

**Effect of spraying number with potassium and liquid humate on (2)
oil yield and chemical composition of Indian mustard *Brassica juncea*
(L.) Czern. and Coss.**

Essam H. A. Al- Doghachi

**Hort. and Landscape Design Dept. Agric. Coll., Basrah Univ.,
Basrah–Iraq**

Abstract

A study was conducted during two growing seasons of 2011/ 2012 and 2012/2013 in a private orchard at Abu Al- Khaseeb district, Basrah, to study the effect of number of spraying with potassium and liquid humate and their interactions on oil yield of Indian mustard plant *Brassica juncea* (L.) Czern. and Coss .and its chemical composition. The study Included 18 factorial treatments, which were the combinations of three potassium concentrations 0, 1.5 and 3.0 ml.l⁻¹ , three liquid humate concentrations 0, 50 or 70 ml.l⁻¹ spraying once or twice. Complete Randomized Block Design in a factorial experiment was used with three replicates. Treatment means were compared according to the Least Significant Difference (LSD) at 0.05 levels . Results showed that, plants sprayed with potassium at 3.0 mg l⁻¹ gave significant increases in oil percentage (27.9% and 30.1%), oil yield. plant⁻¹ (14.7 and 16.5g) and productivity of oil. hectare⁻¹ (527.8 and 591.0 kg) for the two growing seasons, respectively. On the other hand, plants sprayed with liquid humate at 70 mg l⁻¹ gave significant increases in oil percentage (28.8 and 30.6%), oil yield. plant⁻¹ (15.8 and 17.8 g) and productivity of oil. hectare⁻¹ (567.1 and 635.9 kg) for both growing seasons, respectively. Meanwhile, plants sprayed twice gave significant increases in oil percentage (26.4 and 28.8 %), oil yield.

plant⁻¹ (12.4 and 14.0 g) and productivity of oil. hectare⁻¹ (444.0 and 502.4 kg) for both growing seasons. Interactions between the studied factors, showed significant effects in all studied parameters. Gas Chromatography- Coupled with Mass Spectrometry showed that the major chemical oil components were unsaturated fatty acid, i.e. Linoleic acid, Methyl 11-eicosenoate and Ethyl 13-docosenoate which ranged from 48.24% to 81.01% and minor chemical oil components that included saturated fatty acid, i.e. Palmitic acid, Stearic acid, Methyl 18-methylnonadecanoate and Lignoceric acid which ranged from 9.36% to 21.78% and unsaturated fatty acid, i.e. cis-13-Eicosenoic acid and Methyl nervonate which ranged from 2.96% to 31.94%.

Key words:- Indian mustard – potassium – liquid humate – spraying number -oil yield – components

Introduction

In human nutrition, plant lipids and seed oils are preferable to animal fats because of their lower contents of cholesterol and their generally high proportions of unsaturated fatty acids, e.g. linoleic acid and linolenic acid which were the most important (1). Vegetable oils account for 0.4% of the total crop production in Iraq, groundnut oil makes up the largest proportion

(65.5%) of production followed by sunflower and then sesame (2). These product cover small ratios of the annual requirements of vegetable oils, therefore, large quantities of edible oil are being imported annually from other countries. This shortage in edible oils has converged the attentions of agricultural scientist to introduce new of crops.

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] an annual plant in the Brassicaceae (Cruciferae) family, is an important oilseed crop in South East Asia and is the second after groundnut in India in terms of acreage and productivity (3), and the first in Bangladesh due to its presence 72% of oil crops (4).

Potassium plays a vital role it is needed for metabolic plant cell's processes and apparently has a role in influencing the uptake of certain mineral elements, regulating the rate of respiration, affecting the rate of transpiration and activation of a large number of enzymes and hence, controls many physiological functions, e.g., formation of proteins and chlorophyll, carbohydrate metabolism (respiration) and water use efficiency as well as in the production and translocation of

assimilates to the storage organs. K provides strength to plant cell walls and is involved in the lignifications of sclerenchyma tissues. Adequate K nutrition ensures adequate translocation of assimilates to the seeds (5). The high K concentration well as for oil crops K increases leaf area and leaf chlorophyll content, delays leaf senescence and therefore, contributes to a greater canopy photosynthesis and crop growth (6). Potassium fertilizer has the pivotal role in increasing crop production. Besides N and P, the use of K has been reported to influence the productivity of seed yield and seed oil contents (7). Kuo and Chen (8) reported that K addition increased seed oil content of rape. Potassium fertilization also, increased seed oil concentration, but caused a simultaneous decrease in protein concentrations (9). High levels of

potassium fertility also, can cause changes in fatty acid profiles within the seed oils (10). Potassium fertilization increased the concentration of linolenic acid in the seed oils, while, oleic acid decrease

In this experiment, an attempt was made to investigate the effect of varying spraying rates of potassium, liquid humate and spraying number on the growth, yield and oil content of Indian mustard and its chemical constituents.

Materials and methods

Field experiment was conducted in two growing seasons of 2011/2012 and 2012/2013 in a private orchard at Abu Al-Khaseeb district, 8 km from Basrah center, in a silty clay soil with pH of 7.8 and 8.0 and Electric conductivity (E.C.) of 1.3ds /m² and organic matter of 2.20 and 2.85% for the two growing seasons, respectively. The

experiment carried out to study the effect of spraying potassium and liquid humate once or twice on seed yield and oil yield of Indian mustard plant { *Brassica juncea* (L.) Czern. and Coss.} and its chemical constituents.

This study was conducted as factorial experiment within Randomized Complete Block Design (R.C.B.D.) with three factors

1. Spraying with potassium fertilizer at conc. of 0, 1.5 and 3.0 ml/L. used as Foliartal EDTA which produced by Francisco R. Artal SL Company, Spain.
2. Liquid humate at conc. of 0, 50 and 75 ml/L. which contains humic and Fulvic acids at percentage of 18.1% , potassium of 3%, organic matter of 16.5%, ferrous of 10.3% which is produced by HUMIN TECH, Germany.

3. **Spraying number, once or twice. and the interactions of the three above factors on seed yield and oil.**

Analysis of variance was used for result analysis. Least significant difference (LSD) was also used to compare means at probability of 0.05 (11).

Soil was ploughed twice, manure fertilizer was add during soil preparation at a rate $40 \text{ m}^3 \cdot \text{h}^{-1}$. Soil was leveled and calcium mono superphosphate (P%18) at a rate of $400 \text{ kg} \cdot \text{h}^{-1}$ was also added. The field was divided to 18 furrows at a length of 13 m with a width of 0.70 m. Each furrow was divided into three experimental units with a length of 3.6 m. There were 0.60 m intervals between each experimental unit 0.50 m. was left at the beginning and end of each furrow as guard unit. Each experimental unit contain 12 hills of 30 cm apart. Pure quality seeds were

obtained from Medicinal and Aromatic Unit, College of Agriculture, Basrah University.

These seeds were sowed on 1/10 into the field for both seasons at a rate of three seeds per hill. After the emergency of the first true leaf seedlings were thinned to one seedling per hill.

All other experimental practices were done equally as recommended by Chris *et al.* (12), e.g. irrigation and fertilization. Plants were fertilized with nitrogenous fertilizer as urea at a rate of $160 \text{ kg} \cdot \text{h}^{-1}$ with two doses, the first was applied after one month from sowing, and the second dose was applied after one month of the first addition. Plants were supported by sticks when they flowered to avoid siliqua from logging.

Crop picking was done on the third of April for both seasons.

Experimental measurements were done for both seasons from each experimental unit at the end of growing season which included the yield of plant, fixed oil percentage and productivity of hectare.

Gas Chromatography

Quantitative and qualitative data were determined by GC- MS. The oil was injected into Shimadzu GC MS –QP2010 Ultra. Indian mustard oil was diluted with 1.0 ml of dichloromethane and 1.0 ml of the resulting solution was injected (Spilt injection 30:1) into the GC-MS.

GC/ MS parameters

Oven

Injection temperature	280.0 °C
Detector interface temperature	280.0 °C
Initial temperature	60.0 °C
Final temperature	280.0 °C

Column

Column length	30 m
Column diameter	0.25 mm
Carrier gas	Helium 99.9999% purity
Carrier gas pressure	104.1 KPa
Column flow	1.67 ml/min.
Linear velocity	47.2 cm / sec.
Spilt ratio	30.0
Total flow	54.9 ml/ min.

GC Program

Mass Spectrometer

M/Z range	50.0 to 600.0 amu
-----------	-------------------

Scan interval	0.50 sec
Threshold	0
Scan speed	1250 amu/sec
Solvent cut time	3.0 min
Detector gain	0.82 kv + 0.10 kv

Results

Table (1) showed that all main factors and their interactions had significant effects on all oil yield parameters for both seasons. Spraying of potassium fertilizer gave significant increases in oil percentage, oil yield.plant⁻¹ and productivity of oil. hectare⁻¹ and their effect increase with the increased potassium concentration.

Tab.1. Effect potassium fertilizer, liquid humate and spraying number on oil yield parameter

Potassium fertilizer (ml.l ⁻¹)	Liquid Humate (ml.l ⁻¹)	Spraying number	Oil %		Oil yield.plant ⁻¹ (g)		Oil productivity(Kg. hect.- ¹)	
			2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
0	0	1	20.5	22.6	6.3	6.9	226.1	246.1
		2	20.8	23.3	6.4	7.3	228.9	258.9
	50	1	24.3	25.7	7.7	8.2	274.9	292.9
		2	24.8	26.9	8.4	9.2	299.3	326.8
	75	1	27.3	26.8	12.5	12.5	447.5	445.0
		2	27.8	29.7	14.1	15.9	504.3	566.4

1.5	0	1	24.8	27.5	8.6	9.3	309.3	333.1
		2	25.0	27.7	8.7	9.6	312.5	341.8
	50	1	25.8	27.2	12.3	13.3	439.6	476.7
		2	26.0	27.8	12.5	14.0	447.5	501.4
	75	1	28.0	29.5	14.3	16.4	511.7	584.6
		2	28.8	31.9	15.2	18.0	543.2	643.6
3.0	0	1	26.0	28.4	11.1	12.0	397.5	429.6
		2	26.0	28.4	12.1	13.6	434.6	497.1
	50	1	26.8	28.3	12.9	14.1	461.4	504.3
		2	27.4	29.9	13.4	15.1	477.5	539.3
	75	1	29.8	31.9	18.1	20.4	647.1	729.3
		2	31.1	33.9	20.9	23.7	748.6	846.4
LSD 0.05			1.5	4.0	2.2	3.3	78.5	120.5
Potassium fertilizer (ml.l⁻¹)								
0			24.3	25.8	9.2	10.0	330.2	356.0
1.5			26.4	28.6	11.9	13.4	427.3	480.2
3.0			27.9	30.1	14.7	16.5	527.8	591.0
LSD 0.05			0.6	1.6	0.90	1.3	32.1	49.2
Liquid Humate (ml.l⁻¹)								
0			23.9	26.3	8.9	9.8	318.1	351.1
50			25.9	27.6	11.2	12.3	400.0	440.2
75			28.8	30.6	15.8	17.8	567.1	635.9
LSD 0.05			0.6	1.6	0.90	1.3	32.1	49.2

Spraying number						
1	25.9	27.5	11.5	12.6	412.8	449.1
2	26.4	28.8	12.4	14.0	444.0	502.4
LSD 0.05	0.5	1.3	0.7	1.1	26.2	40.1

Table (1) continue

Interactions

Potassium fertilizer (ml.l ⁻¹)	Liquid Humate (ml.l ⁻¹)	Oil %		Oil yield.plant ¹ (g)		Oil productivity(Kg. hect.- ¹)	
		2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013
0	0	20.7	23.0	6.4	7.1	227.5	252.5
	50	24.6	26.3	8.0	8.7	287.1	309.8
	75	27.6	28.3	13.3	14.2	475.9	505.7
1.5	0	24.9	27.6	8.7	9.4	310.9	337.4
	50	25.9	27.5	12.4	13.7	443.5	489.0
	75	28.4	30.7	14.8	17.2	527.4	614.1
3.0	0	26.0	28.4	11.7	12.8	416.0	463.3
	50	27.1	29.1	13.1	14.6	469.4	521.8
	75	30.5	32.9	19.5	22.1	697.8	787.9
LSD 0.05		1.1	2.8	1.5	2.3	55.5	85.2

Interaction Potassium fertilizer (ml.l⁻¹) and spraying number							
0	1	24.0	25.0	8.9	9.2	316.2	328.0
	2	24.5	26.6	9.6	10.8	344.2	384.0
1.5	1	26.2	28.1	11.8	13.0	420.2	464.8
	2	26.6	29.1	12.2	13.9	434.4	495.6
3.0	1	27.5	29.5	14.1	15.5	502.0	554.4
	2	28.2	30.7	15.5	17.5	553.6	627.6
LSD 0.05		0.9	2.3	1.2	1.9	45.3	69.6
Interaction Liquid Humate ml.l⁻¹) and spraying number							
0	1	23.8	26.2	8.7	9.4	311.0	336.2
	2	23.9	26.5	9.1	10.1	325.3	365.9
50	1	25.6	27.1	11.0	11.9	392.0	424.6
	2	26.1	28.2	11.4	12.8	408.7	455.8
75	1	28.4	29.4	15.0	16.4	535.4	586.3
	2	29.2	31.8	16.8	19.2	598.7	685.5
LSD 0.05		0.9	2.3	1.2	1.9	45.3	69.6

The relative percentages of fatty acids

The relative percentages of fatty acids extracted from *Brassica juncea* seeds treated with different levels of potassium fertilizers, Liquid Humate and Spraying number are presented in Tables 2, 3 and 4.

Seven unsaturated fatty acids and five saturated ones were markedly identified and grouped into three classes, i.e., major fatty acids (more than 10 %); minor fatty acids (with less than 10 %) and traces one (with less than 1 %) were identified.

Data in Table (2) showed that all major fatty acids were unsaturated, e.g. Linoleic acid ranged from 12.29 % in the seed oil of plant treated with high level of potassium, without liquid humate and two sprays increased it to 18.72% in the seed oil of plants treated with the lowest level of potassium, the highest level of humic acid and one spray. Methyl 11-eicosenoate ranged from 6.07% in

the treatment of without potassium, the lowest level of liquid humate and two sprays treatment to 26.40% in the seed oil of control plants. Ethyl 13-docosenoate ranged from 29.88 % in the treatment of without potassium, the highest level of liquid humate and one spray treatment increased to 35.89% in the seed oil of plant treated without potassium, the highest level of liquid humate and two sprays.

Tab 2: Effect potassium fertilizer, liquid humate and number of spraying on major oil components of season 2012/2013

Potassium fertilizer (ml.l ⁻¹)	Liquid Humate (ml.l ⁻¹)	Spraying number	Linoleic acid, methyl ester {9,12-Octadecadienoic acid (Z,Z)-, methyl ester}	Methyl 11-eicosenoate	Ethyl 13-docosenoate
0	0	1	16.82	26.40	30.35
		2	15.69	15.58	33.40
	50	1	15.07	22.45	34.11
		2	16.38	6.07	32.52
	75	1	13.77	18.13	29.88
		2	16.55	23.41	35.89

1.5	0	1	14.65	15.71	32.71
		2	14.57	18.91	30.92
	50	1	14.71	16.48	32.56
		2	14.69	17.69	30.68
	75	1	18.72	14.75	32.61
		2	16.98	22.62	34.53
3.0	0	1	14.69	17.60	31.04
		2	12/29	18.38	30.33
	50	1	16.14	16.47	31.75
		2	16.31	16.88	29.95
	75	1	16.08	23.42	33.62
		2	16.18	13.54	34.26

Table (3) revealed that minor fatty acids were grouped into two groups saturated fatty acid Palmitic acid ranged from 4.24 % in seed oil of control plants to 7.49% in the seed oil of plants without potassium, the lowest level of liquid humate and one spray. Stearic acid ranged from 2.71% in the seed oil of plant treated with the lowest level of potassium, highest level of liquid humate and

one spray increased to 6.23% in the seed oil of control plants. Methyl 18-methylnonadecanoate was found as minor fatty acid ranged from 2.41% in the seed oil of plant treated with the lowest level of potassium, the highest level of liquid humate and one spray increased to 4.49% in the seed oil of plants without potassium, the lowest level of liquid humate and two sprays. Lignoceric acid ranged

from not detected in control plants, seed oil of plants without potassium, the lowest level of liquid humate and one spray, seed oil of plants without potassium, the lowest level of liquid humate and two sprays, seed oil of plants with the lowest level of potassium, the lowest level of liquid humate and two sprays and seed oil of plants with the highest level of potassium, the highest level of liquid humate and one sprays increased to 3.57 % in the seed oil of plants with the highest level of potassium, without liquid humate and two sprays. Second group unsaturated fatty acids that included cis-13-Eicosenoic acid, methyl ester ranged from 2.96% in the seed oil of plants with the lowest level of potassium, without liquid humate and two

sprays increased to 22.31% in the seed oil of plants without potassium, the lowest level of liquid humate and two sprays. Methyl nervonate ranged from not available in control plants, seed oil of plants without potassium, the lowest level of liquid humate and one spray, seed oil of plants without potassium, the lowest level of liquid humate and two sprays, seed oil of plants with the lowest level of potassium, the lowest level of liquid humate and two sprays and seed oil of plants with the highest level of potassium, the highest level of liquid humate and one sprays increased to 9.63 % in the seed oil of plants with the highest level of potassium, without liquid humate and two sprays.

Table 3: Effect potassium fertilizer, liquid humate and spraying number on minor oil components of season 2012/2013

Potassium fertilizer (ml.l ⁻¹)	Liquid Humate (ml.l ⁻¹)	Sprayin g number	Palmitic acid, methyl ester {Hexadecanoic acid, methyl ester}	Stearic acid, methyl ester {Octadecanoic acid, methyl ester}	Methyl 18-linoleic decanoate	Lignoceric acid, methyl ester {Tetracosanoic acid, methyl ester}	cis-13-Eicosanoic acid, methyl ester	Methyl nonadecanoic acid, methyl ester {15-Tetracosanoic acid, methyl ester, (Z)}
0	0	1	4.24	6.23	4.17	-	6.18	-
		2	5.12	2.87	2.54	2.95	3.52	8.95
	50	1	7.49	4.65	3.89	-	5.34	-
		2	5.45	5.37	4.49	-	22.31	-
	75	1	5.68	3.13	2.83	3.42	3.16	9.51
		2	4.48	4.36	4.05	-	4.80	-
1.5	0	1	5.15	3.00	2.69	3.25	3.52	9.22
		2	5.50	3.07	2.67	3.37	2.96	9.15
	50	1	5.23	2.91	2.65	3.22	3.03	9.11
		2	5.43	3.08	2.71	-	3.12	-
	75	1	4.94	2.71	2.41	3.46	3.22	8.85
		2	4.36	4.57	3.39	3.37	5.30	8.98
3.0	0	1	5.40	3.22	2.84	3.31	3.08	9.04
		2	5.55	3.17	2.80	3.57	3.10	9.63
	50	1	5.30	3.06	2.60	3.08	3.18	8.97

		2	5.50	3.03	2.65	3.19	3.36	9.05
	75	1	4.30	5.00	4.42	-	4.97	-
		2	5.05	2.95	2.57	3.09	3.49	9.11

Table (4) showed the trace constituents in seed oil, Myristic acid for example was detected as saturated fatty acid it ranged from not available in the seed oil of plants with the lowest level of potassium, without liquid humate and two sprays increased to 0.25% in the seed oil of untreated plants (control) and from plants without potassium, the lowest level of liquid humate and two sprays. Methyl 7,10,13-hexadecatrienoate was detected as unsaturated fatty acid it ranged from not available in the seed oil of plants with the lowest level of potassium, without liquid humate and two sprays reached to 0.58% in the seed oil of untreated plants (control). Palmitoleic acid also

unsaturated fatty acid it ranged from 0.37% in the seed oil of plants with the lowest level of potassium, the highest level of liquid humate and one spray to 0.96% in the seed oil of untreated plants (control).

Discussion

An increase in the seed oil percentage for mustard plant that fertilized with potassium can be attributed to its role in enzyme activation that control many physiological functions, i.e. protein formation and chlorophyll; carbohydrates metabolism (respiration), production and translocation of assimilates; water use efficiency etc. which reflected their effects on increasing plant leaf area, its contents of chlorophyll,

delaying leaf senescence (6), as well as its role in carbohydrates metabolism and its storage in seeds (5), and due to its role in improving carbohydrates formation, it induces lipid formation, due to its role in lipid synthesis, and hence, increased the percentage of oil in the seeds (13). These results were in agreement with that of (14) on grain crops plants.

On the other hand, increasing percentage of seed oil as a result of liquid humate can be returned to its effect on cell membrane permeability, photosynthesis and root growth (15), besides, its indirect effect on fertilizer use efficiency and direct effect on improving all vital activities in plant (16), improving plant chlorophyll contents and induce plants to

Table: 4 Effect potassium fertilizer, liquid humate and spraying number on trace oil components of season 2012/2013

Potassium fertilizer (ml.l ⁻¹)	Liquid Humate (ml.l ⁻¹)	Spraying number	Myristic acid, methyl ester {Methyl tetradecan-oate}	Methyl 7,10,13-hexadecatrienoate	Palmitoleic acid, methyl ester {9-Hexadecenoic acid, methyl ester, (Z)-}
0	0	1	0.25	0.58	0.96
		2	0.15	0.31	0.46
	50	1	0.21	0.46	0.75
		2	0.25	0.52	0.92
	75	1	0.16	0.31	0.49
		2	0.21	0.42	0.71
0	0	1	0.15	0.27	0.45

1.5	50	2	-	-	0.39
		1	0.15	0.28	0.46
	75	2	0.16	0.27	0.47
		1	0.14	0.23	0.37
		2	0.21	0.46	0.74
		1	0.16	0.30	0.46
3.0	0	2	0.16	0.31	0.45
		1	0.15	0.23	0.43
	50	2	0.16	0.30	0.46
		1	0.24	0.46	0.80
		2	0.13	0.29	0.45
		1	0.16	0.30	0.46

growth hormone response in addition to humate role in increasing plant

nitrogen content (17).

attributed to the suitable concentrations for both potassium fertilizer and liquid humate that induce photosynthesis compared with one spraying.

It could be concluded from this experiment that potassium fertilization, liquid humate spraying and spraying number resulted in an increase in the oil yield parameters. In addition, gas chromatography

All the above effects, single or together can play an important role which reflected on photosynthesis efficiency which affected the oil productivity. This was in agreement with that found by Rajpane *et al.* (17) on mustard plant and El-Sherbeny *et al.* (18) on turnip plant. Meanwhile, the increase that was gained in seed oil parameters due to the two spraying number can be

saturated fatty acid and their coupled with mass spectrometry
percentages were affected with proved that unsaturated fatty acid
different treatments. prone to apistacis rather than

Treat.1

Treat.2

2

Treat.3

Treat.4

Treat.5

Treat.6

Treat.7

Treat.8

Treat.9

Treat.10

Treat.11

Treat.12

Treat.13

Treat.14

Treat.15

Treat.16

Treat.17

Treat.18

References

1. Beringer, H. (1977): Effects of temperature on the synthesis of essential fatty acids and vitamin E in oil crops. Proc. of the 13th Colloquium of IPI in York, UK.
2. Statistically Center Enterprise (2009). Report of Agricultural Statistics for 2009. Iraq.
3. Damodaran, T. and D.M. Hedge (2005). Oilseeds situation: A statistical compendium. Directorate Oilseeds Research. Indian Council of Agricultural Research, Hyderabad, Table 1.4. p. 5.
4. Basak, N. C.; J. C. Panditb and M. M. H. Khurramc(2007). On-farm evaluation of three mustard varieties under different fertilizer packages. Bangladesh J. Sci. Ind. Res., 42(3): 335-340.
5. Haeder, H.E. (1977). Effects of potassium on phloem loading and transport. Proc. of the 13th Colloquy. of IPI: "Fertilizer Use and Production of Carbohydrates and Lipids" held in York/UK.
6. Marschner, H. (1995). Mineral nutrition of higher plants. Academic Press. London. U.K.. pp: 889.
7. Ghosh, D.C.; P.K. Panda and P.M. Sahoo (1995). Response of rainfall rapeseed (*Brassica compestris*) to NPK. Indian J. Agric. Res., 29: 5–9.
8. Kuo, N.C. and H. Chen (1980). Response of agronomic characters, seed yield, oil contents and fatty acid composition rape seed to NPK fertilizer treatments. J. Agric. Assoc., China 11: 23–35.
9. Yin, X.H. and T.J. Vyn (2003). Potassium placement effects on yield and seed composition of no-till soybean seeded in alternate row

- widths. *Agronomy Journal* 95:126-132.
10. Pissarek, H.P. (1981). Einfluss der Na-Versorgung auf die K-Grenzwerte von Futterraps. VDLUFA-Kongressband Trier.(c.f. Orlovius, K. Fertilizing for high yield and quality oilseed rape. International Potash Institute Schneidergasse 27
11. Al-Rawi, K. M. and A. M. Khalaf Allah (1980). Design and analysis of agricultural experiments. Mousil Univ. Press: 488p. (In Arabic).
12. Chris, W.; N. Anderson and R. B. Stewart (2005). Soil and foliar application of humic acid for mustard production. *Environ. Pollution*, pp. 254-257.
13. Lindhauer, M.G. (1985). Influence of K nutrition and drought on water relations and growth of sunflower (*Helianthus annuus* L.). *Z. Pflanzenernaehr, Bodenk.* 148: 654-669.
14. Mobasser, H. and M. Sarhadi (2012). Effect of potassium, sulfate and water deficit on quantitative and qualitative yield of Rapeseed (*Brassica napus* L.). *Annals of Biological Research*, 2012, 3 (6):2575-2578.
15. Russo, R.O. and G.P. Berlyn (1990). The use organic biostimulants to help low input sustainable agriculture. *J. Sustainable Agric.*, 1: 19-42.
16. Nardi, S.; D. Pizzeghello and S. G. Pandalai (2004). Rhizosphere: A communication between plant and soil. *Recent Res. Development in Crop Sci.*, 1 (2): 349-360.
17. Rajpar. M. B. ; Z. Ul-Hassan ; A. N. Shah and S. D. Tunio (2011). Humic acid improves growth. yield and oil content of *Brassica campestris* L.. *Pak. J. Agri.. Agril. Engg.. Vet. Sci.*, 27 (2): 125-133.
18. El-Sherbeny, S. E.; S.F. Hendawy; A.A.Youssef; N.Y. Naguib

and M.S. Hussein(2012). Response of treatments. Journal of Applied
turnip (*Brassica rapa*) plants to Sciences Research, 8(2): 628-634.
minerals or organic fertilizers

تأثير الرش بالسماد البوتاسي والهيومت السائل وعدد الرشاشات في (2) حاصل زيت الخردل
الهندي *Brassica juncea* (L.) Czern. and Coss. ومكوناته الكيميائية

عصام حسين علي الدوغجي

قسم البستنة وهندسة الحدائق – كلية الزراعة – جامعة البصرة – البصرة/ العراق

الخلاصة

أجريت تجربة عاملية بتصميم القطاعات العشوائية الكامل خلال الموسمين الزراعيين 2012/2011
و2013/2012 في قضاء أبي الخصيب بأحد البساتين الأهلية لمعرفة تأثير الرش بالسماد البوتاسي بتركيز 0
أو 1.5 أو 3.0 مل.لتر⁻¹ و الهيومت السائل بثلاثة تراكيز 0 أو 50 أو 70 مل.لتر⁻¹ وعدد الرشاشات رشة أو
رشتان وتداخلاتهم في حاصل زيت للخردل الهندي *Brassica juncea* (L.) Czernj and Cosson
(Czern. and Coss.) ومكوناته. حلت النتائج باستعمال تحليل التباين وقورنت المتوسطات حسب اختبار
اقل فرق معنوي Least Significant Differences (L.S.D) عند مستوى احتمال 0.05. يمكن تلخيص
أهم النتائج التي تم الحصول عليها كما يأتي:-

أدى التسميد البوتاسي إلى زيادة معنوية في جميع صفات الزيت المدروسة وأزداد التأثير كلما أزداد تركيز
السماد المستعمل، إذ أعطت النباتات المعاملة بالتركيز العالي أعلى النسبة المئوية للزيت هي 27.9 و 30.1%
وحاصل الزيت..نبات⁻¹ هو 14.7 و 16.5 غم وإنتاجية الهكتار الواحد من الزيت 527.8 و 591.0 كغم. كما
أدى الرش بالهيومت السائل أدى إلى زيادة معنوية في هذه الصفات وأزداد التأثير كلما أزداد التركيز، فقد
أعطت النباتات المعاملة بتركيز 70 مل.لتر⁻¹ أعلى نسبة المئوية للزيت بلغت 28.8 و 30.6% وحاصل
الزيت..نبات⁻¹ كان 15.8 و 17.8 غم وإنتاجية الهكتار الواحد من الزيت كانت 567.1 و 645.9 كغم. وتفوقت
النباتات التي رشت مرتان معنويًا في النسبة المئوية للزيت بلغت 26.4 و 28.8% وحاصل الزيت..نبات⁻¹
وإنتاجية الهكتار الواحد من الزيت كان 444.0 و 502.4 كغم مقارنة بتلك التي رشت لمرة واحدة. وكان لجميع
التداخلات الثنائية والثلاثية لعوامل الدراسة تأثير معنوي في جميع المؤشرات المدروسة.

أظهر تحليل جهاز كروماتوگرافي الغاز المتصل بمطياف الكتلة نوع Shimadzu GC MS –QP2010

Ultra أهم المكونات الكيميائية الكبرى للزيت هي أحماض دهنية غير مشبعة **Linoleic acid** و **Methyl 11-eicosenoate** و **Ethyl 13- docosenoate** وتأثرت نسبتها بتأثير المعاملات تراوحت بمجموعها بين 48.24 % إلى 81.01% والمكونات الصغرى التي شملت مجموعتي من الأحماض الدهنية المشبعة وشملت **Palmitic acid** و **Stearic acid** و **Methyl 18-methylnonadecanoate** و **Lignoceric acid** والتي تأثرت نسبتها بالمعاملات وتراوح مجموعها بين 9.36 % إلى 21.78% وأحماض دهنية غير مشبعة هي **cis-13-Eicosenoic acid** و **Methyl nervonate** واللذان تراوح مجموع نسبهما من 2.96 % إلى 31.94% واللذين تأثرا بمعاملات التجربة.

كلمات مفتاحية: الخردل الهندي – البوتاسيوم – الهيومت السائل – عدد الرشاشات – حاصل الزيت – المكونات

الكيميائية