Response of two Cabbage cultivars (Brassica oleracea L. var. Capitata) to organic and chemical fertilization

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ABSTRACT

The experiment was conducted in the field of vegetables belonging to the Department of Horticulture and Landscape Gardening, College of Agriculture, Al-Qasim Green University to study the response of two Cabbage cultivars (Brassica oleracea L. var. Capitata) to organic and chemical fertilization for the winter agricultural season (2018-2017). The experiment was conducted according to the Spilt-Plots system within the randomized complete block design (RCBD), with three replicates, where the cultivars were placed in the main plot and the organic and chemical fertilization in the subplot. Two cultivars were used (Green Globe, Roza), and the fertilizer combinations (without fertilization, leaf palm residue 20 tons.ha⁻¹, rice residue 20 tons.ha⁻¹, chemical fertilizer 18:18:18 NPK with the rate of 300 kg.ha⁻¹). The averages were compared using the least significant difference test L.S.D at a probability level of 0.05. The results can be summarized as follows: Green Globe cultivar was significantly excelled in the traits of (length and diameter of the stem, number of wrapped leaves in the head, the diameter of the head, the width of the largest leaf in the head, weight of marketable head). The Roza cultivar has excelled in the traits of (the percentage of nitrogen and protein in the leaves and the leaves content of vitamin C). As for the fertilizer treatments, the fertilizer treatment (NPK) was significantly excelled in (the length and diameter of the stem, the diameter of the head, the width of the largest leaf in the head, weight of the marketable head and the head content of vitamin C. The fertilization treatment with rice residues excelled in the percentage of nitrogen and protein in the leaves. As for the bi-interaction between the cultivar and the added fertilizers, the interaction between the Green Globe cultivar and the NPK fertilizer has excelled in the traits of (the length and diameter of the stem, the diameter of the head, the width of the largest leaf in the head, weight of the marketable head). The bi-interaction between Roza cultivar and NPK fertilizer also exceeded in the trait of the leaves content of vitamin C.

استجابة صنفين من اللهانة (Brassica oleracea L. var. capitata) للتسميد العضوي والكيميائي

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المستخلص

نفذت التجربة في حقل الخضروات التابع الى قسم البستنة وهندسة الحدائق/ كلية الزراعة /جامعة القاسم الخضراء لدراسة استجابة صنفين من اللهانة للتسميد العضوي والكيميائي للموسم الزراعي الشتوي,2017-2018 نفذت التجربة وفق نظام الالواح المنشقة Spilt صنفين من اللهانة للتسميد العضوي والكيميائي للموسم الزراعي الشتوي,2017-2018 نفذت التجربة وفق نظام الالواح المنشقة Spilt Main plot - ضمن تصميم القطاعات العشوائية الكاملة (RCBD) وبثلاث مكررات حيث وضعت الاصناف في القطع الرئيسية Main plot والتسميد العضوي والكيميائي في القطع الثانوية sub-plot ، استعمل صنفان من اللهانة (Robe وRoza)), و كانت التوليفات السمادية (بدون تسميد , مخلفات سعف النخيل 20طن.¹ , مخلفات الرز 20طن.¹ , سماد كيمياوي 18:18:18 و كانت التوليفات السمادية (بدون تسميد , مخلفات سعف النخيل 20طن.¹ , مخلفات الرز 20طن.¹ , سماد كيمياوي 18:18:18 معلوباً فرق معنوي الكيمياني المقارنة بين متوسطات بأستعمال اختبار اقل فرق معنوي (20لن.¹ , سماد كيمياوي 20.00 ويمكن عرض أكبر ورقة بالرأس, وزن الرأس الصالح للتسويق)، اما الصنف Roza تطوى الاوراق الملتفة بالرأس, قل الرأس الصالح السماد فقد تفوقت معاملة السماد الكيمياوي المانة ولوراق و تلخيص النتائج كما بلي : تفوق الصنف Green Globe معنوباً في (طول وقطر الساق, عدد الأوراق الملتفة بالرأس, قطر الرأس عرض أكبر ورقة بالرأس, وزن الرأس الصالح التسويق)، اما الصنف Roza تقوق في (نسبة النيتروجين والبروتين في الاوراق و مطره, قطر الرأس, عرض اكبر ورقة بالرأس, وزن الرأس الصالح للتسويق ومحتواها من فيتامين), و تفوقت معاملة التسميد بمخلفات الرز في نسبة النيتروجين والبروتين في الاوراق. وفي التداخل التثاني بين الصنف والاسدة المضافة تفوق التداخل بين مطره, قطره الرأس, عرض اكبر ورقة بالرأس, وزن الرأس الصالح للتسويق ومحتواها من فيتامين), و تفوقت معاملة التسميد المانف والاسمدة المضافة تفوق التداخل بين مطره, قطر الرأس, ون منهيا ليروتين في الاوراق. وفي التداخل الثنائي بين الصنف والاسمدة المضافة تفوق التداخل بين معرفي أي منفيتامين), و تفوق الماد الكيميائي NPK في وقطر الساق, عرض اكبر ورقة بالرأس, قطر الرأس, وزن الرأس

1. INTRODUCTION

Cabbage (Brassica olearaca var.capitata Cabbage) is considered an important winter vegetable cultivated in Iraq which belongs to the Brassicaceae Jim family (Tony, 2006) which known since more than 4,500 years ago in the Mediterranean region, it was growing wild on the coasts of England, Denmark, and northern France and in different parts of Europe (Al-Quzat et al., 2007). Cabbage belongs to leafy vegetables and it is cultivated for its wrapped leaves that make up the head where it is used freshly or pickles, salads or stuffed and some are eaten boiled (Chatterjee et al., 2014). The importance of the Cabbage leaves comes from the value of their nutritional content where each 100 g fresh weight

contains a dry matter (6.1 - 11.2 %), carbohydrates (5.4-3 %), proteins (2-1%), fat (0.2%), vitamin C (50-30 mg), vitamin A and thiamine (0.05 mg) as well as contains Potassium (238 mg), phosphorus (49 mg), magnesium (9 mg), iron (1.2 mg) and 24 calories. It also contains folic acid and dietary fiber as well as glutamine acid and it has many medical benefits, including the treatment of stomach ulcers and duodenal ulcers and reducing blood sugar (Euras et al., 2011). Therefore, It protects against cancer (Tatalay and Fahey, 2001). It is noted that the production of Cabbage in 2015 about 19 thousand tons, while the productivity of Iraq amounted to $(12.667 \text{ tons.ha}^{-1})$, with an area of (1500 ha) (Arab Organization for Agricultural

Development, 2016). It is noted that the average production in Iraq is much lower than the production of the world and this is linked to many factors that are affected by it the growth of Cabbage plant, including genetic factors for the cultivar and environmental conditions and agricultural service operations, which include fertilization (Al-Saidi and Abdul Qader, 2000). Manea, (2017) found in her study, two cultivars of Cabbage using four types of liquid organic fertilizer and the fertilization (Higro Amin L) achieved the highest weight for total head and marketable head. While the interaction between Copenhagen cultivar and Maxinim fertilizer achieved the highest weight of dry matter, head diameter, and marketable yield compared to the interaction between Ramso cultivar and urea fertilization which gave the lowest average of total head diameter and marketable yield. Considerable attention has been paid to organic fertilization to ensure the quality of food products and food safety from pesticide residues and chemical fertilizers (Magdoff and Weil, 2004). The use of organic fertilization causes an increase in vegetative growth and yield for its high content of nutrients. This study aims to;

 Cultivation of two cultivars of cabbage within the conditions of the Babylon province.
 Knowing the effect of organic fertilizers (palm leaves and rice residues) and comparing them with chemical fertilization (NPK) on growth and yield of cabbage plant.

2. MATERIALS AND METHODS

The experiment was conducted in the field of vegetables belonging to the Department of Horticulture and Landscape Gardening, College of Agriculture, Al-Qasim Green University to study the response of two Cabbage cultivars (Brassica oleracea L. var. Capitata) to organic and chemical fertilization for the winter agricultural season (2018-2017). Samples of field soil were taken randomly and from different areas before the experiment began at a depth of 30 cm from the soil surface area and then dried in air, milled and passed through a sieve diameter of 2 mm holes and analyzed to determine some of the physical and chemical properties of the soil of the field as shown in Table (1).

Seeds were cultivated on 25/8/2017 in cork seedling trays, the seedlings were cultivated in the stage of four _ five real leaves, then transferred afternoon to the field on 2/10/2017 in terraces, with rate of 16 seedlings for each terrace which distributed on two lines the distance between one line and another is 50 cm and between the plant and another is 40 cm. The cultivated plants were taken care of from the first day until the maturation and harvesting of the heads were completed. The experiment involved two factors: The first factor: cultivars, which are two cultivars of cabbage (GreenGlobe, Roza F1)

The second factor: Four levels of fertilizers included:

- The control treatment (without fertilization)
- the Fertilizer of palm leaves residues (20 tons.ha⁻¹)
- The Fertilizer of rice residues (20 tons.ha⁻¹)
- NPK 1818:18 neutral compound chemical fertilizer at a rate of (300 kg.ha⁻¹).

Table 1: Chemical and physical traits for the soil of the field before cultivating.

Trait	Unit	Value
pH		7.03
Electrical Conductivity Ec	dS.m ⁻¹	3.73
Organic matter	g.kg ⁻¹	1.4
Nitrogen availability	ma ka ⁻¹	31.11
phosphorus availability	ш <u>д.</u> кg	7.6
Potassium availability		98
Sand		335
Silt	Silt g.kg ⁻¹	
Clay		331
Soil texture	Silty loam	

The chemical and physical traits for the soil were analyzed in the laboratory belonging to the College

of Agriculture, Al-Qasim University.

Traits	Units	Palm leaves residues	Rice residues
Ec	dS.m ⁻¹	2.66	0.93
pН	-	7.04	6.50
С	%	43.70	44.6
Ν	%	2.30	2.48
C/N	%	19.00	18.0
Р	%	0.650	0.540
Κ	%	2.80	0.260
Ca	%	2.93	1.30
Mg	%	0.850	0.38
Na	%	0.622	0.430
Fe	%	0.423	0.259
Zn	%	0.055	0.031
Mn	%	0.013	0.011
Cu	%	0.005	0.003
Humidity	%	30	35-30

Table 2: Physical and chemical traits for organic fertilizers used in the study.

The experiment was conducted according to the Spilt-Plots system within the randomized complete block design (RCBD), with three replicates, where the cultivars were placed in

the main plots and the organic and chemical fertilization in the sub-plot. Significant differences between the averages were compared at a probability level of 0.05 using the Least Significant Difference (LSD) test (Al-Sahuki and Wahib, 1990). Statistical Analysis Software program (SAS) (SAS, 2012) was used in statistical analysis and the following experimental measurements were recorded: stem length (cm), stem diameter (cm), number of wrapped leaves (leaves.plant⁻¹), diameter of head (cm), width of the largest leaf in the head, the weight of the marketable head (g.plant⁻¹), the percentage of nitrogen in the leaves (%): It was estimated according to the method reported in (Jackson, 1958), the percentage of protein in the leaves on the basis of dry weight was estimated by the method of (Dalali and Hakim, 1987), the leaves content of vitamin C: It was estimated according to Davies method (Abbas Abbas, 1992).

3. RESULTS AND DISCUSSION

Table (3) indicates that there are significant differences in the trait of stem length, stem diameter and number of wrapped leaves between the two cultivars, where the GreenGlobe cultivar has excelled by giving it the highest stem length amounted to (10.47 cm) compared to Roza cultivar which gave the lowest stem length amounted to (9.28 cm). GreenGlobe cultivar has excelled by giving it

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the highest stem diameter amounted to (2.05 cm) compared to Roza cultivar which gave the lowest stem diameter amounted to (1.86 cm). GreenGlobe cultivar was excelled by giving it highest number of wrapped leaves the amounted to $(40.72 \text{ leaves.plant}^{-1})$ compared to Roza cultivar, which gave the lowest number of leaves amounted to wrapped (33.31 leaves.plant⁻¹). The results of the same table also showed that there was a significant effect for the added fertilizers on the stem length, stem diameter and the number of wrapped leaves. where chemical fertilization (NPK) gave the highest average of stem length amounted to (10.44 cm) compared to the control treatment while the other treatments did not differ significantly, NPK gave the highest average of stem diameter amounted to (2.09 cm) compared to the control treatment while the other treatments did not differ significantly. The fertilization with residues of palm leaves and rice gave the highest number of wrapped leaves amounted to (37.70) compared to the control treatment which gave the lowest average number of wrapped leaves amounted to (35.65). There were also significant differences in the interaction between the cultivar, fertilization for the length of the stem, stem diameter and the number of wrapped leaves, where the interaction between GreenGlobe cultivar and NPK fertilizer was excelled by giving it the highest average of stem length amounted to (10.80 cm) compared to the interaction treatment between Roza cultivar and the control treatment which gave the lowest average of stem length amounted to (8.77 cm), where the interaction between Roza cultivar and chemical fertilizer (NPK) has excelled by giving it the highest average of stem diameter amounted to (2.10 cm), which did not significantly differ from the interaction treatment between GreenGlobe cultivar and NPK, compared to the interaction treatment between Roza cultivar and the control treatment, which gave the lowest average of stem diameter amounted to (1.75 cm). The interaction between GreenGlobe cultivar and fertilization with palm leaves residue has excelled by giving it the highest average number of wrapped leaves amounted to (42.08 leaves) compared to the interaction between Roza cultivar and the control treatment which gave the lowest average number of wrapped leaves amounted to (32.33 leaves).

Table 3: Effect of cultivar, fertilization treatments and interaction between them on the stem leng	gth
(cm), stem diameter (cm) and the number of wrapped leaves (leaves.plant ^{-1}).	

Cultivars		Stem length	Stem diameter	Number of wrapped leaves
		(cm)	(cm)	(leaves.plant ⁻)
Gre	een Globe	10.47	2.05	40.72
	Roze	9.28	1.86	33.31
LSD0.05 v	alue for cultivar	0.628	0.116	1.130
		Effect o	of Fertilization	
(Control	9.39	1.88	35.62
Palm le	aves residues	9.79	1.92	37.70
Ric	e residues	9.89	1.93	37.70
Chemi	cal fertilizer	10.44	2.09	37.04
LSD0.05 values for		0.8886	0.164	1.598
fertilization				
	In	teraction betwee	en cultivar x Fertili	zation
	Control	10.02	2.01	38.91
Green	Palm leaves residues	10.56	2.01	42.08
Globe	Rice residues	10.49	2.08	41.83
	Chemical fertilizer	10.80	2.09	40.08
	Control	8.76	1.75	32.33
Roze	Palm leaves residues	9.01	1.82	33.33
	Rice residues	9.29	1.79	33.58
	Chemical fertilizer	10.07	2.10	34.00
LSD0.05 values for interaction		1.0843	0.246	2.713

Table (4) shows that there are significant differences between the two cultivars in the trait of the diameter of the head, the width of the largest leaf in the head, weight of the marketable head, where the GreenGlobe cultivar was significantly excelled by giving it the highest average diameter amounted to (18.40 cm) compared to Roza cultivar which gave the lowest average amounted to (13.59 cm). GreenGlobe cultivar was significantly excelled by giving it the highest average for the width of the largest leaf in the head amounted to (28.46 cm) compared to Roza cultivar which gave the lowest average amounted to (20.17 where GreenGlobe cultivar cm). was significantly excelled by giving it the highest average for the weight of the marketable head amounted to (1.85 kg) compared to Roza cultivar, which gave the lowest average amounted to (0.99 kg). The results of the same table also showed that there was a significant effect for the added fertilizers on the diameter of the head, the width of the largest leaf in the head, weight of the marketable head. where chemical fertilization (NPK) gave the highest average for stem diameter amounted to (16.98 cm) compared to the control treatment which gave the lowest average amounted to (15.2), the treatment of chemical fertilization (NPK) achieved a significant excelling by giving it the highest average amounted to (25.88 cm), which

differed significantly with the fertilization treatment with rice residues, which gave an average amounted to (23.35 cm), where the chemical fertilization (NPK) treatment achieved the highest weight of head amounted to (1.662 kg) while the lowest head weight amounted to (1.290 kg) at the control treatment. There were also significant differences in the interaction between the cultivar, fertilization for the diameter of the head, the width of the largest leaf in the head, weight of the marketable head, where the interaction between GreenGlobe cultivar and NPK fertilizer was excelled by giving it the highest average amounted to (19.31 cm) compared to the interaction treatment between Roza cultivar and the control treatment which gave the lowest average amounted to (12.67 cm), where the interaction between GreenGlobe cultivar and chemical fertilizer (NPK) has excelled by giving it the highest average amounted to (29.60 cm) compared to the interaction between Roza cultivar and rice residue fertilizer which the lowest average amounted to (18.41 cm), where the interaction between GreenGlobe cultivar and NPK chemical fertilizer gave the highest average weight of the marketable head amounted to (2.100 kg) compared to the interaction between Roza cultivar and the control treatment which gave the lowest average for that trait amounted to (0.826 kg).

Table 4: Effect of cultivar,	, fertilization treatmen	ts and interaction	n between them	on the diameter of	the
head (cm), the width	of the largest leaf in th	ne head (cm), we	ight of the marke	etable head (kg).	

Cultivars		The diameter of	The width of the largest	Weight of the
		the head (cm),	leaf in the head (cm)	marketable head (kg)
Gre	en Globe	18.40	28.46	1.856
	Roze	13.59	20.17	0.990
LSD0. c	05 value for ultivar	1.0	1.52	0.223
		Effect of	Fertilization	
(Control	15.31	23.87	1.290
Palm le	aves residues	15.55	24.15	1.303
Rice	e residues	16.14	23.35	1.436
Chemi	cal fertilizer	16.98	25.88	1.662
LSD0.05 values for fertilization		1.414	2.161	0.315
		Interaction between	cultivar x Fertilization	
	Control	17.95	27.85	1.753
Green	Palm leaves residues	17.65	28.08	1.663
Globe	Rice residues	18.68	28.29	1.907
	Chemical fertilizer	19.31	29.60	2.100
	Control	12.67	19.90	0.826
Roze	Palm leaves residues	13.45	20.21	0.944
	Rice residues	13.60	18.41	0.965
	Chemical fertilizer	14.00	22.15	1.224
LSD0.0 int	05 values for eraction	2.115	3.79	0.457

Table (5) shows that there are significant differences between the two cultivars in the trait of the percentage of nitrogen and protein in the leaves and the leaves content of vitamin C, where the GreenGlobe cultivar was significantly excelled by giving it the highest average for the percentage of nitrogen amounted to (1.74 %) compared to Roza cultivar which gave the lowest average for the percentage of the percentage of the percentage of the percentage of the percentage for the percentage for the lowest average for the percentage of the percenta

Roza cultivar was significantly excelled by giving it the highest average for the percentage of protein amounted to (10.91%) compared to GreenGlobe cultivar which gave the lowest average for this trait amounted to Roza cultivar was significantly (7.87%). excelled by giving it the highest average for the leaves content of vitamin C which amounted to (338.80 mg.100 g⁻¹ fresh matter) compared to the GreenGlobe cultivar, which gave the lowest

average for this trait amounted to (100.79 mg. 100 g^{-1} fresh matter). The results of the same table also showed that there was significant effect for the added fertilizers on the percentage of nitrogen and protein and the leaves content of vitamin C, where the fertilization treatment with rice residues achieved a significant superiority by giving it the highest average percentage of nitrogen in the leaves amounted to (1.63%) compared to other treatments. The fertilization treatment with rice residues was significantly excelled by giving it the highest average percentage of protein in leaves amounted to (10.20%) compared to other treatments that did not significantly differ from each other. The chemical fertilization (NPK) treatment achieved the highest average for the leaves content of vitamin C amounted to $(235.60 \text{ mg}.100 \text{ g}^{-1})$ compared to the control treatment Which showed a significant decrease by giving it the lowest content of vitamin C in the leaves amounted to $(189.84 \text{ mg}.100 \text{ g}^{-1})$. There were also significant differences in the interaction between the cultivar and fertilization in the traits of the percentage of nitrogen and

protein and the leaves content of vitamin C. where the interaction between Roza cultivar and rice residue fertilizer gave the highest average for the percentage of nitrogen in the leaves amounted to (1.90%) compared to the interaction between GreenGlobe cultivar and palm leaves residues which gave the lowest average amounted to (1.16%). The interaction between Roza cultivar and fertilization with rice residues was significantly excelled by giving it the highest average for the percentage of protein in the leaves amounted to (11.88%) compared to the interaction between the GreenGlobe cultivar and fertilization with palm leaves residues, which gave the lowest average for this trait which amounted to (7.30%). The interaction between Roza cultivar and chemical fertilizer (NPK) was significantly excelled by giving it the highest content of vitamin C amounted to (392.81 mg. 100 g⁻¹ fresh matter) compared to the interaction between GreenGlobe cultivar and chemical fertilizer (NPK), which gave the lowest average amounted to (78.39 mg. 100 g^{-1} fresh matter).

Table 5: Effect of cultivar,	fertilization treatments	and interaction betw	veen them on t	he percentage of
nitrogen and protein in the	leaves (%) and the leave	es content of vitami	n C (mg. 100 g	g^{-1} fresh matter).

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Cultivars		The percentage of nitrogen in the leaves	The percentage of protein in the leaves	The leaves content of vitamin C (mg. 100 g^{-1} fresh matter)
Gre	en Globe	1 260	7 87	100 79
	Roze	1.200	10.91	338.80
LSD0.	05 value for ultivar	0.106	0.666	51.25
		Effect of I	Fertilization	
C	Control	1.439	8.99	189.84
Palm lea	aves residues	1.440	9.00	230.70
Rice	e residues	1.633	10.20	223.03
Chemi	cal fertilizer	1.499	9.36	235.60
LSD0.05 values for fertilization		0.150	0.942	72.486
		Interaction between	cultivar x Fertilization	
	Control	1.248	7.80	95.45
Green	Palm leaves residues	1.169	7.30	118.0
Globe	Rice residues	1.365	8.53	111.2
	Chemical fertilizer	1.257	7.86	78.3
	Control	1.631	10.19	284.2
Roze	Palm leaves residues	1.712	10.70	343.3
	Rice residues	1.901	11.88	334.8
	Chemical fertilizer	1.740	10.87	392.8
LSD0.0 inte	95 values for eraction	0.296	1.85	95.23

The above results indicate that the cultivars had a significant effect on vegetative growth, quantitative and qualitative traits. This was due to the different genotypes for the two cultivars and the interaction of the genetic factors with the surrounding environment. These results agree with (Abdel Ghali and Saadoun, 2005; Saied and Abdel Rahman, 2016). This also agrees with (Al-Saidi, 2005; Olaniyi and Ojetayo, 2011) who stressed that the cultivars

results of Fertilization cabbage. The of show NPK treatments that treatment significantly excelled in the traits of vegetative growth. This is due to the abundance of nutrients provided by chemical fertilization, which is fast chemical absorption. It did not significantly differ on organic fertilization with decomposition and absorption slow thus helping abundant elements to speed cell

had a significant effect on the growth and yield

division and increase root total, thus raise plant's ability to absorb nutrients from the soil, which leads to early growth. These results agree with (Aboudahi and Younis, 1988; Schippers, 2000; Ali et al., 2000; Khalaf, 2012) who found that the addition of NPK led to a significant increase in vegetative traits. The use of organic fertilizers and what contain from the micro and macronutrients compared to the control treatment increases the process of photosynthesis and respiration and in the process of building protoplasmic where it is involved in the synthesis of nucleic acids RNA and DNA necessary division of cells. Organic fertilizers have a role in improving the physical and chemical traits of the soil, increasing the proportion of organic matter in the soil and increasing the activity of microorganisms, as well as encouraging chelating compounds with micro-nutrients and granting them from fixation and increasing the chance of absorbing it by the plant, thus its positive role in increasing the traits of vegetative growth and quantitative and qualitative yield for the plant. The results agree with (Mackowaik et al., 2001; Mohammed, 1991; Tawfiq and AL-Sahaf, 2014; Jingjing et al., 2015) who indicated to the role of chemical fertilizer NPK in increasing the yield and its components. There were significant differences between fertilization treatments on the qualitative yields, It was found that the fertilization treatment with rice significantly

affected the percentage of nitrogen and protein compared to other treatments. This is due to the fact that organic fertilizers improve the physical and chemical properties for the soil and provide nutrients in a balanced and sufficient for plant growth (Hassan 2008). In addition, rice residues increase the ability of the soil to retain nutrients through their effect on cation exchange capacity (Hosseny et al., 2009). In the case of significant superiority for some bi-interaction, it may be attributed to the cumulative effect for individual factors.

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