International Journal of Advanced Biotechnology and Research (IJBR)
ISSN 0976-2612, Online ISSN 2278–599X,
Vol-8, Issue-3, 2017, pp2239-2244
http://www.bipublication.com

Research Article

Olive pomace potential appropriate alternative of chemical fertilizers on the growth and yield of the three rice varieties

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ABSTRACT
This investigates on the reuse of agriculture by-products are becoming increasingly important due to storage and environment problems related with this wastes. We have studied changes in agricultural traits and plant growth of rice (Oryza sativa) exposed to olive solid pomace (OSW) application rates. OSW was mixed with soil at rates of 0, 1, 3, 5, and 7% w/w. Samples of rice after elongation and complete ripeness were harvested. This research carried at two years. Results showed that OSW can be used as an organic source for plant growth. Application of 5% OSW produced the optimal effect on soil parameters across all treatments. Additionally changes in soil physical and chemical properties were observed.

KeyWords: Olive Pomace, Rice, Growth, Yield, Organic fertilizer, Biomass.

[I] INTRODUCTION
There is a growing public concern about the environmental impact of industrial development and population expansion in recent decades (Xu et al., 2006). The olive tree (*Olea europaea L.*) is characteristic of Mediterranean countries olive oil solid waste (OSW) is called pomace or olive husk. It contains olive pulp, stones, residual oil and vegetative waters. Due to its high carbon and nitrogen contents, osw residues can be used in agricultures as a soil conditioner (Kavdir and Killi, 2008) OSW contains more than 94% organic matter and it has a potential to increase organic matter content of soils (Abu-Zreig and Widyan, 2002). Rice is an important cereal crop of the poacea family and major staple food that is widely consumed all over the world. World population is expected to increase to 8.5 billion by 2025 to maintain the self-sufficiency in rice, an increase of 2%-3% per year in rice production had to maintain within limited land (Haque and Haque, 2016). IT is a principal cereal grain consumed as cooked rice and is a staple food in most Asian countries (Lee et al, 2017). Also, rice is one of the strategic products in Iran. Continuous use of inorganic fertilizers cause to decay in physical, chemical and biological properties and soil condition (Maharajan et al, 2008). Olive solid waste and other residues can be used as green waste which contribute to the sustainability of agro-ecosystem (Manios, 2004).

Olive oil pomace has been considered as a soil additive to reduce the use chemical fertilizers, because it provide required nutrient amounts,

increases cation exchange capacity and improves water holding capacity (Kavdir and Killi, 2008).

Previous studied have suggested the possible advantage of olive oil waste in agriculture system, such as plant nutrient and organic matter sources to improve soil fertility (Altieri and Esposito, 2010, Ilay et al, 2013).

The aim of this study was to determine effect OSW applications on growth of rice and soil properties in two successive year.

[II] MATERIAL AND METHODS

2.1. Experimental location and soil

This study was carried out at shavoor agriculture research station in Khuzestan, Iran situated at 31▫50 N latitude and 48▫28 E longitude at an altitude of 33 m above the sea level at 2013 and 2014 years. The soil of the experimental was silt clay.

2.2. Planting material and Experimental design and treatment

Olive oil pomace from an oil extraction factory in northern Iran was collected. Experiment was factorial with completely randomized design with three replications. The experiment consist of two factors i.e. 5 levels of olive pomace A0 = 0 (control), A1 = 1% (150 gr pomace mixed with 15000 gr soil), A2 = 3% (450 gr pomace mixed with 15000 gr soil), A3 = 5% (750 gr pomace mixed with 15000 gr soil), A4 = 1050 gr pomace mixed with 15000 gr soil) and 3 levels rice variety called Champa, Red Anboori , Danial. Pot included 30 cm diameter pots with capacity of 20 kg. 15 transplant were planted per pot, the planted were harvested at ripening stage.

2.3. Economical yield

Economical yield was calculated by weight of grains of pot

2.4. Biological yield (biomass)

Biological yield on principal of biomass weight

1.5 Harvest index (%)

Harvest index is the relationship between economical yield and biological yield. It was calculated by using the following formula: (Jamil Mahmud et al, 2016).

$$HI = \frac{\text{Economical yield}}{\text{Biological yield}} \times 100$$

2.5. STATISTICAL ANALYSIS

The data were statistically analyzed by using MSTAT-C, (Russell, 1994) program. The mean differences among the treatments were compared by Duncan test at 1 and 5% level of significance.

[III] RESULT AND DISCUSSION

3.1. Plant height

Significant differences was observed between interaction year, varieties and levels of olive pomace (table 2). The tallest plant (73.55 cm) was observed in 5% pomace application, Champa in second year. The smallest was observed in first year of control (figures1 and 2).

The variation in plant height due to nutrient sources was considered to be the variation in the availability of major nutrients. (Jamil Mahmud et al, 2016). The analysis of olive pomace showed that due to the presence of some micro and macro elements it could be a source of growth (table 1). It is might be increase in soil organic matter content through the application of olive pomace cause increasing plant height. Plant height is affected by genetic characteristics, proper temperature, and nutrition and soil fertility. Soil fertility is effective on plant growth, and plant growth increases plant length (Etesami et al, 2015). The cultivars use shortening the growth period and plant height as a mechanism for opposition with heat stress (Gilani 2010).

Table1. Mean comparison some content Micro and macro elements of olive pomace

Olive Pomace in Soil (%)	N	Zn	K	P
control	0.09^{e}	1.35^{d}	276.8^{e}	9.36^{c}
1%	0.11^{d}	1.58^{a}	297.7^{d}	7.7^{e}
3%	0.12^{c}	1.35^{d}	405.6^{c}	8.4^{d}
5%	0.14^{b}	1.47^{c}	507.7^{b}	10.3^{b}
7%	0.18^{a}	1.49^{b}	678^{a}	10.53^{a}

Different letters in single column show statiscally differences according to Duncan, s multiple range test (P=0.05)

Sorces	Degree of Freedom	Hieght of Plant (cm)	Thousand grain weight (gr)	Biomass (gr)	Yield (gr)	Harvest Index(%)
Concentration of olive pomace (A)	4	411.004**	22.377**	174.403**	170.957**	1142.507**
Interact A and Year(y)	4	84.341**	1.280*	12.668**	101.8**	82.794**
Cultivar (B)	2	722.763**	37.136**	109.366**	0.473ns	883.617**
Interact B and Y	2	144.089**	0.111	1.005ns	0.490ns	53.588*
Interact A and B	8	18.464ns	1.099*	34.052**	13.408**	816.90**
Interact A, B and y	8	21.920*	0.043	4.236**	2.100**	20.023ns
Error	56	9.21	0.448	0.965	0.195	11.248
Coefficient of variatioin (%)		6.66	3.39	4.83	3.6	5.6

* and** significant Statistically respectively

ns : Non significant

Table2. Analysis of variance of agricultural parameters of Rice at ripening stage

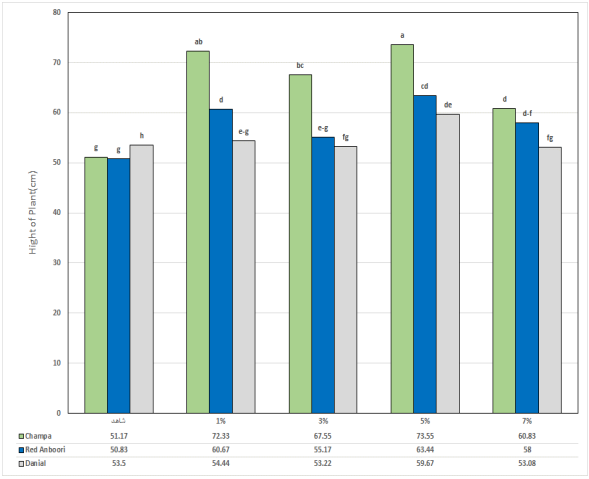

Fig1. Mean comparison interaction olive pomace, cultivars and year on plant height (First Year)

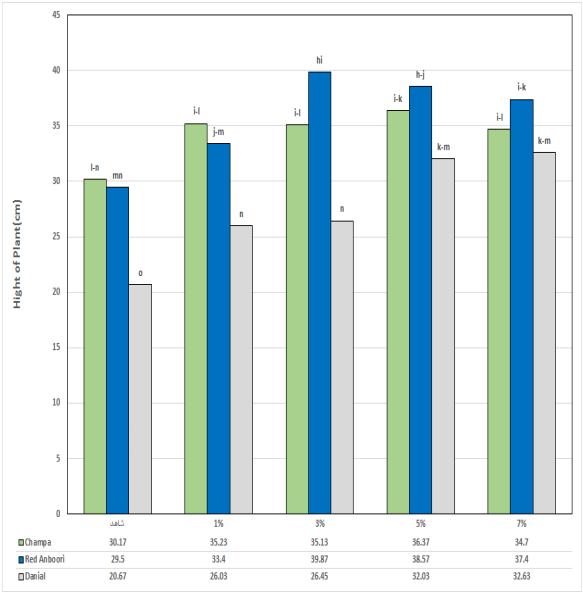

Fig2. Mean comparison interaction olive pomace, cultivars and year on plant height (Second Year)

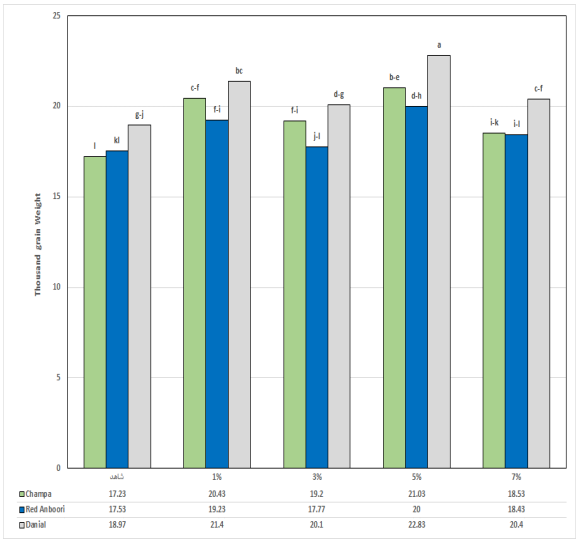

Fig.3 Mean comparison interaction olive pomace, cultivars and year on 1000-grain weight (First Year)

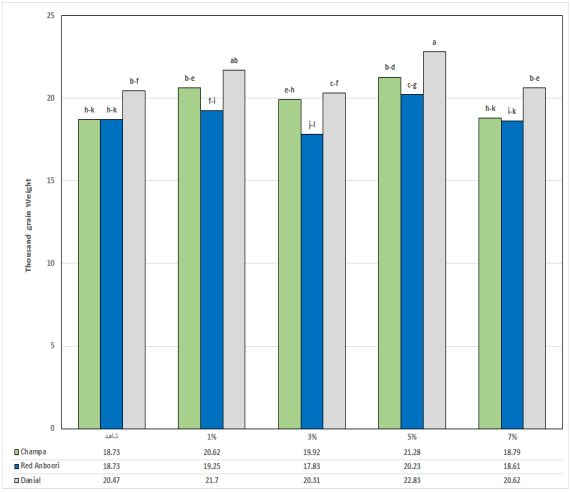

Fig4. Mean comparison interaction olive pomace, cultivars and year on on 1000-grain weight (Second Year)

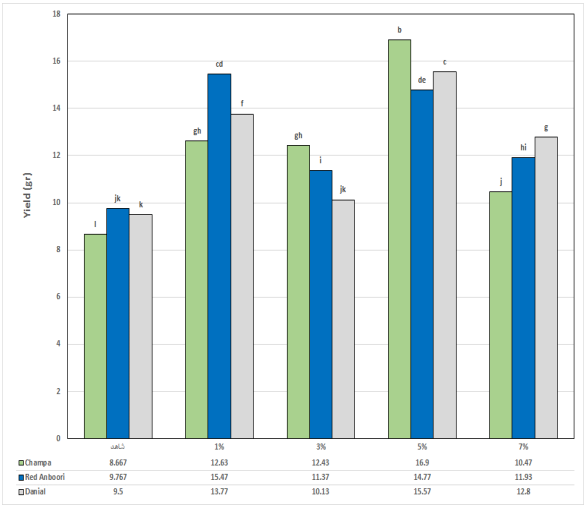

Fig5. Mean comparison interaction olive pomace, cultivars and year on yield (First Year)

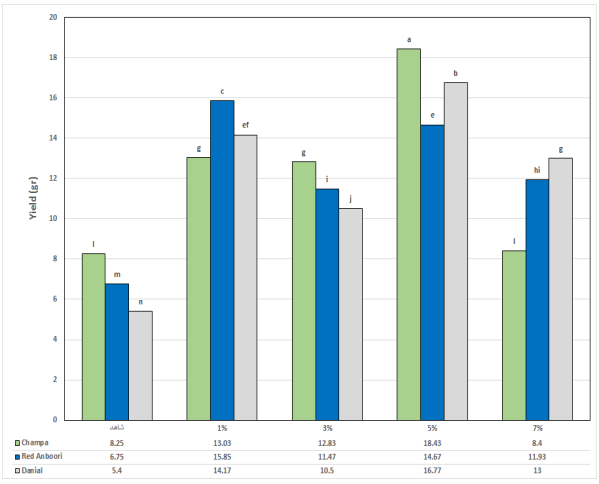

Fig6. Mean comparison interaction olive pomace, cultivars and year on yield (Second Year)

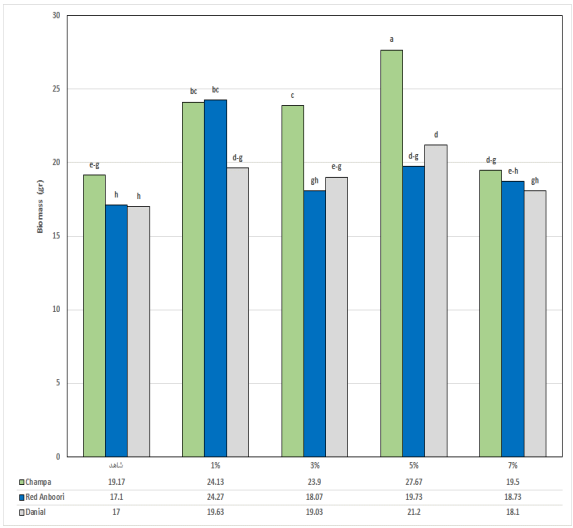

Fig7. Mean comparison interaction olive pomace, cultivars and year on biomass (First Year)

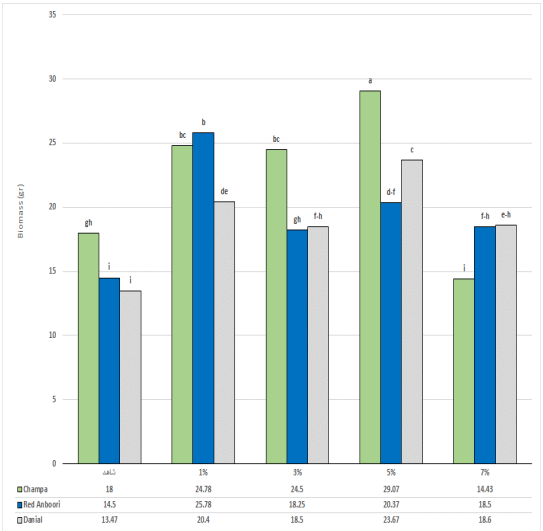

Fig8. Mean comparison interaction olive pomace, cultivars and year on plant biomass (Second Year)

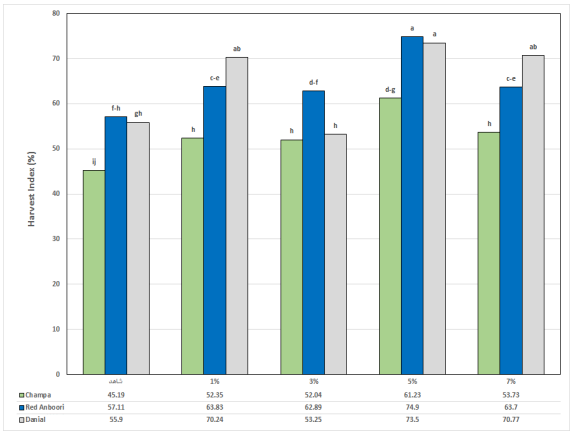

Fig9. Mean comparison interaction olive pomace, cultivars and year on harvest index (First Year)

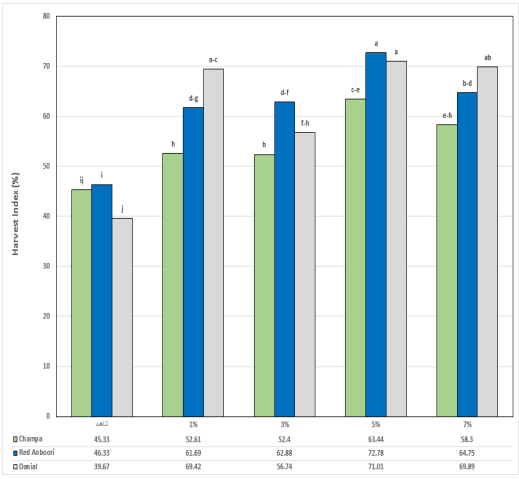

Fig10. Mean comparison interaction olive pomace, cultivars and year on plant harvest index (Second Year)

3.1. Economical yield (yield of grain)

Grain as a part of the total dry matter produced in rice, like other poaceae family of, is completely affected by genotype characteristics, environmental and contributing factors and their positive complex. Although yield depends on the genetic potential of the cultivar but it is subjected to environmental conditions (Hoseini and Alaeibakhsh, 2015).

The in the total yield resulting from application of the olive pomace may be attributed to the presence of readily available form of nutrient (Gross et al, 2007 and also to its property to enhanced soil aggregation, soil aeration and water holding capacity, offers good environmental conditions for the root system of rice plants.(Jigme et al, 2015)

This better availability of soil nutrients and favorable soil condition resulted in healthy plants

with large vegetative growth, which lead to higher yield. The better yield in treatment compare to the control is due to availability of readily available micro and macro elements exist in olive pomace. The lowest yield in control is due to insufficient supply of plants in nutrients (Lawlor, 2002).

3.2. Biological yield (biomass)

Application of olive pomace cause increase of biomass in all treatment compare to the control in two years (figures 5 and 6). The highest biomass was obtained from Champa CV at 5% and there is no significant difference between two years. The minimum of biomass was observed at control.

The production of dry matter results in trapping light energy during the process of photosynthesis. The absorbed light is directly proportional to the leaf area index of the crops and the leaf area level is also closely related to the nutritional status of the plant. (Gislum and Boelt, 2009)

More biomass production can be a reason for grain filling, and biomass production is less likely to be due to poor seed filling. (Peng and Senadhara. 2003) Olive pomace increased the leaf durability by improving the growth, increasing the rate of photosynthesis, increasing the biomass and plant height. The amount of dry matter produced depends on the degree of photosynthesis efficiency of the plant (Ilay et al, 2013).

3.3. Harvest index

The results showed that there was significant differences between cultivars and levels of treatment at one percent. The maximum harvest index was observed in Danial and red Anboori cv.s and there is no significant difference between two years (figures 9 and 10). The high values of the harvest index in the high yielding Danial cultivar can be attributed to improving the geometric structure of the plant, better penetration of the light into the canopy, reducing respiration rate and plant height, and ultimately increasing dry matter accumulation per unit area.(Gilani, 2010). Harvest index is the economic yield to biomass (biological yield) (Teimoorian et al, 2009). High value of harvest index in red Anboori varieties can be attributed to its ability in fertility, number of grains per panicle, degree of maturity and high dry matter accumulation (Gilani, 2010).

Higher yield and harvest index due to olive pomace indicates better partitioning of photosynthetic substance to economic yield. High harvest index showed the efficiency of converting biological yield into economic yield (Jamil Mahmud et al, 2016).Olive pomace contain significant amount of sugars, minerals and proteins that promote plant growth (Ilay et al, 2013).

[IV] DISCUSSION

Olive pomace as an organic fertilizer can be a better compare to inorganic fertilizer as a soil improver to produce better growth and healthy yield of rice. The results indicates that olive pomace is an appropriate alternative for chemical fertilizers, whilst that is economic and helps preserve the environment in terms of preventing environmental pollution caused by the use of chemical fertilizers.

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