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Effect of Different Nitrogen Levels and Vermicompost on Cabbage (*Brassica oleraceae* var. capitata L.) Growing in Rice Straw under Greenhouse Conditions

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ABSTRACT

The current study was carried out during two seasons in 2012/2013 and 2013/2014 at the experimental site of Central Laboratory for Agricultural Climate, Agricultural Research Center, Egypt. The experiment aims to evaluate the ability of using rice straw as growing media, different levels of nitrogen and vermicompost on vegetative growth and quality of cabbage (*Brassica oleraceae* var. capitata L.) cv. OS Cross. The experimental design was a split-split plot design with three replications. The first factor was four growing media comber to control soil (old rice straw, 50% old + 50% new rice straw, new rice straw and bale rice straw), the second factor was three different nitrogen levels (10, 12 and 14 g N/plant) and the third factor was three vermicopmost addition time (30 and 60 days after transplanting and without addition). The obtained results showed that the highest significant values of vegetative growth and head cabbage quality dry weight obtained in plants grown in soil followed by old straw without significant differences between them while, the lowest value was recorded in bale straw. Increasing nitrogen levels and vermicompost addition times led to increase all vegetative growth, head quality, dry weight and NPK content in head cabbage. The highest plant parameters recorded in plants grown in soil received 14 g N/plant and vermicompost at two times (400 cm^3). Whereas, the lowest values obtained in plants grown in bale straw received 10 g N/plant without vermicopmpot addition in both growing seasons. It can concluded that using the old straw to cultivate cabbage due to the same vegetative growth and head cabbage quality that obtained in plants grown in soil without significant differences and the Increasing of nitrogen levels and vermicompost addition times led to increase all vegetative growth, head quality, dry weight and NPK content in head cabbage.

Keywords: Cabbage, Rice straw, Nitrogen and Vermicompost

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INTRODUCTION

Rice is the world's second largest cereal crop after wheat cultivated in approximately 1.1 million feddans (462000 hectares) [1]. However; it produces large amounts of crop residues. Only about 20% of rice straw was used for purposes such as ethanol, paper, fertilizers and fodders [2]. The remaining amount is either removed from the field, in situ burned, piled or spread in the field, incorporated in the soil, or used as mulch for the following crop. Burning cause air pollution called the "Black Cloud" [3]. Rice residues are important natural resources, and recycling of these residues improves the soil physical, chemical and biological properties. However, [4] studied the effect of using rice straw bales as a medium for cultivation of pepper cv. 4408 F_1 hybrid on disease infection by root pathogens in two locations (El-Ismailia and Abo-Swear), under plastic greenhouse. Pepper grown in rice bales showed better growth and increased fruit number and weight compared with those grown in soil. Considerable efforts were therefore made by the public authorities to explore opportunities for the use of rice straw residues as livestock feed, for the production of compost, paper production and manufacturing and energy [5]. Effective management of post-harvest rice straw is perhaps the biggest challenge facing intensive rice production in Egypt. Rice residues contain large quantities of silica and burning is the most cost-effective and the predominant method of disposal in areas under combined harvest [6]. Moreover, [7] studied the effect of inter planting system between cabbage and mushroom in rice straw and cotton waste substrate on the head quality of cabbage cv. Balady . It was found that the inter planting system achieved a much larger cabbage yield than sole especially in plots with rice straw substrate which increased cabbage head yield by about 21.8% compared with the sole crop.

Vermicomposting is a simple-technology, environmentally-friendly process used to treat organic waste. Vermicompost an organic source of plant nutrients contains a higher percentage of nutrients necessary for plant growth in readily available forms [8]. Vermicompost is rich in organic matter resources that have the unique ability to improve the chemical, physical, and biological characteristics of soils or growing media [9] Vermicompost may also increase the nutritional quality of some vegetable crops such as tomatoes [10], Chinese cabbage [11], spinach [12] and lettuce [13].

Nitrogen (N) is an essential element obtained from the soil. Nitrogen is classified as a macronutrient because of its high concentration (1.5 ppm dry matter concentration) in plant leaves, stems, and roots compared to other essential mineral elements [14]. Nitrogen is taken up by plants in two different forms; nitrate (NO_{-3}) or ammonium (NH^{+4}) ions with nitrate being the most common form [15]. From a biochemical perspective nitrogen is a critical constituent in nucleotides and proteins [16]. The application of nitrogen to increase yield in leafy vegetables is a well-recognized practice. It is known that nitrogen deficiency exerts its effects on plant growth through reduced leaf area index and hence low light interception and low dry matter production [17]. Also, the leaf nitrogen content correlates well with the leaf chlorophyll content, hence N deficiency leads to reduced photosynthesis resulting in lower biomass accumulation [18]. Nitrogen has been reported to have a tremendous effect on leaf growth and yields [19]. Therefore, the study aimed to evaluate the rice straw as agriculture media, different nitrogen levels and vermicompost on quality and vegetative growth of cabbage under greenhouse conditions.

MATERIALS AND METHODS

The current study was carried out during two successive seasons in 2012-2013 and 2013-2014 at the experimental site of Central Laboratory for Agricultural Climate (CLAC), Dokki location the altitude, latitude and longitude 30.00 N and 31.140 °E, respectively, Agricultural Research Center, Giza governorate, Egypt.

Greenhouse preparation

The experiment was conducted in single tunnel greenhouses, 60 m long and nine meter wide with three meter height. The total area of the greenhouse was 540 m^2 was covered by awhite screen net. The experimental greenhouse was divided into five ridges separated by pathway 0.60m wide. Each ridge was 1m wide and 60 meters long. Four ridges were dug to create ditches for rice straw treatments. The ditch was 0.5 m depth, 1 m width and 60 meters long. All of the four ditches have been covered withblack plastic mulch with thickness of 40 microns. Black plastic was perforated for drainage irrigation water before placing rice straw treatments.

The fifth part of the green house was bare soil (control) to compare by the rice straw growing media. The soil prepared by turning and plow to allow for excellent development of the root system. It was used raised beds which ensure less compaction and raised bed was1m width, 60m length and 0.2m height.

A mix of organic and inorganic fertilizers was added to all treatments, two weeks before transplanting, as starter fertilizer. Plants of cabbage (*Brassica oleraceae* var. capitata L.) cv. OS Cross 40 days old were transplanted on 15 October in both seasons. The distance between plants was 0.5 m for cabbage.

Treatments

The experimental was content three factors four growing media (old rice straw, 50% old + 50% new rice straw, new rice straw and bale rice straw) and normal soil as control), three different nitrogen levels (10, 12 and 14 g N/plant) and three vermicopmost addition time (30 and 60 days after transplanting and without addition)

Bale straw dimensions were (1 m length, 0.9 m width and 0.5 m depth). Old rice straw produced from the previous cultivation which cultivated 6 months before, new rice straw produced from the field, mixture (50% new rice straw+50% old rice straw and soil (control). The dose of vermicompost was 200 cm^3 for each plant of cabbage.

The characteristics of the rice straw media as shown in Table (1), while Table (2) showing the physical and chemical properties of vermicompost

Table (1): characteristics of the rice straw media

Characteristic Rice straw	
Moisture content (%)	8.90
Organic matter (%)	80.25
Organic Carbon (%)	77.56
Total N (%)	0.76
Total P (%)	0.63
Total K (%)	0.42
Ash (%)	12.3
C/N ratio	1: 166

Tables (2): The physical and chemical properties of vermicompost

Analysis	UNITS	*T.P.S	Analysis	UNITS	*T.P.S
Bulk Density	Kg/m^3	715	P	%	1.27
Organic Matter	%	33.22	K	%	0.59
C/N ratio		1:12.27	Fe	ppm	802
pH		8.17	Mn	ppm	143
EC	dS/m	6.67	Zn	ppm	37.0
Total N	%	1.57	Cu	ppm	14.0
NH_4	ppm	65	Pb	ppm	9.0
NH_3	ppm	81	Cd	ppm	n.d.

*(T.P.S.): Total Pore Space

Plant measurements:

Plants were determined in a split split plot design. Three plants were randomly chosen from each replicate for determining plant and head characteristics vegetative growth (plant height, leaf area (cm^2), head characteristics (head diameter and weight) and chemical characteristics (dry weight, N, P and K). Total nitrogen was determined as mg/100g dry weight by using micro-Kjeldahl method as described by [20], total phosphorus was determined colorimetrically as mg/100g dry weight using the hydrocarbonand sodium sulphite method [21] and total potassium was determined as mg/100g dry weight using flame photometer according to [22].

Statistical analysis:

The experiment was laid out in split- split plot design with three replications, where rice straw (growing media) was distributed in the main plot, nitrogen levels allocated in sub plots and vermicompost rates as sub-sub plots. Analysis of data was done Statistix-8, to calculate the analysis of variance (ANOVA). The differences among means for all traits were tested for significance at the5% level according to [23].

RESULTS AND DISCUSSION

Cabbage vegetative growth

Effects of different growing media, nitrogen levels and vermicompost addition time on cabbage vegetative growth were presented in Tables (3 and 4). Concerning the effect of growing media, it was found that, the highest vegetative growth values we rerecorded in cabbage plant grown in soil followed by old straw media without significant differences between them, while the lowest values were obtained in plants grown in bale straw in both growing season. Obtained results are in agreement with [24] who reported that chopped rice straw consists of high nutritional value. [4] mentioned that, rice straw bales could be used as a growing media for cultivation vegetable crops instead of soil. Regarding to nitrogen levels effect, the results exhibit a significant increase in cabbage vegetative growth as nitrogen levels increased. The highest significant values obtained in plants received 14 g N/plant. While, the lowest cabbage vegetative growth was found on cabbage plants received 10 g N/plant in both two seasons.

The improvement of vegetative growth with increase in nitrogen levels may be attributed to increased uptake of nitrogen and its associated role in chlorophyll synthesis and hence the process of photosynthesis and carbon dioxide assimilation [25]. These results agree with those of [26-27-28].

Concerning the effect of vermicompost addition time, it was found that the highest significant cabbage vegetative growth recorded in plants treated vermicompost at two times. Whereas, the lowest values recorded in control plants (without vermicompost addition) this results were found in the two seasons.The enhancement of plant growth by vermicompost may due to its content of biologically active plant growth-influencing substances [29]. Results were in agreement with [30-31] who reported that add 30% compost to rice straw results the highest significant plant height of eggplant.

Referring the interaction effect between growing media, nitrogen levels and vermicompostaddition time, data indicate significant differences. However, the highest significant value of cabbage vegetative growth was noticed in cabbage plants grown in soil fertilized with 14 g N/plant and applied vermicompost at two times. On the contrary the lowest value resulted from plant grown in bale straw with 10 g N/plant without vermicopmpst addition (control) in both two growing seasons.

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Table (3): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage plant height (cm) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	37^{i}	39^{h}	40^{g}	**39^{C}**	43^{i}	43^{h}	44^{g}	**43^{C}**
	N1	41^{f}	42^{e}	43^{d}	**42^{B}**	45^{f}	46^{e}	47^{d}	**46^{B}**
	N2	44^{c}	46^{b}	47^{a}	**46^{A}**	47^{c}	49 ^{b}	50^{a}	**49^{A}**
Mean		**41^{C}**	**42^{B}**	**43^{A}**		**45^{C}**	**46^{B}**	**47^{A}**	
Soil	N0	41^{m}	42^{j}	43^{g}	**42^{C}**	46j	47^{i}	48^{h}	**47^{D}**
	N1	45^{f}	46^{e}	47^{d}	**46^{B}**	49 ^{g}	50 ^{e}	51^{d}	**50^{B}**
	N2	48^{c}	50^{b}	51^{a}	**50^{A}**	51^{c}	53^{b}	55^{a}	**53^{A}**
Mean		**44^{C}**	**46^{B}**	**47^{A}**	**46^{A}**	**49^{C}**	**50^{B}**	**51^{A}**	**50^{A}**
Bale straw	N0	34^{v}	35^{u}	36 ^{t}	**35^{J}**	38 ^{v}	39^{u}	40^{t}	**39^{J}**
	N1	36^{s}	38^{qr}	39^{o}	**38^{H}**	41^{s}	41^{r}	43 ^{p}	**42^{H}**
	N2	41^{m}	42^{jk}	43^{h}	**42^{E}**	43^{o}	44^{mn}	45^{k}	**44^{F}**
Mean		**37^{K}**	**38^{J}**	**39^{I}**	**38^{D}**	**41^{L}**	**42^{K}**	**43^{I}**	**42^{D}**
Old straw	N0	40^{n}	42^{j}	$43g^{h}$	**42^{E}**	46^{j}	47^{i}	48^{h}	**47^{D}**
	N1	44^{f}	46^{e}	47^{d}	**46^{H}**	49^{g}	50^{ef}	51^{d}	**50^{B}**
	N2	48^{c}	50^{b}	51^{a}	**50^{A}**	51^{c}	53^{b}	54^{a}	**53^{A}**
Mean		**44^{C}**	**46^{B}**	**47^{A}**	**46^{A}**	**49^{C}**	**50^{B}**	**51^{A}**	**50^{A}**
50% new straw 50%oldd straw	N0	40^{o}	41^{m}	42^{j}	**38^{D}**	42^{q}	43^{o}	44^{mn}	**43^{G}**
	N1	42^{jk}	43^{h}	44^{f}	**41^{F}**	45^{l}	46^{k}	46 ^{j}	**46^{E}**
	N2	44^{lm}	45^{k}	46^{j}	**45^{C}**	47^{i}	48^{h}	49^{f}	**48^{C}**
Mean		**42^{F}**	**43^{E}**	**44^{D}**	**41^{B}**	**45^{F}**	**46^{E}**	**47^{D}**	**46^{B}**
New straw	N0	37^{r}	38^{q}	39^{o}	**41^{I}**	40^{t}	41^{s}	42^{qr}	**41^{I}**
	N1	40^{op}	42^{kl}	42^{i}	**43^{G}**	42p	43o	44^{n}	**43^{G}**
	N2	43^{hi}	45^{ef}	46^{e}	**45^{E}**	44^{lm}	45^{k}	46 ^{j}	**45^{E}**
Mean		**40^{H}**	**42^{G}**	**42^{F}**	**43^{C}**	**42^{J}**	**43^{H}**	**44^{G}**	**43^{C}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (4): effect of growing media, nitrogen levels and vermicompost and their integration on cabbage leafarea (cm2) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	408^{i}	416^{h}	423^{g}	**415^{C}**	451^{i}	458^{h}	466^{g}	**459^{C}**
	N1	429^{f}	434^{e}	443^{d}	**435^{B}**	470^{f}	476^{e}	485^{d}	**477^{B}**
	N2	448^{c}	453^{b}	459^{a}	**453^{A}**	492^{c}	498^{b}	502^{a}	**497^{A}**
Mean		**428^{C}**	**434^{B}**	**441^{A}**		**471^{C}**	**477^{B}**	**484^{A}**	
Soil	N0	449^{kl}	454^{ij}	460^{h}	**455^{C}**	464^{q-s}	472 ^{no}	481^{kl}	**472^{E}**
	N1	465^{fg}	471^{e}	477^{d}	**471^{B}**	485i^{-k}	492 ^{g}	503^{e}	**494^{C}**
	N2	483 ^{c}	489^{b}	496^{a}	**489^{A}**	513^{d}	524^{bc}	530^{a}	**522^{A}**
Mean		**466^{C}**	**472^{B}**	**478^{A}**	**472^{A}**	**487^{cd}**	**496^{b}**	**505^{a}**	**496^{A}**
Bale straw	N0	366^{b}	371^{a}	378^{z}	**372^{J}**	436^{a}	438 ^{za}	440^{y-a}	**438^{J}**
	N1	383^{xy}	386^{wx}	390^{vw}	**386^{I}**	441^{yz}	444 ^{xy}	450^{vw}	**445^{I}**
	N2	394^{uv}	398^{tu}	401^{t}	**398^{G}**	455^{uv}	459 $^{s-u}$	465^{qr}	**459^{H}**
Mean		**381^{K}**	**385^{J}**	**390^{I}**	**385^{D}**	**444^{I}**	**447^{I}**	**452^{H}**	**447^{D}**
Old straw	N0	448^{l}	453^{jk}	459^{hj}	**453^{C}**	461^{r-t}	470 $^{n-p}$	479^{lm}	**470^{EF}**
	N1	464^{gh}	470^{ef}	476^{d}	**470B**	483^{j-l}	488 $^{h-j}$	499^{ef}	**490^{CD}**
	N2	482^{c}	488^{b}	492^{ab}	**488A**	511^{d}	521^{c}	527^{ab}	**520^{A}**
Mean		**465^{C}**	**470^{B}**	**476^{A}**	**470^{A}**	**485^{D}**	**493^{B}**	**502^{A}**	**493^{A}**
50% new straw 50%oldd straw	N0	396^{u}	406^{s}	415^{r}	**406^{F}**	456^{tu}	465^{p-r}	474^{mn}	**465^{G}**
	N1	422^{q}	434o^{p}	445^{lm}	**434^{D}**	482^{kl}	488^{h-j}	492^{gh}	**487^{D}**
	N2	449 ^{kl}	455^{ij}	464^{gh}	**456^{C}**	495^{fg}	498^{ef}	501^{e}	**498^{B}**
Mean		**422^{F}**	**431^{E}**	**441^{D}**	**432^{B}**	**478^{E}**	**484^{D}**	**489^{C}**	**483^{B}**
New straw	N0	380^{yz}	393^{uv}	401^{t}	**391^{H}**	439^{y-a}	447^{wx}	456^{tu}	**448^{I}**
	N1	408^{s}	408^{s}	424^{q}	**413^{E}**	460^{r-u}	467^{o-q}	479^{l}	**469^{F}**
	N2	431^{p}	437no	44^{mn}	**436^{D}**	487^{h-k}	488^{h-j}	489^{hi}	**488^{D}**
Mean		**406^{H}**	**413^{G}**	**422^{F}**	**414^{C}**	**462^{G}**	**467^{F}**	**475^{E}**	**468^{C}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

Head cabbage quality

The effected of growing media, nitrogen levels and vermicompost addition time and their interaction on the head cabbage diameter and yield are shown in Tables (5 and 6). Concerning the effect of growing media on head diameter and yield, the obtained results showed that, the highest values of head diameter and yield of cabbage plants recorded in plants grown in soil conditions followed by old straw treatment. While, the lowest value of head diameter and yield were recorded in plants grown in bale straw in both two seasons. These results may be due to the ability of small size straw media to save the water and nutrient solution for plant uptake for long period than the big size or impact of straw (bale straw**)** [30].

Regarding the effect of nitrogen levels on head cabbage diameter and yield, data revealed that, the highest value of head cabbage diameter and yield was obtained from plants treated with 14 g N/plant. While, the lowest value recorded in plants received 10 g N/plant in both growing seasons. The obtained results agree with **[32-33]** they stated that, increasing nitrogen levels 150, 250 and 350 kg N/ halead to significantly increased head cabbage diameter and yield.

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Table (5): effect of growing media, nitrogen levels and vermicompost and their interaction on head cabbage diameter (cm) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	20.6^{i}	21.0^{h}	21.5^{g}	**21.0^{C}**	23.2 ^{i}	23.3^{h}	23.5^{g}	**23.3^{C}**
	N1	22.1^{f}	22.7^{e}	23.2^{d}	**22.7^{B}**	23.6 ^{f}	23.8^{e}	24.0^{d}	**23.8^{B}**
	N2	23.7^{c}	24.1^{b}	24.8^{a}	**24.2^{A}**	24.1 ^{c}	24.3 ^{b}	24.4^{a}	**24.3^{A}**
Mean		**22.1^{C}**	**22.6^{B}**	**23.2^{A}**		**23.6^{C}**	**23.8^{B}**	**24^{A}**	
Soil	N0	22.2^{l}	22.8^{ij}	23.3^{h}	**22.8^{D}**	24.4 ^{j}	24.6^{h}	24.8^{g}	**24.6^{C}**
	N1	24.2^{f}	25.0^{e}	25.5 ^{d}	**24.9^{B}**	25.0^{f}	25.1^{e}	25.3^{d}	**25.1^{B}**
	N2	26.0^{c}	26.3 ^{b}	27.2 ^{a}	**26.5^{A}**	25.5 ^{c}	25.6^{b}	25.8^{a}	**25.6^{A}**
Mean		**24.1^{C}**	**24.7^{B}**	**25.3^{A}**	**24.7 ^{A}**	**25^{C}**	**25.1^{B}**	**25.3^{A}**	**25.1^{A}**
Bale straw	N0	18.9^{w}	19.4^{v}	19.6^{tu}	**19.3^{J}**	22.1^{c}	22.3^{b}	22.4^{za}	**22.2^{K}**
	N1	20.0^{s}	20.4^{r}	21.0^{p}	**20.5^{H}**	22.5^{xy}	22.6^{w}	22.8^{uv}	**22.6^{I}**
	N2	21.6^{o}	21.9^{n}	22.6^{jk}	**22.0^{F}**	22.9st	23.0^{r}	23.2^{pq}	**23.0^{G}**
Mean		**20.2 ^{K}**	**20.6^{J}**	**21.1^{H}**	**20.6^{D}**	**22.5^{J}**	**22.6^{I}**	**22.8^{H}**	**22.6^{D}**
Old straw	N0	22.2^{m}	22.7^{i-k}	23.3^{h}	**22.7^{D}**	24.4^{j}	24.6^{i}	24.8^{g}	**24.6^{C}**
	N1	24.2^{f}	24.9 ^{e}	25.4^{d}	**24.8^{B}**	24.9^{f}	25.1^{e}	25.3^{d}	**25.1B**
	N2	25.9^{c}	26.3^{b}	27.2^{a}	**26.5^{A}**	25.4^{c}	25.6^{b}	25.7^{a}	**25.6A**
Mean		**24.1^{C}**	**24.62^{B}**	**25.3^{A}**	**24.7^{A}**	**24.9^{C}**	**25.1^{B}**	**25.3^{A}**	**25.1^{A}**
50% new straw 50%oldd straw	N0	20.1^{s}	20.6^{qr}	21.1^{p}	**20.6^{H}**	22.5 ^{x}	22.7^{w}	22.8^{tu}	**22.7^{I}**
	N1	21.4^{o}	22.0 ^{mn}	22.6^{jk}	**22.0^{F}**	22.98^{rs}	23.2^{p}	23.4^{n}	**23.2^{F}**
	N2	22.9^{i}	23.26^{h}	23.6^{g}	**23.3^{C}**	23.6^{m}	23.8^{l}	23.9^{k}	**23.8^{D}**
Mean		**21.5^{G}**	**21.6^{E}**	**22.4^{D}**	**22^{B}**	**23.1^{F}**	**23.2^{E}**	**23.4^{D}**	**23.2^{B}**
New straw	N0	19.4^{uv}	19.8^{t}	20.2^{s}	**19.8^{J}**	22.3^{ab}	22.4^{yz}	22.5^{x}	**22.4^{J}**
	N1	20.7^{q}	21.2 ^{p}	21.6^{o}	**21.2G**	22.7^{vw}	22.9 t	23.1^{q}	**22.9^{H}**
	N2	22^{l-n}	22.6 ^{k}	23.2^{h}	**22.6E**	23.2^{p}	23.3^{o}	23.5^{n}	**23.3^{E}**
Mean		**20.7^{I}**	**21.2^{H}**	**21.7^{F}**	**21.2^{C}**	**22.7^{H}**	**22.9^{G}**	**23.0^{F}**	**22.9^{C}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (6): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage yield (kg/m²) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	3.7^{i}	3.8^{h}	3.9^{g}	**3.8^{C}**	4.0^{i}	4.1^{h}	4.2^{g}	**4.1^{C}**
	N1	4.0^{f}	4.1^{e}	4.2^{d}	**4.1^{B}**	4.3^{f}	4.4^{e}	4.5^{d}	**4.4^{B}**
	N2	4.3^{c}	4.4^{b}	4.4^{a}	**4.4^{A}**	4.5^{c}	4.6^{b}	4.7^{a}	**4.6^{A}**
Mean		**4.0^{C}**	**4.1^{B}**	**4.2^{A}**		**4.3^{C}**	**4.4^{B}**	**4.5^{A}**	
Soil	N0	4.1^{lm}	4.1^{ij}	4.3^{gh}	**4.2^{D}**	4.4^{kl}	4.5^{ij}	4.6^{gh}	**4.5^{D}**
	N1	4.3^{f}	4.4^{e}	4.6^{d}	**4.5^{B}**	4.7^{fg}	4.8^{e}	4.9^{cd}	**4.8^{B}**
	N2	4.7^{c}	4.8^{b}	4.9^{a}	**4.8^{A}**	4.9^{c}	5.1b	5.2^{a}	**5.1^{A}**
Mean		**4.4^{C}**	**4.5^{B}**	**4.6^{A}**	**4.5^{A}**	**4.7^{C}**	**4.8^{B}**	**4.9^{A}**	**4.8^{A}**
Bale straw	N0	3.3 ^{a}	3.3 ^{a}	3.4^{z}	**3.3^{J}**	3.6^{v}	3.7^{u}	3.7^{t}	**3.7^{J}**
	N1	3.5 ^{y}	3.6 ^{x}	3.7^{w}	**3.6^{I}**	3.8^{t}	3.8^{rs}	4.0^{q}	**3.9^{I}**
	N2	3.7 ^{uv}	3.8 st	3.9^{p-r}	**3.8^{H}**	4.0^{q}	4.0^{p}	4.1^{o}	**4.0^{G}**
Mean		**3.5^{K}**	**3.6^{J}**	**3.6^{I}**	**3.6^{D}**	**3.8^{L}**	**3.8^{K}**	**3.9^{J}**	**3.9^{D}**
Old straw	N0	4.0^{mn}	4.1 ^{jk}	4.2^{hi}	**4.1^{DE}**	4.3^{lm}	4.5^{j}	4.6^{hi}	**4.5^{D}**
	N1	4.3 ^{fg}	4.4 ^{e}	4.5^{d}	**4.4^{B}**	4.6^{g}	4.8^{e}	4.9^{d}	**4.7^{B}**
	N2	4.6 ^{c}	4.7 ^{b}	4.9^{a}	**4.7^{A}**	4.9^{c}	5.0^{b}	5.2^{a}	**5.0^{A}**
Mean		**4.3^{C}**	**4.4^{B}**	**4.6^{A}**	**4.4^{A}**	**4.6^{C}**	**4.7^{B}**	**4.9^{A}**	**4.7^{A}**
50% new straw 50%oldd straw	N0	3.8 ^{tu}	3.8 ^{rs}	3.9^{pq}	**3.8^{GH}**	4.0^{p}	4.1^{o}	4.2^{n}	**4.1^{F}**
	N1	3.9 ^{op}	4.0^{mn}	4.1^{jk}	**4.0^{F}**	4.3^{mn}	4.4^{kl}	4.5^{j}	**4.4^{E}**
	N2	4.2 ^{i}	4.3 ^{f}	4.4^{e}	**4.3^{C}**	4.5^{i}	4.6^{gh}	4.7^{f}	**4.6^{C}**
Mean		**4.0^{F}**	**4.1^{E}**	**4.2^{D}**	**4.1^{B}**	**4.3^{F}**	**4.4^{E}**	**4.5^{D}**	**4.4^{B}**
New straw	N0	3.5 ^{y}	3.6 ^{x}	3.7^{vw}	**3.6^{I}**	3.9^{r}	3.9 ^{qr}	4.0^{pq}	**3.9^{H}**
	N1	3.7 ^{u}	3.9 ^{qr}	4.0^{no}	**3.9^{G}**	4.0^{p}	4.1 ^{o}	4.2^{n}	**4.1^{F}**
	N2	4.0 ^{m}	4.1 ^{kl}	4.2^{ij}	**4.1^{E}**	4.3^{m}	4.4 ^{jk}	4.5^{j}	**4.3^{E}**
Mean		**3.8^{H}**	**3.9^{G}**	**4.0^{G}**	**3.9^{C}**	**4.1^{H}**	**4.2^{G}**	**4.2^{F}**	**4.1^{C}**

Where: N= Nitrogen levels, V= vermicompost rates
Treatments that are not significantly different at the 5% level are indicated by the same letters.

Concerning the effect of vermicompost addition time, data indicated that head cabbage quality was a significant affected by vermicompost treatments. The highest value of head volume was found in plants applied with vermicompost at two times (400 cm^3), while the lowest value obtained in control plants (without vermicompost addition) in both growing season.

The increase in cabbage yield can be attributed to vermicompost contains plantgrowth regulators which increase the growth and yield of the plants [34]. However, these results in agreement with [35-36-9], who reported that, vermicompost is rich in organic matter resources and improves the chemical and physical characteristics of growing media because vermicompost is activate substance for plant growth especially in straw media, so the increase of growth characters values may be due to the increase of vermicompost rates.

Regarding the interaction effect between growing media, nitrogen levels and vermicompost addition time, data indicate significant differences. The highest significant value of head cabbage diameter and yield was recorded in cabbage plants grown in soil fertilized with 14 g N/plant and applied vermicompost at two times. On the contrary the lowest value resulted from plant grown in bale straw with 10 g N/plant without vermicopmpst addition (control) in both two growing seasons.

Head cabbage chemical content

Dry weight

The results of the effect various growing media, nitrogen levels and vermicompost addition time and their interaction on head dry weight of cabbage plants in both two growing season of 2012-2013 and 2013-2014 are shown in Table (7).

It was found that, growing media had a significant effect. The highest significant value of head dry weight recorded in plants grown in soil followed by old straw. On the other hand, plants grown in bale straw gave the lowest value of head cabbage dry weight in both two seasons. According to effect nitrogen levels, it was revealed that head cabbage dry weight increased significantly with increased nitrogen level. While, the lowest value was obtained in plants fertilized by 10 g N/plant in both growing season. The obtained results agree with [37-38-39] explained this increase by the fact that nitrogen stimulates plant growth and more specifically increases the leaf surface, resulting in higher photosynthetic capacity and consequently in better dry matter content.

Regarding the effect of vermicompost addition, the results indicated that the dry weight of cabbage was affected by the vermicompost addition times. The highest dry weight was recorded in cabbage plants watered vermicompost at two times. While, the lowest value of head dry weight was recorded in control plants without vermicompost addition in both growing season. This result may be due to vermicompost has a potential for improving plant growth and dry matter yield when added to the soil [40-41]. The results agree with [30-42].

With respect to the interaction effect of different growing media, nitrogen levels and vermicompost addition times on the head dry weight during the two seasons, data shows that there were significant differences between treatments. The highest dry weight value was obtained from plants grown in soil received the highest level of nitrogen (14 g N/plant) and applied vermicompost at two times. Whereas, the lowest value of dry weight recorded in plants grown in bale straw fertilized 10 g N/plant without vermicompost addition (control) in both growing season.

Ascorbic acid and chlorophyll reading (spad):

The influence of different growing media, nitrogen levels and vermicompost addition time and their interaction on ascorbic acid content and chlorophyll reading (spad) of head cabbage in both two seasons 2012-2013 and 2013-2014 is presented in Tables (8 and 9). Concerning the growing media, data indicated that there were significant differences between growing treatments. The highest significant value of ascorbic acid content and chlorophyll reading (spad) was obtained by plants grown in soil. Whereas, the lowest value recorded in bale straw plants in both two seasons. With regard to the effect of nitrogen levels, data showed that there was significant difference between treatments. The plants fertilizer by 14 g N/plant gave highest significant value. On the other hand, the lowest value recorded in cabbage plants received 10 g N/plant in both two seasons. Nitrogen has been reported to govern plant growth by virtue of being a major constituent of chlorophyll, protein, amino acids and which plays a crucial role in photosynthetic activity [43-44]. Obtained results agree with [45] who reported that Vitamin C content increased according to the increase in nitrogen dose.

Regarding to vermicompost addition time, the highest significant value recorded in plants applied vermicompost at two times. While, the lowest one belonged to control plants (without vermicompost addition) in both growing season. This increase attributed to improved uptake of N, P and K from vermicompost as well as increased chlorophyll production in the leaves [46]. The results agree with [47-48].

Referring the effect of different growing media, nitrogen levels and vermicompost addition time data showed that all treatments had a significant effect on the content of ascorbic acid in head cabbage. The highest value of ascorbic acid was found in plants grown in soil using high level of nitrogen fertilizer 14 g N/plant and amended by vermicompost at two times with rate 400 cm3. On the other hand, the lowest value

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of this content obtained by plants grown in bale straw received 10 g N/plant without addition of vermicompost (control) in both growing season.

Table (7): effect of growing media, nitrogen levels and vermicompost and their interaction on head cabbage dry weight (g) during seasons of 2012-2013 and 2013-2014.

Media	N	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	0.12^{i}	0.12^{h}	0.13^{g}	**0.12^{C}**	0.15i	0.15^{h}	0.16^{g}	**0.15^{C}**
	N1	0.13f	0.14e	0.15d	**0.14^{B}**	0.16^{f}	0.17^{e}	0.17^{d}	**0.17^{B}**
	N2	0.15c	0.16b	0.16^{a}	**0.16^{A}**	0.18^{c}	0.18^{b}	0.19^{a}	**0.18^{A}**
Mean		**0.14^{C}**	**0.14^{B}**	**0.15^{A}**		**0.16^{C}**	**0.17^{B}**	**0.18^{A}**	
Soil	N0	0.14^{i}	0.15^{h}	0.16^{g}	**0.15^{D}**	0.18^{k}	0.19^{j}	0.20^{h}	**0.19^{C}**
	N1	0.16^{f}	0.17^{e}	0.17^{d}	**0.17^{C}**	0.20^{g}	0.21^{f}	0.21^{de}	**0.21^{B}**
	N2	0.18^{c}	0.19^{b}	0.20^{a}	**0.19^{A}**	0.22^{c}	0.22^{b}	0.24^{a}	**0.23^{A}**
Mean		**0.16^{C}**	**0.17^{B}**	**0.18^{A}**	**0.17^{A}**	**0.20^{C}**	**0.21^{B}**	**0.22^{A}**	**0.21^{A}**
Bale straw	N0	0.08^{w}	0.09^{v}	0.10^{u}	**0.09^{J}**	0.12^{a}	0.12^{a}	0.12^{z}	**0.12^{L}**
	N1	0.10^{t}	0.11^{s}	0.11^{r}	**0.11^{I}**	0.12^{y}	0.13^{x}	0.13^{x}	**0.13^{K}**
	N2	0.11^{q}	0.12^{pq}	0.12^{no}	**0.12^{H}**	0.13^{w}	0.13^{uv}	0.14^{t}	**0.14^{I}**
Mean		**0.10^{L}**	**0.10^{K}**	**0.11^{J}**	**0.11^{D}**	**0.12^{L}**	**0.13^{K}**	**0.13^{J}**	**0.13^{D}**
Old straw	N0	0.14^{i}	0.15^{h}	0.16^{g}	**0.15^{D}**	0.18^{k}	0.18 ^{j}	0.19^{hi}	**0.19^{C}**
	N1	0.16^{f}	0.17^{e}	0.17^{d}	**0.17^{C}**	0.20^{g}	0.21^{f}	0.21^{e}	**0.21^{B}**
	N2	0.18^{c}	0.19^{b}	0.20^{a}	**0.19^{B}**	0.21^{cd}	0.22^{b}	0.23^{a}	**0.22^{A}**
Mean		**0.16^{C}**	**0.17^{B}**	**0.18^{A}**	**0.17^{A}**	**0.20^{C}**	**0.20^{B}**	**0.21^{A}**	**0.20^{A}**
50% new straw 50%oldd straw	N0	0.12^{op}	0.12^{n}	0.13^{m}	**0.12^{G}**	0.14st	0.15^{r}	0.15^{q}	**0.15^{G}**
	N1	0.13 ^{l}	0.14^{k}	0.14^{j}	**0.14^{F}**	0.16^{op}	0.16^{n}	0.17^{m}	**0.16^{E}**
	N2	0.15 ^{i}	0.15^{h}	0.16^{g}	**0.15^{D}**	0.17^{l}	0.18^{k}	0.19^{i}	**0.18^{D}**
Mean		**0.13^{F}**	**0.14^{E}**	**0.14^{D}**	**0.14^{B}**	**0.16^{F}**	**0.16^{E}**	**0.17^{D}**	**0.16^{B}**
New straw	N0	0.1 ^{tu}	0.11^{s}	0.11^{r}	**0.11^{I}**	0.12^{y}	0.13^{x}	0.13^{vw}	**0.13^{J}**
	N1	0.11^{q}	0.12^{n}	0.13^{lm}	**0.12^{G}**	0.14^{u}	0.14^{s}	0.15^{r}	**0.14^{H}**
	N2	0.14^{k}	0.14 ^{j}	0.15^{i}	**0.14^{E}**	0.15^{q}	0.16^{p}	0.16^{o}	**0.16^{F}**
Mean		**0.12^{I}**	**0.12^{H}**	**0.13^{G}**	**0.12^{C}**	**0.14^{I}**	**0.14^{H}**	**0.15^{G}**	**0.14^{C}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (8): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage ascorbic acid content (mg/100 g fresh weight) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	34.2^{i}	34.2^{h}	34.3^{g}	**34.2^{C}**	35.3^{i}	35.4^{h}	35.5^{g}	**35.4^{C}**
	N1	34.4^{f}	34.5^{e}	34.5^{d}	**34.5^{B}**	35.6^{f}	35.7^{e}	35.8^{d}	**35.7^{B}**
	N2	34.6^{c}	34.7^{b}	34.8^{a}	**34.7^{A}**	35.9^{c}	36.0^{b}	36.2^{a}	**36.0^{A}**
Mean		**34.4^{C}**	**34.5^{B}**	**34.5^{A}**		**35.6^{C}**	**35.7^{B}**	**35.8^{A}**	
Soil	N0	36.8^{j}	37.0^{h}	37.0^{h}	**36.9^{E}**	37.2^{j}	37.3^{i}	37.4^{h}	**37.3^{D}**
	N1	37.1^{fg}	37.2^{e}	37.2^{d}	**37.2^{C}**	37.5^{fg}	37.6^{e}	37.7^{d}	**37.6^{C}**
	N2	37.3^{c}	37.4 ^{b}	37.5^{a}	**37.4^{A}**	37.9^{c}	38.0^{b}	38.1^{a}	**38.0^{A}**
Mean		**37.1^{C}**	**37.17 ^{B}**	**37.3^{A}**	**37.2^{A}**	**37.5^{D}**	**37.6^{B}**	**37.7^{A}**	**37.6^{A}**
Bale straw	N0	31.5^{k}	31.6^{j}	31.7^{i}	**31.6^{O}**	33.1^{l}	33.2^{h}	33.3^{g}	**33.2^{M}**
	N1	31.8^{h}	31.8^{g}	31.9^{f}	**31.8^{N}**	33.4^{f}	33.5^{e}	33.6^{d}	**33.5^{L}**
	N2	32.0^{e}	32.1^{d}	32.2^{c}	**32.1^{M}**	33.7^{c}	33.8^{b}	33.9^{a}	**33.8^{K}**
Mean		**31.7^{N}**	**31.8^{M}**	**31.9^{L}**	**31.8^{E}**	**33.4^{N}**	**33.5^{M}**	**33.6^{L}**	**33.5^{E}**
Old straw	N0	36.7l	36.7^{k}	36.8^{j}	**36.7^{F}**	37.1^{j}	37.2^{i}	37.4^{h}	**37.2^{D}**
	N1	36.9^{j}	37.0^{h}	37.1^{g}	**37.0^{D}**	37.4^{gh}	37.5^{ef}	37.7^{d}	**37.6^{C}**
	N2	37.1^{ef}	37.3^{c}	37.4^{b}	**37.3^{B}**	37.8^{d}	37.9^{b}	38.1^{a}	**37.9^{B}**
Mean		**36.9^{E}**	**37.0^{D}**	**37.1^{C}**	**37.0^{B}**	**37.4^{E}**	**37.6^{C}**	**37.7^{A}**	**37.6^{B}**
50% new straw 50%oldd straw	N0	33.5^{s}	33.5^{r}	33.6^{q}	**33.5^{I}**	35.0^{s}	35.1 ^{r}	35.1^{q}	**35.1^{G}**
	N1	33.7^{p}	33.7^{p}	33.8^{o}	**33.7^{H}**	35.3^{p}	35.4^{o}	35.5^{n}	**35.4^{F}**
	N2	33.9^{n}	33.9^{n}	34.1^{m}	**34.0^{G}**	35.6^{m}	35.7^{l}	35.8^{k}	**35.7^{E}**
Mean		**33.7^{H}**	**33.7^{G}**	**33.8^{F}**	**33.7^{C}**	**35.3^{H}**	**35.4^{G}**	**35.5^{F}**	**35.4^{C}**
New straw	N0	32.37^{b}	32.4^{a}	32.4^{z}	**32.4^{L}**	34.0^{z}	34.1^{y}	34.2^{y}	**34.1^{J}**
	N1	32.5^{y}	32.6^{x}	32.7^{w}	**32.6^{K}**	34.3^{x}	34.5^{w}	34.6^{v}	**34.4^{I}**
	N2	32.8^{v}	32.8^{u}	32.9^{t}	**32.9^{J}**	34.7^{u}	34.8^{t}	35.0^{rs}	**34.8^{H}**
Mean		**32.5^{K}**	**32.6^{J}**	**32.7^{I}**	**32.6^{D}**	**34.4^{K}**	**34.5^{J}**	**34.6^{I}**	**34.4^{D}`**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (9): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage chlorophyll (Spad) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	48.9i	49.1^{h}	49.4^{g}	**49.1^{C}**	51.6^{i}	51.9^{h}	52.1^{g}	**51.9^{C}**
	N1	49.6^{f}	49.8^{e}	50.1^{d}	**49.8^{B}**	52.2^{f}	52.4^{e}	52.7^{d}	**52.5^{B}**
	N2	50.4^{c}	50.8^{b}	51.1^{a}	**50.8^{A}**	52.9^{c}	53.2^{b}	53.3^{a}	**53.1^{A}**
Mean		**49.6^{C}**	**49.9^{B}**	**50.2^{A}**		**52.3^{C}**	**52.5^{B}**	**52.7^{A}**	
Soil	N0	50.1^{qr}	50.3^{op}	50.$^{6l-n}$	**50.3^{G}**	52.4^{n}	52.6^{lm}	52.7^{k}	**52.6^{F}**
	N1	50.8^{jk}	51.1^{hi}	51.4^{e-g}	**51.1^{D}**	52.9^{hi}	53.1^{d}	53.4^{de}	**53.1^{C}**
	N2	51.6^{d}	52.3^{b}	52.7^{a}	**52.2^{A}**	53.5^{c}	53.9^{b}	54.1^{a}	**53.8^{A}**
Mean		**50.8^{E}**	**51.2^{C}**	**51.5^{A}**	**51.2^{A}**	**53.0^{E}**	**53.2^{C}**	**53.4^{A}**	**53.2^{A}**
Bale straw	N0	46.3^{e}	46.6^{d}	46.8^{c}	46.6^{N}	50.6^{y}	50.8^{x}	51.0^{w}	**50.8^{M}**
	N1	47.1^{b}	47.2^{b}	47.5^{a}	**47.3^{M}**	51.1^{v}	51.5^{u}	51.7^{s}	**51.4^{L}**
	N2	47.7^{z}	48.0^{y}	48.3^{x}	**48.0^{L}**	51.9^{r}	52.0^{q}	52.1^{p}	**52.0^{I}**
Mean		**47.1^{M}**	**47.3^{L}**	**47.5^{K}**	**47.3^{E}**	**51.2^{N}**	**51.4^{M}**	**51.6^{L}**	**51.4^{D}**
Old straw	N0	49.9^{rs}	50.2^{pq}	50.4^{m-o}	**50.2^{H}**	52.1^{p}	52.4^{n}	52.6^{lm}	**52.4^{G}**
	N1	50.6^{j}	50.9^{ij}	51.2^{gh}	**50.9^{E}**	52.8^{ij}	53.0^{gh}	53.3^{ef}	**53.0^{D}**
	N2	51.5^{d-f}	52.1^{c}	52.5^{a}	**52.0^{B}**	53.5^{cd}	53.8^{b}	54.0^{a}	**53.8^{A}**
Mean		**50.7^{F}**	**51.0^{D}**	**51.4^{B}**	**51.0^{B}**	**52.8^{F}**	**53.1^{D}**	**53.3^{B}**	**53.1^{B}**
50% new straw 50%oldd straw	N0	49.6^{t}	49.8 ^{s}	50.1^{qr}	**49.8^{I}**	51.5^{u}	51.8^{rs}	52.0^{q}	**51.8^{J}**
	N1	50.3^{o-q}	50.7^{kl}	50.8^{j-l}	**50.6^{F}**	52.3^{o}	52.6^{lm}	52.8^{jk}	**52.5^{F}**
	N2	51.0^{hi}	51.3^{fg}	51.5^{de}	**51.3^{C}**	53.0^{h}	53.2^{f}	53.4^{d}	**53.2^{B}**
Mean		**50.3^{G}**	**50.6^{F}**	**50.8^{E}**	**50.6^{C}**	**52.3^{I}**	**52.5^{H}**	**52.7^{G}**	**52.5^{C}**
New straw	N0	48.4^{x}	48.7^{w}	48.9^{w}	**48.7^{K}**	51.5^{u}	51.6^{t}	51.9^{r}	**51.7^{K}**
	N1	49.1^{v}	49.3^{u}	49.7^{s}	**49.4^{J}**	52.0^{q}	52.0^{q}	52.5^{m}	**52.2^{H}**
	N2	50.1^{qr}	50.4^{n-p}	50..6^{k-m}	**50.3^{G}**	52.7^{kl}	52.9^{hi}	53.1^{g}	**52.9^{E}**
Mean		**49.2 ^{J}**	**49.5^{I}**	**49.75 ^{H}**	**49.5^{D}**	**52.0^{K}**	**52.2^{J}**	**52.5^{H}**	**52.2^{D}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

Chemical contents (NPK)

Data recorded in Tables (10, 11 and 12) show the effect of growing media, nitrogen levels and vermicompost addition time as well as their interaction on nitrogen, phosphorous and potassium content in head cabbage. Regarding the effect of growing media, it is obvious from the data that plants grown in soil had highest significant value of nitrogen content. While, the lowest value of nitrogen was recorded in plants grown in bale straw during two seasons. Regarding to affect nitrogen levels, data show that there were significant differences, highest nitrogen content was observed in cabbage plants fertilized with 14 g N/plant, on the other hand, plants received 10 g N/plant gave lowest value in both growing season. The obtained results agree with [33-28].

Regarding the effect of vermicompost addition, the results indicated that, application vermicompost significantly effect on nitrogen content in both seasons, plants watered vermicompost at two times gave highest nitrogen content. Whereas, the lowest value of head cabbage nitrogen content was found in control plants (without vermicompost addition). [49] reported that vermicompost enhance the nutrient uptake by the plants by increasing the permeability of root cell membrane, stimulating root growth and increasing proliferation of root hairs. The obtained results are in agreement with [4] reported that application of

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vermicompost resulted in increased mineral contents and higher concentrations of N, P, Ca, Mg, Cu, Mn and Zn in lettuce.

As for the effect of the interaction of growing media, nitrogen levels and vermicompost addition times, data revealed that the nitrogen content in head cabbage was significantly affected due to the interaction treatments. The highest values of head cabbage nitrogen content were obtained by using the highest level of nitrogen (14 g N/ plant) with applied vermicompost at two times in soil condition. On the contrary, the lowest values of nitrogen content were recorded in case of using bale straw as growing media fertilized by low levels of nitrogen (10 g N/plant) without vermicompost addition (control) in both two season.

Table (10): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage nitrogencontent (mg/100 g dry weight) during seasons of 2012-2013.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	1.9^{i}	2.0^{h}	2.1^{g}	**2.0^{C}**	1.9^{j}	2.0^{h}	2.1^{g}	**2.0^{C}**
	N1	2.2^{f}	2.3^{e}	2.4^{d}	**2.3^{B}**	2.2^{f}	2.3^{e}	2.5^{d}	**2.3^{B}**
	N2	2.5^{c}	2.6^{b}	2.7^{a}	**2.6^{A}**	2.6^{c}	2.7^{b}	2.8^{a}	**2.7^{A}**
Mean		**2.2^{C}**	**2.3^{B}**	**2.4^{A}**		**2.2^{C}**	**2.3^{B}**	**2.5^{A}**	
Soil	N0	2.0^{vw}	2.1^{rs}	2.2^{no}	**2.1^{H}**	2.0^{q-t}	2.1^{o}	2.3^{kl}	**2.1^{I}**
	N1	2.4^{jk}	2.5^{hi}	2.6^{e}	**2.5^{C}**	2.4^{i}	2.5^{gh}	2.7^{d}	**2.6^{D}**
	N2	2.7^{c}	2.8^{b}	3.0^{a}	**2.8^{A}**	2.8^{c}	2.9^{b}	3.0^{a}	**2.9^{A}**
		2.4^{E}	**2.5^{C}**	**2.6^{A}**	**2.5^{A}**	**2.4^{D}**	**2.5^{B}**	**2.7^{A}**	**2.5^{A}**
Bale straw	N0	1.7^{a}	1.8^{z}	1.9^{y}	**1.8^{M}**	1.7^{x}	1.8^{w}	1.9^{uv}	**1.82^{J}**
	N1	2.0^{wx}	2.0^{uv}	2.1^{rs}	**2.0^{J}**	2.0^{q-s}	2.1^{o}	2.3^{lm}	**2.1^{I}**
	N2	2.2^{o-q}	2.3^{lm}	2.5^{hi}	**2.3^{F}**	2.3^{k}	2.4^{i}	2.7^{d}	**2.5^{E}**
Mean		**1.9^{L}**	**2.02^{K}**	**2.1^{IJ}**	**2.0^{E}**	**2.0^{I}**	**2.1^{H}**	**2.3^{F}**	**2.2^{E}**
Old straw	N0	2.0^{wx}	2.09^{st}	2.2^{pq}	**2.1^{I}**	2.0^{tu}	2.0^{pq}	2.2^{no}	**2.1^{M}**
	N1	2.3^{kl}	2.4^{i}	2.6^{ef}	**2.5^{D}**	2.3^{lm}	2.4^{i}	2.8^{fg}	**2.4^{F}**
	N2	2.7^{cd}	2.8^{b}	3.0^{a}	**2.8^{A}**	2.7^{de}	2.8^{c}	2.9^{b}	**2.8^{B}**
Mean		**2.3^{F}**	**2.4^{D}**	**2.6^{B}**	**2.5^{B}**	**2.3^{F}**	**2.4^{D}**	**2.6^{B}**	**2.4^{B}**
50% new straw 50%oldd straw	N0	1.9^{y}	2.0^{vw}	2.1^{s}	**2.0^{K}**	1.9^{u}	2.0^{r-t}	2.1^{op}	**2.0^{K}**
	N1	2.2^{o-q}	2.3^{mn}	2.4^{j}	**2.3^{G}**	2.2^{mn}	2.3^{k}	2.5^{h}	**2.4^{G}**
	N2	2.5^{i}	2.6^{fg}	2.7d	**2.6^{B}**	2.6^{fg}	2.7^{de}	2.8^{c}	**2.7^{C}**
Mean		**2.2^{I}**	**2.3^{G}**	**2.4^{E}**	**2.3^{C}**	**2.2^{G}**	**2.3^{E}**	**2.5^{C}**	**2.4^{C}**
New straw	N0	1.8^{z}	1.9^{y}	1.9^{x}	**1.9^{L}**	1.9^{vw}	2.0^{s-u}	2.0^{qr}	**2.0^{L}**
	N1	2.1^{tu}	2.2^{qr}	2.2^{n-p}	**2.2^{H}**	2.1^{o}	2.3^{lm}	2.34^{jk}	**2.2^{H}**
	N2	2.3^{l-n}	2.4^{j}	2.5^{gh}	**2.4^{E}**	2.4^{ij}	2.5^{gh}	2.6^{ef}	**2.5^{DE}**
Mean		**2.0^{K}**	**2.1^{J}**	**2.2^{H}**	**2.1^{D}**	**2.1^{H}**	**2.3^{G}**	**2.3^{E}**	**2.2^{D}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (11): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage phosphorus content (mg/100 g dry weight) during seasons of 2012-2013 and 2013-2014.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	0.2^{i}	0.3^{h}	0.3^{g}	**0.3^{C}**	0.2^{i}	0.3^{h}	0.4^{g}	**0.3^{C}**
	N1	0.4^{f}	0.5^{e}	0.5^{d}	**0.5^{B}**	0.4^{f}	0.6^{e}	0.7^{d}	**0.6^{B}**
	N2	0.6^{c}	0.7^{b}	0.8^{a}	**0.7^{A}**	0.8^{c}	0.9b	1.0^{a}	**0.9^{A}**
Mean		**0.4^{c}**	**0.5^{b}**	**0.6^{a}**		**0.5^{c}**	**0.6^{b}**	**0.7^{a}**	
Soil	N0	0.2^{s-u}	0.3^{o-q}	0.4^{k-m}	**0.3^{G}**	0.3 ^{tu}	0.4^{r}	0.5^{o}	**0.4^{H}**
	N1	0.5^{hi}	0.6^{ef}	0.7^{d}	**0.6^{C}**	0.6^{mn}	0.7^{h-j}	0.8^{f}	**0.8^{B}**
	N2	0.8^{c}	0.8^{b}	0.9^{a}	**0.9^{A}**	0.9^{e}	1.0^{bc}	1.1^{a}	**1.0^{A}**
		0.5^{EF}	**0.6^{C}**	**0.7^{A}**	**0.6^{A}**	**0.6^{F}**	**0.7^{BC}**	**0.8^{A}**	**0.7^{A}**
Bale straw	N0	0.1^{v}	0.2^{u}	0.3^{rs}	**0.2^{I}**	0.2^{x}	0.2^{u-w}	0.3st	**0.2^{K}**
	N1	0.3^{t}	0.4^{m-o}	0.4^{jk}	**0.4^{F}**	0.4^{r}	0.5^{op}	0.6^{n}	**0.5^{G}**
	N2	0.5^{h}	0.6^{fg}	0.6^{e}	**0.6^{D}**	0.6^{lm}	0.7 $^{i-k}$	0.8^{g}	**0.7^{B}**
Mean		**0.3^{J}**	**0.4^{H}**	**0.5^{G}**	**0.4^{E}**	**0.4^{J}**	**0.5^{I}**	**0.5^{GH}**	**0.5^{E}**
Old straw	N0	0.2 $^{s-u}$	0.3^{pq}	0.4^{k-m}	**0.3^{G}**	0.3^{tu}	0.3^{rs}	0.4^{r}	**0.3^{I}**
	N1	0.5 $^{h-j}$	0.6^{e}	0.7^{e}	**0.6^{D}**	0.4^{pq}	0.6^{lm}	0.7^{hi}	**0.6^{E}**
	N2	0.7 ^{d}	0.8^{b}	0.9^{a}	**0.8^{A}**	0.9^{f}	1.0^{cd}	1.1^{b}	**1.0^{B}**
Mean		**2.3^{F}**	**0.5^{F}**	**0.6^{D}**	**0.7^{B}**	**0.6^{B}**	**0.5^{H}**	**0.6^{DE}**	**0.7^{B}**
50% new straw 50%oldd straw	N0	0.2^{tu}	0.3^{r-t}	0.3^{n-p}	**0.3^{H}**	0.2 $^{v-x}$	0.3^{tu}	0.4^{qr}	**0.3^{J}**
	N1	0.4^{m-o}	0.4^{kl}	0.5^{hi}	**0.4^{E}**	0.5^{op}	0.6^{n}	0.6 $^{j-l}$	**0.6^{E}**
	N2	0.6^{g}	0.6^{e}	0.7^{d}	**0.6^{C}**	0.7^{gh}	0.8^{f}	1.0^{df}	**0.8^{C}**
Mean		**0.4^{H}**	**0.4^{G}**	**0.5^{E}**	**0.4^{C}**	**0.5^{I}**	**0.6^{G}**	**0.7^{CD}**	**.6^{C}**
New straw	N0	0.2 ^{u}	0.3^{r-t}	0.3^{qr}	**0.3^{H}**	0.2^{wx}	0.2^{uv}	0.3st	**0.2^{K}**
	N1	0.3 ^{pq}	0.4^{k-m}	0.4^{i-k}	**0.4^{F}**	0.4^{qr}	0.5^{o}	0.6k^{l}	**0.5^{F}**
	N2	0.5 ^{h}	0.6^{e}	0.7^{d}	**0.6^{BC}**	0.7^{h-j}	0.9^{f}	1.0d^{e}	**0.8^{C}**
Mean		**0.3^{I}**	**0.4^{G}**	**0.5^{F}**	**0.4^{D}**	**0.4^{J}**	**0.5^{GH}**	**0.6^{E}**	**0.5^{D}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

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Table (12): effect of growing media, nitrogen levels and vermicompost and their interaction on cabbage potassium content (mg/100 g dry weight) during seasons of 2012-2013.

Media	Nit.	V0	V1	V2	Mean	V0	V1	V2	Mean
		2012/2013				2013/2014			
NXV	N0	2.3^{i}	2.3^{h}	2.4^{g}	**2.3^{C}**	2.1^{i}	2.2^{h}	2.2^{g}	**2.2^{C}**
	N1	2.5^{f}	2.5^{e}	2.6^{d}	**2.5^{B}**	2.3^{f}	2.4^{e}	2.4^{d}	**2.3^{B}**
	N2	2.7^{c}	2.7^{b}	2.8^{a}	**2.7^{A}**	2.5^{c}	2.5^{b}	2.6^{a}	**2.5^{A}**
Mean		**2.5^{C}**	**2.5^{B}**	**2.6^{A}**		**2.3^{C}**	**2.4^{B}**	**2.4^{A}**	
Soil	N0	2.5^{no}	2.5^{kl}	2.6^{ij}	**2.5^{H}**	2.2^{rs}	2.3^{o-q}	2.3^{ln}	**2.3^{I}**
	N1	2.65^{g}	2.8^{e}	2.9^{d}	**2.8^{C}**	2.4^{j}	2.5^{g}	2.6^{d}	**2.5^{D}**
	N2	2.9^{c}	3.0^{b}	3.1^{a}	**3.0^{A}**	2.6^{c}	2.7^{b}	2.8^{a}	**2.7^{A}**
Mean		**2.7^{D}**	**2.8^{B}**	**2.9^{A}**	**2.8^{A}**	**2.4^{C}**	**2.5^{B}**	**2.6^{A}**	**2.5^{A}**
Bale straw	N0	2.1^{a}	2.2^{yz}	2.3^{wx}	**2.2^{L}**	2.0^{x}	2.0^{x}	2.1^{w}	**2.0^{M}**
	N1	2.3^{uv}	2.4^{rs}	2.42^{pq}	**2.4^{I}**	2.1^{v}	2.2^{s}	2.3^{pq}	**2.2^{J}**
	N2	2.5^{mn}	2.5^{kl}	2.62^{gh}	**2.5^{G}**	2.3^{m-p}	2.4^{j-l}	2.4^{h}	**2.4^{G}**
Mean		**2.3^{L}**	**2.4^{J}**	**2.4^{H}**	**2.4^{E}**	**2.2^{I}**	**2.2^{H}**	**2.3^{F}**	**2.2^{E}**
Old straw	N0	2.4^{op}	2.5^{lm}	2.6^{jk}	**2.5^{H}**	2.2^{uv}	2.2^{st}	2.3^{n--q}	**2.2^{J}**
	N1	2.6^{hi}	2.7^{g}	2.7^{f}	**2.7^{D}**	2.4^{k-m}	2.4^{ij}	2.5^{gh}	**2.4^{F}**
	N2	2.8^{e}	2.9^{d}	3.0^{c}	**2.9^{B}**	2.5^{ef}	2.6^{c}	2.7^{ab}	**2.6^{B}**
Mean		**2.6^{E}**	**2.7^{D}**	**2.7^{C}**	**2.7^{B}**	**2.3^{E}**	**2.4^{C}**	**2.5^{B}**	**2.4^{B}**
50% new straw 50%oldd straw	N0	2.2^{y}	2.25^{x}	2.32^{t-v}	**2.3^{K}**	2.1^{w}	2.2^{tu}	2.2^{s}	**2.2^{K}**
	N1	2.4^{st}	2.4^{qr}	2.5^{mn}	**2.4^{I}**	2.3^{qr}	2.4^{j-l}	2.4^{ij}	**2.4^{H}**
	N2	2.5^{mn}	2.6^{g}	2.7^{f}	**2.6^{E}**	2.5^{gh}	2.6^{de}	2.6^{c}	**2.6^{C}**
Mean		**2.4^{J}**	**2.4^{HI}**	**2.5^{F}**	**2.4^{C}**	**2.3^{F}**	**2.4^{D}**	**2.4^{C}**	**2.4^{C}**
New straw	N0	2.2^{z}	2.3^{x}	2.29^{vw}	**2.2^{K}**	2.1^{w}	2.1^{vw}	2.2^{tu}	**2.1^{L}**
	N1	2.3^{s-u}	2.4^{qr}	2.5^{n-p}	**2.4^{I}**	2.2^{s}	2.3^{q}	2.3^{m-o}	**2.3^{J}**
	N2	2.5^{lm}	2.6^{ij}	2.6^{g}	**2.6^{F}**	2.4^{jk}	2.4^{hi}	2.5^{fg}	**2.4^{E}**
Mean		**2.3^{K}**	**2.4^{I}**	**2.5^{G}**	**2.4^{D}**	**2.2^{G}**	**2.3^{F}**	**2.3^{E}**	**2.3^{D}**

Where: N= Nitrogen levels, V= vermicompost rates

Treatments that are not significantly different at the 5% level are indicated by the same letters.

CONCLUSION

Using the old straw to cultivate cabbage due to the same vegetative growth and head cabbage quality dry weight that obtained in plants grown in soil without significant differences. While, using the bale straw to cultivate cabbage resulted in the lowest value in both of vegetative growth and crop yield. Increasing nitrogen levels and vermicompost addition times led to increase all vegetative growth, head quality, dry weight and NPK content in head cabbage.

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