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Effect of Various Levels of Organic Fertilizer and Humic Acid on the Growth and Roots Quality of Turnip Plants (*Brassica rapa*).

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ABSTRACT

Two field experiments were carried out during the two seasons of 2011 and 2012 at the experimental station of National Research Centre, Beheira Governorate (North of Egypt) to investigate the effect of organic compost manure fertilizer at rates of (0, 10 and 20 m^3/fed.) as well as humic acid at rate of (2, 4 and 6 L/fed.) for influence plant growth, roots physical and chemical quality of turnip plants c.v. Balady. The important obtained results were as following:

1- Adding organic compost manure (produced from recycling the agriculture residues) at high rates (20 m^3/fed.) had a significant effect on growth characters, i.e. plant length, number of leaves/plant, fresh and dry weight/plant as well as root fresh and dry weight and its components (root length and diameter). Also, gave the highest percentage of protein, N, P, K and Fe ppm as well as total carbohydrate percentage.

2- By increasing rate of humic acid increased growth characters, root yield characters and increment the percentage of protein, N, P, K, carbohydrate and Fe contents of turnip root tissues.

3- The highest values of the growth characters, roots characters and the percentage of protein, N, P, K, carbohydrate and Fe content ppm in turnip root tissues were associated with that plants received higher compost level (20 m^3/fed.) with higher level of humic acid (6 L/fed.).

Key words: Turnip- Nile compost- humic acid - growth- root yield –root quality.

Introduction

Turnip (*Brassica rapa*) is a member of the cruciferous family of vegetables. Brassica rapa, commonly known as field mustard or turnip mustard is a plant widely cultivated as a leaf vegetable, a root vegetable, and an oilseed. Plants for a future can not take any responsibility for any adverse effects from the use of plants. Always seek advice from a professional before using a plant medicinally. A decoction of the leaves or stems is used in the treatment of cancer (Duke and Ayensu 1985). The powdered seed is said to be a folk remedy for cancer (Duke 1983). The crushed ripe seeds are used as a poultice on burns (Foster and Duke 1990). The root when boiled with lard is used for breast tumors (Duke 1983). A salve derived from the flowers is said to help skin cancer (Duke 1983). Moreover, turnip extract is also useful for lowering uric acid and extracting renal stones. It increases visual keenness and is used to treat night blindness. Turnips syrup strengthens the memory (Khashayar, 2007). Turnip root peelings contain a natural insecticide Allardice (1993).

The organic manures are numerous, they prepared initially from either animal or plant residues. All organic manures improve the behaviors of several elements in soils through that active group (filvic and humic acids) which have the ability to retain the elements in complex and chelate form. These materials release the elements over a period of time and are broken down slowly by soil microorganisms. The extent of availability of such nutrients depends on the type of organic materials and microorganisms (Saha *et al* 1995). Also, organic manure supplies the plants with many nutrients which improve the physical properties of the soil consequently improve the plant growth (Slawon *et al* 1998) on radish plant and yield of both qualitatively and quantitavely. However, Marculescu *et al*., (2002) revealed that, the soil with its content in macro and microelements, enhanced by the use of organic fertilizers, play an essential role in the plants growing and development, in biosynthesis of the organic substances. In the same respect, Shafeek *et al* (2003) on Japanese radish reported that increasing the rate of organic manure up to (40 m^3/ fed.) resulted in the highest total roots yield and the highest values of crude protein, N,P and K as well as the heaviest seed production. Also it is very cheap and expressed cash money improving the income of farmer, in addition, uses this organic materials are safe for human health. However, Entesharil *et al* (2012) on turnip plants reported that using organic compost reduces the negative effects of chemical fertilizer and increase soil fertility. The results showed that the germination, growth parameters (total chlorophyll content, fruit diameter, leaf number, leaf area, shoot fresh weight and dry weight) was significantly altered, especially with these root of plants in 20% organic compost. Moreover, El-Sherbeny *et al* (2012) found that adding organic compost tea increased carbohydrate content of turnip roots. Also, Heba and Sherif (2014) found that compost manure as a soil drench alone or with yeast increased the N % and % P uptake rates, the values were 126%, 174% for N and 255%, 322% for P respectively.

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On the other hand, many commercial products containing humic acid, including K humate have been promoted for use on various crops (Liu *et al*., 1998). Benefits ascribed to the use of humic acid, particularly in low organic matter, alkaline soil, include increased nutrient uptake, tolerance to drought and temperature extremes, activity of beneficial soil microorganisms and availability soil nutrients (Russo and Berlyn, 1990). Humic materials may also increase root growth in a manner similar to auxins (Senn and Kingman 1973). Humic acid is an organically charged bio-stimulant that significantly affects plant growth and development and increases crop yield. It has been extensively investigated (Nardi *et al*., 2004) that humic acid improves physical (Varanini *et al*., 1995), chemical and biological properties of soils (Mikkelsen, 2005). The role of humic acid is well known in controlling, soil-borne diseases and improving soil health and nutrient uptake by plants, mineral availability, fruit quality, (Mauromicale *et al*., 2011). Humic acid based fertilizers increase crop yield (Mohamed *et al*., 2009), stimulate plant enzymes/hormones and improve soil fertility in an ecologically and environmentally benign manner (Mart, 2007). Several research workers highlighted the positive benefits of humic acid application on higher plants (Ashraf *et al*., 2005; Susilawati *et al*., 2009). Humic acids also reduce toxic effects of salts on turnip (Albayrak, 2005) and mustard (Duval *et al.,* 1998). Enhanced nutrient uptake by plants as a result of humic acid application is also well established (Aydin *et al.*, 1999 and Sharif *et al*., 2004). Likewise, the increased yield is also observed in many crops due to humic acid application, including brassica (Erik *et al.*, 2000 and Vetayasuporn, 2006). However, Albayrak and Camas (2005) found that increasing application of humic acid up to1200 (ml/ha) has significantly promoted root and leaf yield of forage turnip (*Brassica rape* L.). In the same respect, Rajpar *et al* (2011) found that the application of humic acid at 6.35 kg /acre positively affected almost all the growth and yield parameters of *Brassica compestris plants*. El-Sherbeny *et al* (2012) found that adding humic acid increased carbohydrate content of turnip roots.

The aim of this study was to investigate the effect of both organic manure application and humic acid levels on growth, root yield and quality of turnip plants.

Materials and Methods

Two field experiments were carried out at the experimental station of National Research Centre at Nubaria, Behira Governorate, Egypt during the two growing seasons of 2011 and 2012 in order to study the effect of the addition of different levels (0, 10 and 20 m3/fed.) of organic manure (Nile compost) produced by recycling the agricultural residues with various concentrations of humic acid (2, 4 and 6 L /fed.) on vegetative growth, root yield characters and root quality of turnip plants (*Brassica rape* L.) cv. Balady. The physical and chemical properties of organic manure (Nile compost) are shown in Table (1) and the chemical analysis of used humic acid are presented in Table (2). The experimental site had a sandy soil texture with pH of 7.6, Ec of 0.19 and the organic matter was 0.21% with 14.00, 8.90 and 15.60 mg/100g soil of N, P and K respectively. Phosphorus (P_2O_5) and potassium (K_2O_5) were applied 50 and 100 kg/fed. each at the time of soil preparation. Seeds of turnip were obtained from Horticultural Research Institute, Agriculture Research Center and sown on September 20^{th} and 25^{th} in 2011 and 2012, respectively. The area of experimental plot was 10.5 m^2. Every plot consisted of 5 dripper lines 3m in length and 0.7m in width. Seeds were sown in hills 10 cm apart on one side of dripper lines and two seeds per hill. The normal agriculture practices of turnip under drip irrigation system were followed according to the recommendations of Agriculture Ministry. The levels for organic manure fertilizer and humic acid were applied during soil preparation in a split plot design with three replicates, organic manure treatments occupied the main plots, while the application of humic acid were distributed randomly in the sub plots. This experiment included 9 treatments which included all combinations between the three levels of organic manure fertilizers (0, 10 and 20 m^3/ fed.) with three humic acid levels (2, 4 and 6 L/fed.).

Table 1: Physical and chemical properties of Nile compost.

Character	Nile compost values
Weight of cubic meter (kg)	400
Moisture%	30
Ph	7
Ec (m. mhos)	5
Organic carbon %	41
Organic matter %	70
Total nitrogen %	2
C/N ratio	1: 17
Total phosphorus %	0.6
Total potassium %	6.0
Iron mg/kg	7900
Manganese mg/kg	190
Copper mg/kg	20
Zinc mg/kg	4.75

Table 2: Humic acid total analysis.

Guaranteed Analysis	
Humic acid	80%
Potassium (K2O)	10-12%
Zn, Fe, Mn, etc.	100 ppm
Physical Data	
Appearance	Black powder
pH	9-10
Water solubility	> 98 %

At the vegetative growth stage, random samples of five plants from each plot were taken 60 days from sowing for determination of plant length (cm), number of leaves per plant as well as, fresh and dry weight (g) of leaves /plant. Also, root organs (fresh and dry weight) and some physical properties of root (diameter and length) were measured. The chemical constituents of root turnip were determined as the percentage of N, P and K according to the methods of Pregl (1945), Troug and Mayer (1939) and Brown and Lilleland (1946) respectively. However, Fe concentration was determined using flame ionization atomic absorption spectrophotometer model 1100B (Perkin Elmer) according to the method of Chapman and Pratt (1978). Also, total crude protein % and total carbohydrate % was extracted and determined according to A.O.A.C (1975).

All obtained data were subjected to the statistical analysis and means were compared according to LSD at 5% level test described by Gomez and Gomez (1984).

Results and Discussion

Vegetative growth characters:

1-Effect of organic fertilizer levels:

The results reported in Table (3) showed that adding both levels of organic manure (Nile compost) significantly increased the different growth characters expressed as (plant length, number of leaves /plant, fresh and dry weight of leaves/plant) in 2011 and 2012 experiments, except fresh weight of leaves /plant at 2012 experiment was not significant. The highest values of the growth characters of turnip plant were resulted by adding high level of organic manure (20 m^3/fed.). However, the differences between (10 and 20 m^3 compost/fed.) were significantly increased by high level of compost manure addition (20m^3/fed.) compared low level (10m^3/fed.) and without addition (control). In addition, organic manure fertilizer usually improve the physical and chemical properties of soil, plant nutrition, better vegetative growth and increased quantitative and qualitative characteristics of vegetable crops. It could be concluded that, the increasing plant growth characters by increasing levels of organic manure fertilizer it might be concluded that the addition of high level of organic manure to turnip plant caused an increase of the nutritional elements in rooting zone, and also due to increased availability of nutrients especially N, P, K, Zn, Fe and Mn even from the early stage of crop growth. Consequently the more nutrients were absorbed so more and enhancement of plant growth characters. Similar results were obtained by Mokadem (2000) and Heba and Sherif (2014) on sugar beet, Shafeek *et al* (2003) on Japanese radish and El-Sherbeny *et al* (2012) on turnip plant**.**

2- Effect of humic acid levels:

Our results showed that application of Humic acid significantly influenced plant length, number of leaves /plant, fresh and dry weight of leaves /plant (Table 3). However, by increasing rate of humic acid increased growth characters in both seasons. The statistical analysis also showed that the medium and high levels of humic acid (4or 6 L/fed.) significantly increased all growth characters compared to the low level (2 L/fed.). In the same respect, the application of high level of humic acid (6 L/fed.) significantly increased all growth characters compared to the medium level (4 L/fed.). The manifold significance of humic acid application to plants is now well established. The application of humic acid has significant beneficial effect on the growth and yield of mustard David and Samule, (2002). Also, Rao *et al.* (2002) reported such results in case of increased dry matter yields of mustard. Similarly, Albayrak (2005) reported that humic acid significantly affected most of the yield components of turnip *Brassica raya*. In another study, Chris *et al.* (2005) reported that both the foliar and soil application of humic acid significantly improved seed yield and oil content of mustard. However, MacCarthy *et al.* (2001) concluded that humates enhance nutrient uptake, improve soil structure, and increase the yield and quality of various crops. Researchers also found lower dose of humic acid equally effective to their higher levels in increasing plant growth and enhancing the nutrient uptake (Salt *et al*., 2001). Humic acid was influence plant growth both in direct and indirect ways. Indirectly, it improves physical, chemical and biological conditions of soil. While directly, it increases chlorophyll content, accelerates plant respiration and hormonal growth responses, increases penetration in plant membranes, etc. These effects of humic acid operate singly or in integration. The above discussion clearly validates the suitability of humic acid as a beneficial fertilizer product.

3- Effect of the interaction between organic compost and humic acid levels:

The interaction effect of adding organic compost with humic acid levels on the turnip plant growth characters Table (3) recorded that all increasing the levels of organic compost and humic acid increased all plant growth characters compared to all concentrations treatments but these increased non significant in the two studied seasons. On the contrary, the poorest turnip plant growth characters was associated with that plants received without compost manure with low level of humic acid adding (2 L/fed.). These results were consequently similar in both experimental seasons.

Total root yield and physical properties:

1-Effect of organic fertilizer levels:

Data in Table (4) showed clearly that the addition of organic compost fertilizer which produced from recycling the agricultural residues caused an increase in total root yield (fresh and dry weight roots) of turnip plant and its physical properties (diameter and length). Moreover, obtained data revealed that increasing the rate of organic compost up to (20 m^3/fed.) resulted in the highest fresh weight of root per plant (104.31 g/plant in the first season and 104.32 g/plant in the second season respectively). However, the obtained data reported that all addition of organic manure significantly increased total root yield and physical root quality compared untreated control. In other words, addition of (20 m^3/fed.) of organic compost manure fertilizer had superiority on fresh and dry weight of root as well as the physical root quality (length and diameter) compared low level (10 m^3/fed.) in both seasons. It could be suggested that, the superiority of high level of organic compost manure these may be due to the effect of its manure was producing good growth of turnip plants (Table 3) which reflected on the root fresh and dry weight as well as the physical root quality. Similar results were obtained by Mokadem (2000) and Heba *et al* (2014) on sugar beet, Shafeek *et al* (2003) on Japanese radish and El-Sherbeny *et al* (2012) on turnip plant**.**

2- Effect of humic acid levels:

A table (4) shows clearly that the application of high level of humic acid (6L/fed.) had a significant effect on root fresh and dry weight as well as root quality (length and diameter) in both two experimental seasons compared to medium or low levels (4 or 2 L/fed.). Whereas, supplying turnip plants by humic acid at level of (4 L/fed.) resulted the heaviest fresh weight of root compared low level (2 L/fed.). However, humic substances are mostly used to remove or decreased the negative effects of chemical fertilizers from the soil and have a major effect on root yield as shown by many scientists (Ghabbour and Davies, 2001). Also, humic acid stimulate plant growth by the assimilation of major and minor elements, enzyme activation and /or inhabitation, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan, 2008). In this respect, Albayrak and Camas (2005) revealed that the highest root and dry matter yield were obtained from the 1200 ml/ ha humic acid level for turnip (*Brassica rapa L.*). Furthermore, the promotion effect of humic acid on yield characters of turnip plants was due to its higher nutritional value in addition to its capacity to improve the hydro-physical properties of the soil.

3- Effect of the interaction between organic compost and humic acid levels:

The interaction treatments of organic manure and humic acid at different levels did not significantly affect on root fresh and dry weight as well as root length and diameter in both seasons (Table 4). However, the highest yield characters were obtained by addition turnip plants by high level of compost manure at (20 m^3/fed.) with high level of humic acid. These finding were true in both seasons.

Chemical properties of turnip roots:

1-Effect of organic fertilizer levels:

Adding organic compost manure (produced from recycling the agriculture residues) at different rates (10 or 20 m3/fed.) had a significant effect on the percentage of cruse protein, N, P, K and carbohydrate contents of turnip roots in 2011 and 2012seasons except Fe content ppm did significant increased by adding (10 m^3/fed.) in the 2011 season. Such contents increased with increasing the rate of organic compost manure. However, the high level of organic compost manure (20 m^3/fed.) significantly increased these contents of root tissues compared to low level (10 m^3/fed.) in both seasons. It could be stated that the higher values of nutritional values which associated with the higher rates of organic compost manure may be attributed to increasing the level of organic manure in rooting zone which encouraged the root system to absorb more quantity of the needed elements consequently their levels in root tissue increased (Shafeek *et al* 2003). On the other hand, the pronounced increment of total carbohydrate percentage with applied various compost manure levels was observed. This increment may be explained by the promising role of compost to supply the growing plants with required micro and macro nutrients which play important role in metabolic process as photosynthesis, respiration and carbohydrate synthesis. Many other workers had similar findings which are supporting the obtained data (Mokadem, 2000, Shafeek *et al* 2003, El- Sherbeny *et al* 2012 and Heba and Sherif 2014).

Table 3: Effect of organic manure and humic acid levels on growth characters of turnip plant during 2011 and 2012 seasons.

Levels of nile compost (m^3/fed.)	Levels of humic acid (L /fed.)	Plant height (cm)		Number of leaves /plant		Fresh weight of leaves /plant (g)		Dry weight of leaves /plant (g)	
Seasons		2011	2012	2011	2012	2011	2012	2011	2012
0	2	14.00	15.00	4.33	4.67	33.73	34.33	6.41	6.87
	4	18.00	18.00	5.00	5.33	39.00	38.11	7.80	7.62
	6	19.67	20.33	5.33	5.67	39.72	39.90	7.94	7.98
mean		17.22	17.78	4.89	5.22	37.48	37.45	7.39	7.49
10	2	16.67	17.44	5.33	5.67	37.10	36.65	7.44	7.33
	4	20.60	20.17	7.67	6.67	41.35	40.65	8.31	8.13
	6	23.90	23.50	8.67	8.33	45.67	55.59	9.10	9.09
mean		20.39*	20.37*	7.22*	6.89*	41.37*	44.30	8.28*	8.18*
20	2	20.43	20.32	7.33	7.67	40.47	40.00	8.03	8.00
	4	22.83	23.07	9.67	9.00	45.42	45.23	9.09	9.06
	6	29.73	28.96	10.33	10.33	50.53	47.70	10.11	9.54
mean		24.33**	24.12**	9.11**	9.00**	45.47**	44.31	9.07**	8.86**
Average	2	17.03	17.59	5.67	6.00	37.1	36.99	7.29	7.40
	4	20.48*	20.41*	7.44*	7.00*	41.92*	41.33	8.40*	8.27*
	6	24.43**	24.27**	8.11**	8.11**	45.31**	47.73**	9.05**	8.87**
LSD at 5% levels	Nile compost	1.33	1.08	0.48	0.36	1.31	NS	0.33	0.19
	Humic acid	1.08	1.15	0.36	0.42	0.75	4.57	0.27	0.09
	Interactions	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Effect of organic manure and humic acid levels on total roots yield and physical root quality of turnip plant during 2011 and 2012 seasons.

Levels of nile compost (m^3/fed.)	Levels of humic acid (L /fed.)	Fresh weight of roots /plant (g)		Dry weight of roots /plant (g)		Root length (cm)		Root diameter (cm)	
Seasons		2011	2012	2011	2012	2011	2012	2011	2012
0	2	46.57	46.61	13.04	12.59	5.13	5.20	4.60	4.34
	4	57.18	57.51	14.38	13.78	6.27	6.18	5.17	5.06
	6	74.00	74.24	18.56	18.08	7.47	7.14	5.87	5.45
mean		59.25	59.45	15.32	14.82	6.29	6.18	5.21	4.93
10	2	63.35	63.78	15.94	15.41	8.77	8.44	7.02	6.69
	4	68.96	69.30	17.51	17.10	9.17	8.91	7.25	6.80
	6	85.65	86.13	21.45	20.98	9.53	9.59	7.75	7.49
mean		72.65*	73.07*	18.30*	17.83*	9.16*	8.98*	7.34*	6.99*
20	2	91.37	91.53	22.88	22.36	10.07	9.66	8.07	8.00
	4	98.46	98.19	24.58	24.07	10.40	10.12	8.27	8.31
	6	123.11	123.24	31.00	30.45	11.27	11.15	8.55	8.39
mean		104.31**	104.32**	26.15**	25.63**	10.58**	10.31**	8.29**	8.23**
Average	2	67.10	67.31	17.29	16.79	7.99	7.77	6.56	6.34
	4	74.86*	75.00*	18.82	18.32	8.61	8.40	6.90	6.72
	6	94.25**	94.54**	23.67**	23.17**	9.42**	9.29*	7.39*	7.11*
LSD at 5% levels	compost	4.63	4.60	1.34	1.26	0.30	0.20	0.20	0.23
	Humic acid	6.82	6.66	2.06	1.99	0.67	0.99	0.82	0.47
	Interactions	NS	NS	NS	NS	NS	NS	NS	NS

2- Effect of humic acid levels:

The application of humic acid had a great effect on the value of some nutritional elements of root tissues in the two studies seasons. Whereas, increased rates of the application of humic acid caused an increment in the percentage of protein, N, P, K, carbohydrate and Fe contents. However, using humic acid at rate of high level (6 L/fed.) resulted the highest values of the percentage of protein, N, P, and Fe ppm in both seasons compared to medium and low levels (4 or 2L /fed.) except Fe content in the first season. In contrast the application of various humic acid levels produced a promotion effect in the accumulation of total carbohydrate percentage. Moreover, the highest humic acid level caused the maximum significant level for total carbohydrate content.

3- Effect of the interaction between organic compost and humic acid levels:

In spite of the non significant effect of the interaction of compost manure and three rates application of humic acid in the two seasons (Table 5). It could be concluded that the highest values of the percentage of protein, N, P, K, carbohydrate and Fe content ppm in turnip root tissues were associated with that plants received higher compost level (20 m^3/fed.) with higher level of humic acid (6 L/fed.). On the contrary, the lowest values from the above mentioned elements were obtained without compost fertilizer with low level of humic acid addition. These findings are in good accordance in both seasons.

Table 5: Effect of organic manure and humic acid levels on the chemical quality of turnip roots during 2011 and 2012 seasons.

Levels of Compost (m^3/fed.)	Levels of humic (L/fed.)	%										ppm	
		N		protein		P		K		Carbohydrate		Fe	
Seasons		2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
0	2	1.57	1.42	9.79	8.86	0.070	0.063	2.26	2.29	15.67	15.43	2215	2214
	4	1.69	1.65	10.58	10.34	0.081	0.077	2.35	2.37	16.03	15.93	2276	2277
	6	1.76	1.77	11.02	11.07	0.090	0.086	2.59	2.58	16.18	16.10	2310	2297
mean		**1.67**	**1.61**	**10.47**	**10.09**	**0.081**	**0.075**	**2.40**	**2.41**	**15.96**	**15.82**	**2267**	**2262**
10	2	1.78	1.75	11.48	10.96	0.070	0.079	2.43	2.35	16.80	16.75	2227	2228
	4	1.90	1.93	11.90	12.06	0.090	0.088	2.57	2.53	17.18	17.07	2250	2299
	6	1.93	1.90	12.07	11.90	0.101	0.097	2.90	2.90	17.32	17.39	2293	2309
mean		**1.87***	**1.86***	**11.81***	**11.64***	**0.091***	**0.088***	**2.63***	**2.59***	**17.10***	**17.07***	**2257**	**2279***
20	2	2.04	2.10	12.77	13.13	0.111	0.109	3.28	3.23	17.78	17.74	2333	2327
	4	2.18	2.11	13.63	13.21	0.110	0.113	3.42	3.22	18.05	18.10	2345	2347
	6	2.26	2.29	14.15	14.29	0.111	0.114	3.44	3.53	18.18	18.11	2351	2356
mean		**2.16****	**2.17****	**13.52****	**13.54****	**0.111****	**0.111****	**3.38****	**3.33****	**18.00****	**17.98****	**2343***	**2343****
Average	2	1.80	1.76	11.35	10.98	0.0810	0.084	2.66	2.63	16.75	16.64	2259	2256
	4	1.93*	1.90*	12.04*	11.87*	0.0940*	0.093*	2.78	2.70	17.08*	17.03*	2291	2307*
	6	1.99*	1.99*	12.41*	12.42*	0.1001*	0.099**	2.98*	3.00*	17.22*	17.20*	2318*	2321*
LSD at 5% levels	compost	**0.04**	**0.08**	**0.28**	**0.51**	**0.010**	**0.004**	**0.07**	**0.08**	**0.09**	**0.18**	**15.54**	**13.65**
	Humic acid	**0.07**	**0.10**	**0.45**	**0.62**	**0.010**	**0.002**	**0.17**	**0.34**	**0.22**	**0.34**	**40.71**	**22.81**
	Interactions	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

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