havard, K.A. (1997). Yield, vitamin and mineral content of organically and conventionally grow carrots and cabbage. Agri, Ecosys. and Environ. 61:155-162.

Warman, P.R. (2005). Soil fertility, yield, and nutrient contents of vegetable crops after 12 years of compost or fertilizer amendments. Biol. Agri. and Hortic. 23: 85-96.