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RESPONSE OF QUINOA YIELD AND SEED CHEMICAL COMPOSATION TO ORGANIC FERTILIZATION AND NITROGEN LEVELS UNDER El-ARISH REGION

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ABSTRACT

This study has been carried out at the Faculty of Environmental Agricultural Science, Arish University during the two successive growing seasons 2016/2017 and 2017/2018. The investigation aimed to study the effect of four organic fertilization sources on quinoa as follows (control, 4 ton fed^{-1} of chicken manure (CHM), farm yard, compost, all at 10 ton fed^{-1}) also to assess the response of quinoa yield production and chemical composition of seed to chemical fertilization under four levels of N (control (120 kg N ha^{-1}), 150, 200, 250 kg N ha^{-1}) as urea, 46% N and their interaction. The obtained results showed that the highest values of plant height, plant weight, yield weight, 1000 seed weight and harvest index were obtained in both seasons when quinoa was fertilized with chicken manure and 250kg N ha^{-1}. Concerning to chemical composition of seeds, the highest values of moisture, protein, fat and ash were obtained in both seasons when quinoa were fertilized with chicken manure and 250kg N ha^{-1} as urea, while, the highest values of carbohydrate were obtained in both seasons when quinoa were fertilized under control treatments of both organic and N levels in both season.

Key words: Quinoa, chicken manure, organic fertilization, inorganic fertilization, urea, chemical composition.

INTRODUCTION

Chenopodium quinoa, commonly known as quinoa, belongs to the *Chenopodiaceae* family. It is a plant native to the Andes, mainly grown for human consumption. Quinoa has a great plasticity and flexibility. Due to application of organic manure, the seed yield, biological yield, harvest index, 1000-seed weight and chlorophyll content were increased. The superiority of organic manure may be attributed to balanced and gradual release of plant nutrients and increased water holding capacity to support growth **(Mahmud *et al*., 2016)**. Furthermore, chicken manure at the rate of 10 m^3 fed^{-1} was superior for increasing the average values of fat, ash and protein percentage as compared to the control. However, moisture, total carbohydrates decreased significantly with adding organic manure **(Baddour *et al*., 2017)**.

The use of modern commercial fertilizers in agricultural production results in increased crop yields in addition to the effect of better plant nutrition through commercial fertilizers signify themselves not only in increasing yields, but also in an increase in the total biomass production **(Finck, 1982).** Higher nitrogen application significantly increased crude protein and total ash percent **(Ayub *et al*., 2007).** A nitrogen fertilization requirement of quinoa crop is still under study world widely because of variability of ecological conditions. Plant height, seed yield and

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harvest index increased noticeably by increasing nitrogen fertilizer level up to 175 kg N ha^{-1} in both seasons. However increasing nitrogen levels caused a limited but significant decrease in thousand seed weight in both growing season **(Geren, 2015).**

MATERIALS AND METHODS

This study was carried out at the Faculty of Environmental Agricultural Sciences, Arish University during 2016/17-2017/18 seasons. It included 16 treatments which resemble the interaction between four organic fertilizers (control(4 ton fed^{-1} CHM according to **Abdelgadir *et al.* (2016)**, chicken manure, compost, farmyard),which were at 10 ton fed^{-1} and four nitrogen fertilizer levels as follows (control (120), 150, 200, 250 kg N ha^{-1} as urea). Plant received all the proper agricultural procedures for quinoa production according to the estimated recommendations. Treatments were distributed in complete randomized block design in a split plot system. Main plots were devoted to four organic fertilizers and nitrogen fertilizer levels were randomly distributed in sub-plots. Seeds were sown on 15th November. After one month plants were thinned to 5 plant per hill then they singled to one plant after 45 days from planting. Organic fertilizations at the rate of 10 ton fed^{-1} were added during land preparation, nitrogen (Urea, 46% N) levels were added in two equal portions, the first portion was after the second thinning, while, the second was added at the beginning of the emergence of floral siliqua. Soil mechanical and chemical analysis of the experimental soil are shown in Tables 1 and 2.

Organic manure analysis

According to American Public Health Association **(APHA, 1985)**.

Data Recorded

Yield component

At harvest on 22, 25 march , at the first and second season , respectively, 6 plants were pulled up from each sub plot unit and the following characters were recorded: plant dry weight (g), seed weight/plant (g), 1000-seed weight (g) and harvest index (%).

Seed Chemical composition

Moisture content

It was determined by the AOAC 934.06 method **(AOAC, 2000)**.

Protein content

It was determined by using modified Kheldahl method according to **Jackson (1967)**. Protein content was estimated as N content x 6.25.

Crude fat content

It was determined by a Soxhlet extractor (Method No. 930.9) **(AOAC, 2005)**.

Carbohydrates content

It was calculated by difference of total contents from 100.

Statistical Analysis

Data of two seasons were subjected to proper statistical analysis of variance **(Snedecor and Cochran, 1990)** using M-STATC program. Mean values were compared at $P \leq 0.05$ using the multiple range test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Effect of Organic Fertilization on Yield Attribute

As regard to the effect of organic fertilizers, Results in Table 4 show significant effects on all studied traits; viz, plant dry weight, seed weight per plant, weight of 1000 seeds, and harvest index in both seasons.

Table (1): Soil mechanical analysis (Average of the two seasons).

Soil depth (cm)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Soil Texture
0-30	65.1	20.9	2.6	11.4	Sandy loam

Table (2): Initial soil chemical analysis (Average of the two seasons).

Soil depth (cm)	Organic carbon ($g.kg^{-1}$)	pH	EC ($dS\ m^{-1}$)	$CaCO_3$ (%)	Organic matter $g.kg^{-1}$		
0-30	1.09	8.515	1.6	3.89	2.05		
Soluble cations($meq\ l^{-1}$)				Soluble anions($meq\ l^{-1}$)			
K^+	Na^+	Mg^{++}	Ca^{++}	Cl^-	So_4^-	HCO_3^-	CO_3^{-1}
0.47	2.61	2.18	2.6	1.275	20.35	2.305	-

Table (3): Chemical analyses of the used organic manure.

Organic Parameters	(FYM)	(CM)	(CO)	(FYM)	(CM)	(CO)
	First season (2016/2017)			Second season (2017/2018)		
Total nitrogen ($g.kg^{-1}$)	33.7	40.3	16.2	30.6	48.22	31.11
Total phosphor($g.kg^{-1}$)	0.44	0.49	0.30	0.41	0.51	43.56
Total potassium ($g.kg^{-1}$)	20.4	25.7	17.2	18.11	28.99	20.1
Organic carbon ($g.kg^{-1}$)	438	511	220	422	523	433
Organic matter ($g.kg^{-1}$)	741	854	232	756	891	776
C/N Ratio	13	14.6	11.2	14	15.6	14.2

Table (4): Effect of organic fertilizers on yield attributes of quinoa plants during two successive growing seasons (2016 and 2017)

Parameter / Organic fertilizers (10 ton fed^{-1})	Plant dry weight (g)	Seed weight g $plant^{-1}$	Weight of 1000 seed (g)	Harvest index (%)
First season 2016/17				
Control (4 ton fed^{-1})	36.73^{b}	21.15^{c}	3.503^{c}	57.28^{b}
FYM	39.04^{ab}	23.23^{b}	4.038^{ab}	59.00^{b}
Compost	38.32^{a}	23.50^{b}	3.796^{b}	61.04^{a}
CHM	41.58^{a}	26.03^{a}	4.112^{a}	62.32^{a}
Second season 2017/18				
Control (4 ton fed^{-1})	35.40^{d}	20.88^{c}	3.522^{d}	58.68^{b}
FYM	39.56^{b}	24.02^{b}	4.012^{b}	60.45^{b}
Compost	37.20^{c}	23.34^{b}	3.818^{c}	62.44^{a}
CHM	41.45^{a}	26.51^{a}	4.266^{a}	63.72^{a}

The highest values of all traits were recorded with application of chicken manure, while, the lowest values were recorded with control treatment (applying 4 ton ha^{-1} of chicken manure). Results also, cleared that there was no significant difference between application of CHM and compost fertilizers on harvest index in both seasons. It is well known that organic manure improved the structure of the soil and this consequently encourage the plant to have a good growth. Moreover, the slow released nutrients contained in organic manure permit beneficial use of the plants. **Yolcu *et al.* (2010)** reported that manure improves the chemical, physical and biological characteristics of soils and increases the yield and quality of crops. All these reasons resulted in improve plant growth. Such results were illustrated by **Filip and Muller (1984), Kadhim (1986), Borin *et al.* (1987), Moustafa (1994)**, **Onyegbule *et al.* (2014), Arif *et al.* (2014)** and **Mahmud *et al.* (2016).**

Effect of Nitrogen Levels on Yield Attributes

Concerning the effect of nitrogen rates, Results in Table 5 show significant effects for N rates on all studied traits in both season, The highest values of all studied traits were recorded with the level of 250 kg N ha^{-1} followed by the level of 200 kg N ha^{-1}, while, the lowest value was recorded with control treatment. However, there was no significant differences between N levels of 250 or 200 kg N ha^{-1} in both seasons. These increases reflect the importance of nitrogen in accumulating dry matter which in turn enhanced plant vegetative growth which in turn reflected on favorable yield attributes such as weight of seeds per plant and 1000-seed weight **(Shahin *et al.*, 2000; Khan *et al.*, 2002a; Mobasser *et al.*, 2008; Geren 2015; Sabbr *et al.*, 2011).** The dry matter accumulation rate by virtue of increased photosynthetic efficiency can be explained by the fact that the supply of nitrogen enhances the production of leaves, stem small roots and root hairs, which in turn facilitated the high absorbing capacity per unit dry weight. N uptake in response to nitrogen application was in close bearing with the response of total plant dry matter to N nutrient as had been reported by **Hussaini *et al.* (2001)**.

Effect Organic Fertilization on Chemical Composition of Quinoa Seeds

Results in Table 6 clear significant effects for organic fertilizers and nitrogen rates on all studied traits in both seasons. The highest values of moisture were recorded with the application of chicken manure fertilizers followed by FYM; the highest values of protein; fat, and ash were with the application of FYM in both seasons; and the highest values of total carbohydrates were recorded with application of control treatment (4 ton ha^{-1} chicken manure) in both season. The promoting impact of compost on grain quality is mainly attributed to the good supply and positive effect of N-uptake by quinoa which encourages greater uptake of the other available macronutrients. So that, high uptake of nutrient might increase moisture, fat and ash contents in quinoa grain.

Gopinath *et al.* (2008) came to similar explanation, where they reported that, equal available nitrogen supply of manure and mineral fertilizers, as well as higher enzyme activity and available P and K for manure treatment.

Effect of N Levels on Chemical Composition of Seed

Application of 250kg N ha-1 recorded the highest seed content of moisture, protein, fat and ash, while control treatment had the lowest value of total carbohydrates in both seasons. Nitrogen is an integral component of many compounds, including chlorophyll and enzymes and essential for plant growth processes. It is an essential component of amino acids and related

Table (5): Effect of N levels on yield attributes of quinoa plants during two successive growing seasons (2016/2017 and 2017/2018).

Parameter Organic fertilizers (10 ton fed^{-1})	Plant dry weight (g)	Seed weight g plant^{-1}	Weight of 1000 seeds (g)	Harvest index (%)
First season 2016/17				
Control (4 ton fed^{-1})	33.60^{d}	18.70^{d}	3.475^{c}	55.42^{c}
FYM	36.32^{c}	21.82^{c}	3.700^{bc}	59.96^{b}
Compost	40.78^{b}	25.17^{b}	3.907^{b}	61.63^{ab}
CHM	44.97^{a}	28.22^{a}	4.366^{a}	62.68^{a}
Second season 2017/18				
Control (4 ton fed^{-1})	33.10^{d}	18.85^{d}	3.538^{d}	56.82^{c}
FYM	36.15^{c}	22.20^{c}	3.792^{c}	61.36^{b}
Compost	40.59^{b}	25.60^{b}	4.035^{b}	63.03^{ab}
CHM	43.78^{a}	28.08^{a}	4.261^{a}	64.08^{a}

Table (6): Effect of organic fertilizers on seed chemical composition of quinoa plants during two successive growing seasons 2016 and 2017.

Parameters Organic fertilizers (10 ton fed^{-1})	Moisture (%)	Protein (%)	Fat (%)	Total carbohydrates (%)	Ash (%)
First season 2016/17					
Control	7.073^{bc}	13.86^{c}	5.690^{d}	69.46^{a}	3.926^{d}
FYM	7.300^{ab}	15.55^{a}	6.323^{a}	66.36^{c}	4.466^{a}
Compost	7.032^{c}	14.49^{b}	5.930^{c}	68.42^{b}	4.124^{c}
CHM	7.371^{a}	15.46^{a}	6.236^{b}	66.59^{c}	4.352^{b}
Second season 2017/18					
Control	7.210^{c}	15.91^{d}	5.980^{c}	66.59^{a}	4.008^{d}
FYM	7.283^{b}	17.60^{a}	6.570^{a}	63.99^{c}	4.555^{a}
Compost	7.155^{d}	16.51^{c}	6.236^{b}	65.88^{b}	4.213^{c}
CHM	7.480^{a}	17.43^{b}	6.590^{a}	64.04^{c}	4.460^{b}

proteins. Nitrogen is essential for carbohydrate use within plants and stimulates root growth and development as well as the uptake of other nutrients. This element encourages above ground vegetative growth and gives a deep green color to the leaves **(Brady, 1990).**

In the one hand, as nitrogen is the major constituent of protein, increases in N fertilizer application frequently lead to an increase in protein content **(Brennan and Bolland, 2007 a, b)**. These in turn, may refer to the fact that accumulation of fat takes place during the development of storage tissue. Fat increase in quantity and in concentration is probably due to transformation of suger to fat in the seed itself. It's actually suger rather than fat which is translocated in to seed rom leaves **(Deshiri *et al*., 2001).** In the other hand, Regulation of metabolic and developmental processes by sugars also often depends on nitrogen supply, suggesting that the sugar and nitrogen signaling pathways interact **(Paul and Driscoll, 1997; Wingler *et al*., 2004)**. Therefore, the assay of quinoa carbohydrate content may serve to optimize quinoa fertilization technologies.

Present study indicated an increase in total ash percentage with the increase in N-levels which could be due to higher dry matter production in plants that contributed directly or indirectly in biosynthesis of minerals **Safdar (1997).** Similarly, **Ayub *et al*. (2007)** also reported that ash percentage was significantly increased with increase in nitrogen. These results agree with the results obtained by **Sameen *et al*. (2002), Ayub *et al*. (2007), Safina (2010), Makinde *et al*. (2010), El-Bassiouny *et al*. (2014) Oyedeji *et al*. (2014)** and **Baddour *et al*. (2017).**

Effect of the Interaction of Organic Manure Fertilizer and N Rates

Yield components

Results in Tables 8 illustrate significant effects for organic fertilizers on all yield traits in both seasons. The highest values of all studied traits; viz, plant dry weight, seed weight plant^{-1}, weight of 1000 seeds, and harvest index were recorded with application of CHM + 250kg N ha^{-1} followed by CHM +200 kg N ha^{-1} or application of both of compost or FYM + 250kg N ha^{-1} for all studied traits, especially in the first season.

Effect of Nitrogen Levels on Chemical Composition of Seed

Results in Table 9 show significant effect for the interaction between organic fertilizers treatments and N rates treatment on most studied traits, viz; seed moisture the highest content of carbohydrates was recorded with control organic fertilizers with control N rates (120 kg N ha$^{-1)}$ in both seasons.

Table (7): Effect of N levels on seed chemical composition of quinoa plants during two successive growing seasons 2016/17 and 2017/18.

Parameters Nitrogen rates kg ha$^{(-1)}$	Moisture (%)	Protein (%)	Fat (%)	Carbohydrates (%)	Ash (%)
			First season 2016/17		
Control(120)	6.608^{d}	12.68^{d}	5.339^{d}	71.89^{a}	3.483^{d}
150	7.081^{c}	14.51^{c}	5.992^{c}	68.25^{b}	4.165^{c}
200	7.406^{b}	15.82^{b}	6.343^{b}	65.94^{c}	4.490^{b}
250	7.682^{a}	16.34^{a}	6.500^{a}	64.75^{d}	4.730^{a}
			Second season 2017/18		
Control (120)	6.694^{d}	14.65^{d}	5.578^{d}	69.53^{a}	3.551^{d}
150	7.121^{c}	16.64^{c}	6.303^{c}	65.68^{b}	4.254^{c}
200	7.512^{b}	17.86^{b}	6.695^{b}	63.35^{c}	4.582^{b}
250	7.802^{a}	18.29^{a}	6.818^{a}	62.24^{d}	4.849^{a}

Table 8. Effect the interaction of organic fertilizers and N levels on yield attributs of quinoa plants in two successive growing seasons (2016/2017and 2017/2018).

Organic sources	N- levels	Plant dry weight (g)	Seed weight plant^{-1} (g)	Weight of 1000 seeds (g)	Harvest index (%)
		First season (2016/17)			
	Control (120)	30.82^{j}	16.61^{h}	3.173^{h}	53.74^{h}
Control	150	35.08^{hi}	20.03^{f}	3.403^{gh}	56.98^{g}
	200	39.29^{d-f}	22.95^{de}	3.561^{e-g}	58.39^{fg}
	250	41.73^{cd}	25.00^{c}	3.876^{b-d}	60.00^{c-f}
	Control(120)	33.00^{ij}	17.80^{gh}	3.516^{fg}	54.01^{h}
FYM	150	36.03^{gh}	21.53^{e}	3.833^{c-e}	59.59^{d-f}
	200	40.69^{de}	24.76^{c}	4.151^{b}	60.76^{c-e}
	250	46.40^{ab}	28.76^{b}	4.651^{a}	61.82^{bc}
	Control(120)	33.92^{hi}	18.67^{fg}	3.418^{gh}	55.04^{h}
Compost	150	35.49^{hi}	21.82^{e}	3.608^{d-g}	61.49^{cd}
	200	39.43^{d-f}	25.04^{c}	3.998^{b}	63.53^{ab}
	250	44.44^{bc}	28.47^{b}	4.159^{b}	64.10^{a}
CHM	Control(120)	36.68^{f-h}	21.66^{e}	3.794^{c-f}	58.89^{e-g}
	150	38.70^{e-g}	23.9 0^{cd}	3.955^{bc}	61.79^{bc}
	200	43.70^{bc}	27.91^{b}	3.919^{bc}	63.58^{a}
	250	47.27^{a}	30.64^{a}	4.778^{a}	64.79^{a}
		Second season (2017/18)			
	Control(120)	28.84^{k}	15.92^{k}	3.122^{l}	55.14^{h}
	150	33.79^{ij}	19.72^{i}	3.449^{k}	58.38^{g}
Control	200	38.21^{f}	22.85^{g}	3.634^{i}	59.79^{fg}
	250	40.76^{d}	25.02^{ef}	3.881^{g}	61.40^{c-f}
	Control(120)	34.65^{i}	19.21^{ij}	3.671^{i}	55.41^{h}
	150	37.03^{g}	22.59^{g}	3.937^{f}	60.99^{d-f}
FYM	200	41.83^{c}	25.99^{d}	4.116^{d}	62.16^{c-e}
	250	44.75^{b}	28.29^{b}	4.358^{c}	63.22^{bc}
	Control (120)	32.90^{j}	18.57^{j}	3.523^{j}	56.44^{h}
	150	34.51^{i}	21.70^{h}	3.750^{h}	62.89^{cd}
Compost	200	39.54^{e}	25.67^{de}	3.845^{g}	64.93^{ab}
	250	41.84^{c}	27.41^{c}	4.154^{d}	65.50^{a}
	Control(120)	35.99^{h}	21.69^{h}	3.836^{g}	60.29^{e-g}
	150	39.27^{e}	24.80^{f}	4.032^{e}	63.16^{bc}
CHM	200	42.78^{c}	27.91^{bc}	4.544^{b}	65.25^{a}
	250	47.78^{a}	31.63^{a}	4.651^{a}	66.19^{a}

Table (9): Effect the interaction of organic fertilizers and N levels on seed chemical composition of quinoa plants during two successive growing seasons (2016 and 2017).

Organic sources	N- levels	Moisture (%)	Protein (%)	Fat (%)	Carbohydrates (%)	Ash (%)
First season (2016/17)						
Control	Control (120)	6.830^{de}	12.21^{j}	4.973^{k}	72.58^{a}	3.400^{k}
	150	6.960^{c-e}	13.55^{h}	5.683^{g}	70.02^{d}	3.790^{h}
	200	7.050^{cd}	14.44^{g}	6.000^{f}	68.53^{e}	3.983^{g}
	250	7.453^{b}	15.22^{f}	6.103^{e}	66.69^{gh}	4.530^{e}
FYM	Control(120)	6.713^{ef}	13.13^{i}	5.600^{h}	70.91^{c}	3.653^{i}
	150	7.083^{cd}	15.53^{e}	6.307^{d}	66.44^{h}	4.640^{d}
	200	7.530^{b}	16.63^{c}	6.580^{c}	64.52^{j}	4.743^{c}
	250	7.873^{a}	16.90^{b}	6.807^{a}	63.59^{k}	4.827^{b}
Compost	Control(120)	6.350^{g}	12.25^{j}	5.340^{j}	72.70^{a}	3.363^{k}
	150	7.127^{c}	14.44^{g}	5.973^{f}	68.46^{e}	4.000^{g}
	200	7.173^{c}	15.31^{f}	6.110^{e}	66.89^{g}	4.513^{e}
	250	7.480^{b}	15.96^{d}	6.303^{d}	65.63^{i}	4.620^{d}
CHM	Control(120)	6.540^{fg}	13.12^{i}	5.443^{i}	71.38^{b}	3.513^{j}
	150	7.153^{c}	14.52^{g}	6.003^{f}	68.09^{f}	4.230^{f}
	200	7.870^{a}	16.92^{b}	6.683^{b}	63.81^{k}	4.720^{c}
	250	7.920^{a}	17.26^{a}	6.813^{a}	63.07^{l}	4.943^{a}
Second season (2017/18)						
Control	Control (120)	6.917^{g}	14.22^{h}	5.207^{l}	70.22^{a}	3.437^{k}
	150	7.120^{f}	15.75^{f}	5.980^{i}	67.27^{d}	3.880^{h}
	200	7.230^{e}	16.42^{e}	6.333^{g}	65.97^{e}	4.047^{g}
	250	7.573^{c}	17.23^{d}	6.423^{f}	64.10^{g}	4.670^{de}
FYM	Control(120)	6.780^{i}	15.11^{g}	5.753^{j}	68.61^{c}	3.747^{i}
	150	6.833^{h}	17.70^{bc}	6.637^{e}	64.12^{g}	4.710^{d}
	200	7.553^{c}	18.65^{a}	6.903^{d}	62.07^{i}	4.823^{c}
	250	7.967^{b}	18.93^{a}	7.020^{c}	61.14^{j}	4.940^{b}
Compost	Control (120)	6.453^{k}	14.25^{h}	5.623^{k}	70.26^{a}	3.413^{k}
	150	7.270^{de}	16.43^{e}	6.273^{h}	65.94^{e}	4.083^{g}
	200	7.317^{d}	17.42^{cd}	6.443^{f}	64.19^{g}	4.630^{e}
	250	7.580^{c}	17.96^{b}	6.603^{e}	63.14^{h}	4.723^{d}
CHM	Control(120)	6.627^{j}	15.03^{g}	5.730^{j}	69.01^{b}	3.607^{j}
	150	7.260^{e}	16.69^{e}	6.323^{gh}	65.39^{f}	4.343^{f}
	200	7.947^{b}	18.96^{a}	7.100^{b}	61.17^{j}	4.827^{c}
	250	8.087^{a}	19.04^{a}	7.223^{a}	60.58^{k}	5.063^{a}

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استجابة الكينوا للتسميد العضوي ومعدلات النيتروجين تحت ظروف منطقة العريش

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أجريت هذه الدراسة بكلية العلوم الزراعية البيئية، جامعة العريش، مصر خلال الموسمين الزراعيين المتتالين ٢٠١٦-٢٠١٧، ٢٠١٧-٢٠١٨، كان الهدف هو دراسة تأثير أربعة مصادر من التسميد العضوي وهي (كنترول (٤ طن/فدان)، سماد دواجن، سماد بلدي، كومبوست) بمعدل ١٠ طن/فدان والتسميد النيتروجيني باربع معدلات هي كنترول (١٢٠) و١٥٠ و٢٠٠و ٢٥٠ كجم/هكتار) باستخدام سماد يوريا ودراسة التفاعل بين التسميد العضوي والكيماوي علي صفات المحصول ومحتوي البذور من بعض المواد الكيماوية، وكانت أفضل النتائج من (طول النبات ووزن النبات و وزن الألف حبة ووزن محصول النبات ومعامل الحصاد) عند التسميد بسماد الكتكوت مع معدل تسميد نيتروجيني ٢٥٠ كجم نيتروجين/هكتار، وكذلك كانت أعلي نسبه بالبذور (رطوبة ووبروتين ودهن والرماد) كان عند التسميد بسماد الدواجن مع معدل تسميد نيتروجيني ٢٥٠ كجم/هكتار، بينما أعلى القيم المتحصل عليها من الكربوهيدرات كان عند تسميد الكينوا بمعاملة الكنترول في الموسمين.

الكلمات الاسترشادية: الكينوا، الأسمدة الغير العضوية، تسميد عضوي، يوريا، سماد كتكوت، تركيب كميائي.

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