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# USING OF OLIVE PROCESSING WASTES FOR WEED CONTROL

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## ABSTRACT

The herbicidal effect of Solid Olive processing waste (SOPW) on some weed species in sunflower and wheat was investigated under greenhouse conditions at Desert Research Center – Cairo, Egypt, between 2010 and 2011. Solid Olive processing waste (SOPW) placed in pots (25 cm×18 cm×10 cm) in doses of 0, 3, 4.5 and 6 kg/ $m^2$, these doses were mixed into soil (0-10 cm depth). In this experiment, 25 seeds each of Mallow (*Malava sylvestris*), Purslane (*Portulaca oleracea*), Phalaris (*Phalaris minor*) and Barnyard grass (*Echinochloa crus-galli*) besides to ten seeds of sunflower or wheat were sown in pots.

Seedlings of both weeds and crop plants were counted in order to assess the effects of Solid Olive processing waste (SOPW) on weed species and crops plant growth.

The results showed that SOPW reduction in total weed species with sunflower by 76.10, 78.70, 64.50 and 65.80 % & 96.10, 95.30, 83.50 and 85.20 % at doses of 4.5 and 6 kg/ $m^2$, with all weeds above, respectively. Also with wheat crop, the percentage weeds control were 84.3, 79.5, 74.2 and 71.8 % & 96.6, 94.6, 84.7 and 82.5 % with same doses and weed species, respectively.

Solid Olive processing waste showed no toxic effects on sunflower, while wheat was affected in the initial stage but no adverse effect was detected at another growth stages.

The herbicidal effect of Olive processing waste may be considered as an safe alternative instead of chemical control which pollute the environment in some important summer crops (sunflower) and for weeds control in winter wheat.

**Keywords:** Olive processing waste - *Malava sylvestris* - *Portulaca oleracea* - *Phalaris minor* - *Echinochloa crus-galli* - sunflower – wheat.

## INTRODCUTION

Weeds are important pests reducing the yield of many crops, such as wheat and sunflower. Although there are several methods for controlling weeds, chemical control strategies are applied intensively, which has side effects on the environment (Torstenson, 1996).For this reason, alternatives to chemical control have become an important research issue in the world. Recently, there has been an increasing interest in weed control strategies with natural substances released by plants, namely allelopathy, rather than with chemical compounds.

Olive processing waste (OPW) is a by-product of olive oil production. When olives are pressed to produce oil, two sub-products are obtained: broken seed parts (utilized for heating) and the OPW, which is collected in a pool outside of the factory. The OPW loses water by evaporation and becomes a solid known as (solid OPW), which is the subject of this study. Olive oil production is one of the foremost agro-industries in many Mediterranean countries and its processing is traditionally linked to this geographical region (Obied *et al.*, 2005).Application of OPW compost was found to improve the chemical and physicochemical features of treated soil (Paredes *et al.*2005).

OPW is a significant problem for the environment because of its toxic content and antibacterial phenolic compounds that can contaminate the soil (Hı ıl *et al.*, 2003; Casa *et al.*, 2003; D'Annibale *et al.*, 2004; Roig *et al.*, 2006). The phytotoxic effect of olive mill wastes are mainly associated with their concentration of phenols (catechol, hydroxytyrosol, tyrosol, oleuropein) that are known to inhibit plant and bacterial growth (Capasso *et al.*, 1992). Although OPW also contains other organic compounds that contribute to its toxicity, such fatty acids (butyric, acetic, stearic, oleic). The reason for OPW's effectiveness could be that it contains toxic and antibacterial phenolic substances (Galiatsatou *et al.*, 2002; Hi il *et al.*, 2003; Casa *et al.*, 2003; D'Annibale *et al.*, 2004 and Roig *et al.*, 2006).

However, in spite of its effects as a pollutant, OPW contains a high density of organic material that is rich in potassium and phosphorous and that can be broken down by microbial activity (Püskülcü *et al.*, 1995; Karaman, 2002). The application of OPW as a fertilizer has been shown to improve the yield of olive trees (Puskulcu *et al.*, 1995) and strawberry plants (Albay, 2003). Interestingly, OPW has also been shown to suppress the growth of weeds (Ghosheh *et al.*, 1999; Boz , *et al*. 2003; Albay, 2003).

In some studies on the use of OPW as a fertilizer, it was observed that it had a suppressing effect on weeds. Although its efficacy was not evaluated, therefore, the present study was designed to determining the effect of OPW on some important weed species in wheat and sunflower.The herbicidal action of Olive processing waste (OPW) at 3 and 4.5 kg/m$^2$ controlled the *Portulaca oleracea* by 63 and 98% in maize and sunflower respectively (Boz *et al.*, 2003). OPW was also shown to effectively control the common purslane (Ö üt, 2007). OPW reduced the number of *Portulaca oleracea* under field conditions significantly (Albay and Boz, 2003; Boz *et al.* 2003). Similarly Cayuela *et al.* (2008) determined the phytotoxic effect of extracts from OPW and compost on some weeds, such as *Amaranthus retroflexus*.

## MATERIALS AND METHODS

In order to evaluate the efficacy of Solid Olive processing waste (SOPW) on germination rates and growth of wheat and sunflower as well as on weed species, the present investigation was conducted under Greenhouse conditions at Desert Research Center – Mataria, Cairo, Egypt, between 2010 and 2011.

Solid Olive processing waste (SOPW) which had been collected in the previous year and stored under room conditions, was used in this study. The characteristics of the SOPW used in the experiment as according to (Boz *et al.* 2003) were: total salt content, 8.0 (g/kg); pH = 6.20; organic material comprised 117 (g/kg), and nitrogen comprised 18 (g/kg).The OPW also included phosphorus at 154 (mg/kg), potassium at 3500 (mg/kg), calcium at 1000 (mg/kg), magnesium at 1657 (mg/kg), sodium at 18 (mg/kg), iron at 571 (mg/kg), zinc at 75 (mg/kg), manganese at 120 (mg/kg), and total phenolic matter at 1210 (mg/L).

The pots (25 cm×18 cm×10 cm) were treated with dried OPW at doses of 0, 3, 4.5 and 6 kg/ m2. Each pot was filled with a mixture of soil, sand and clay in equal proportions. These doses were mixed into soil (0-10 cm depth).

For the 3, 4.5 and 6 kg/ $m^2$ doses = 1350, 2025 and 2700 g of OPW, respectively, were mixed into the soil in the pots; untreated pots served as controls.

Prior to sowing, all the pots were fertilized with N, P and K at the recommended doses and soil was holding irrigated to its Water Holding Capacity. Pots were left for 48 hours and then 25 seeds of each Mallow (Malava sylvestris), Purslane (Portulaca oleracea), Phalaris (Phalaris minor) and Barnyard grass (Echinochloa crus-galli) in addition to ten seeds of sunflower or wheat were sown in each pots. Each treatment was replicated four times and randomized block design was adopted.

The number of emerged shoots for each weed species and crops was counted in order to assess the effects of SOPW on the emergence of weed and crop plants and % reduction for weed species was calculated. Pots were daily observed to know the effect of SOPW on further growth of weed species after 7, 14, 21 and 28 days from sowing.

Plant height, and fresh weight of sunflower or wheat were measured after 28 days from sowing.The plant roots were first washed with tap water, shoot and root height, fresh weights were measured at the end of the experiment.

Data were analyzed by analysis of variance (ANOVA) and significance was determined by Fisher's least significant difference (FLSD) as mentiond by Gomez and Gomez (1984).

## RESULTS

**Effects of Solid Olive processing waste (SOPW) on sunflower:**

Table (1) shows the influence of solid olive processing (SOPW) on germination percentage of sunflower seeds. It is apparent that no significant difference was observed between treatment after 7 days from the beginning of the experiment. However, after two weeks SOPW was able to reduce the number of germinating seeds by 13.6, 18.5 and 22.8% at 3, 4.5 and 6 kg/ $m^2$, respectively.

Similar results, were obtained after 21 and 28 days post-treatment where 14.5, 19.2 and 23 %; 15.2, 18.5 and 22.5% of reduction were observed, respectively.

Although the effect on germination was significantly affected, but the growth was even stimulated by the 4.5 and 6 kg/ $m^2$ doses. Observations at the end of the experment showed that Solid Olive processing waste (SOPW) stimulated the growth of sunflower at both doses. At 28 days after treatment, shoot height of sunflower were 28.9, 31.7 and 34.9 cm. at 3, 4.5 and 6 kg/ $m^2$ doses, respectively compared to control (25.5). Also at the same time and doses, root height were 13.5, 14.9 and 16.7 cm. compared to 11.8 cm. as control (Table 1).

**Table (1): Influence of Solid Olive processing waste (SOPW) on the % germination, Shoot, root height (cm.) and weight (gm.) of sunflower.**

| OPW (kg /m$^2$) | % germination | | | | Shoot, root height (cm.) and weight (gm.) | | | |
|---|---|---|---|---|---|---|---|---|
| | Days after treatment | | | | 28 Days after treatment | | | |
| | | | | | Shoot | | root | |
| | 7 | 14 | 21 | 28 | height (cm.) | weight (gm.) | height (cm.) | weight (gm.) |
| 0.0 | 90.00 ab | 90.00 a | 90.00 a | 90.00 a | 25.50 c | 13.20 c | 11.80 a | 4.50 b |
| 3.0 | 87.50 ab | 76.40 b | 75.50 b | 74.80 b | 28.90 bc | 16.40 bc | 13.50 a | 6.30 ab |
| 4.5 | 85.00 b | 71.50 bc | 70.80 bc | 71.50 bc | 31.70 b | 19.50 ab | 14.90 a | 7.90 ab |
| 6.0 | 92.50 a | 67.20 c | 67.00 c | 67.50 c | 34.90 a | 22.60 a | 16.70 a | 10.10 a |
| **LSD 0.05** | 4.90 | 4.88 | 4.95 | 4.96 | 4.90 | 4.97 | 4.96 | 4.94 |

**Influences of Solid Olive processing waste (SOPW) on weed species in sunflower:**

Different doses of Solid Olive processing waste (SOPW) caused significant different reductions in all weed species. Highest emergence reduction was observed with 6 kg / m$^2$ followed by 4.5 kg/ m$^2$ dose, which were of significantly greater effect than the lower dose. In the case of Portulaca oleracea and Malava sylvestris, the highest reduction was obtained by 6 and 4.5 kg/ m$^2$, while lower doses provided significantly less emergence reduction in sunflower (Table 2).

**Table (2): Influence of Solid Olive processing waste (SOPW) on fresh weeds (gm. /pot) in sunflower.**

| OPW (kg /m$^2$) | Weed species | | | |
|---|---|---|---|---|
| | Mean 7,14, 21 and 28 days from sowing | | | |
| | *Malava* sylvestris | *Portulaca oleracea* | *Phalaris minor* | *Echinochloa crusgalli* |
| 0.0 | 20.50 a | 25.80 a | 12.10 a | 14.90 a |
| 3.0 | 16.40 b | 21.50 b | 10.80 a | 12.80 a |
| 4.5 | 4.90 c | 5.50 c | 4.30 b | 5.10 b |
| 6.0 | 0.80 d | 1.20 d | 2.00 b | 2.20 b |
| **LSD 0.05** | 3.83 | 3.85 | 3.88 | 3.89 |

Solid Olive processing waste (SOPW) reduced the fresh weights of weed species significantly at 6 and 4.5 kg/ m$^2$ doses and caused significant herbicidal effect measured by 96.10, 95.30, 83.50 and 85.20 % & 76.10, 78.70, 64.50 and 65.80 % reduction in the fresh weight of Malava sylvestris, Portulaca oleracea, Phalaris minor and Echinochloa crus-galli, respectively, Table (3).

**Table (3): Effect of Solid Olive processing waste (SOPW) on % fresh weed reduction in sunflower.**

| OPW (kg /m$^2$) | Weed species | | | |
|---|---|---|---|---|
| | Mean 7,14, 21 and 28 days from sowing | | | |
| | ***Malava* sylvestris** | ***Portulaca oleracea*** | ***Phalaris minor*** | ***Echinochloa crusgalli*** |
| 3.0 | 20.00 c | 16.70 c | 10.70 c | 14.10 c |
| 4.5 | 76.10 b | 78.70 b | 64.50 b | 65.80 b |
| 6.0 | 96.10 a | 95.30 a | 83.50 a | 85.20 a |
| **LSD 0.05** | 5.29 | 5.25 | 7.68 | 5.28 |

**Effects of Solid Olive processing waste (SOPW) on wheat:**

In observations prior to three weeks, effect of Solid Olive processing waste (SOPW) on wheat plant was not clear. While effect of SOPW on germination of wheat seeds was clear after 21 days of treatment, where significant decrease in the number of germinating seeds by 23.6, 36.3 and 41.5 % at 3, 4.5 and 6 kg/ $m^2$ were observed respectively. Concerning wheat crop, emergence was affected by OPW treatments so that the highest dose reduced the emergence of this crop by 41.5 %; middle dose made reduction by 36.3 % and lower dose caused reduction by 23.6 % in the emergence of this crop (Table 4).

**Table (4): Influence of Solid Olive processing waste (SOPW) on the % germination, Shoot, root height (cm.) and weight (gm.) of wheat:**

| OPW (kg /$m^2$) | % germination | | | | Shoot, root height (cm.) and weight (gm.) | | | |
|---|---|---|---|---|---|---|---|---|
| | Days after treatment | | | | 28 Days after treatment | | | |
| | | | | | Shoot | | root | |
| | 7 | 14 | 21 | 28 | height (cm.) | weight (gm.) | height (cm.) | weight (gm.) |
| 0.0 | 95.00 a | 95.00 a | 95.00 a | 95.00 a | 22.40 a | 10.40 a | 8.50 a | 6.20 a |
| 3.0 | 84.50 c | 85.00 b | 71.40 b | 72.40 b | 21.20 ab | 10.10 b | 7.40 a | 6.10 a |
| 4.5 | 86.50 bc | 84.80 b | 58.70 c | 57.90 c | 18.70 b | 9.80 a | 7.10 a | 5.40 a |
| 6.0 | 89.00 b | 88.00 b | 53.50 c | 53.10 d | 15.20 c | 7.10 ab | 5.90 a | 4.30 a |
| LSD 0.05 | 3.46 | 3.44 | 16.27 | 3.45 | 3.46 | 4.87 | 3.47 | 3.48 |

**Influences of Solid Olive processing waste (SOPW) on weed species in wheat:**

Table (5) shows the influence of SOPW on the tested weed species. It was found that SOPW reduced the fresh weights of weed species significantly at 6 and 4.5 kg/ $m^2$.

In summarizing the results, it was noted that SOPW suppressed the number of weeds significantly and decreased the fresh weights of all weeds. Data in Table (5) indicated the effect of SOPW on reduction of all weed species, which decrease by increasing of SOPW dose. Data presented in Table (5) illustrate that mean fresh weights of Malava sylvestris, Portulaca oleracea, Phalaris minor and Echinochloa crus-galli were 5.1, 3.8, 5.9 and 2.9 gram and 1.1, 1.0, 3.5 and 1.8 gram with 4.5 and 6 kg/ $m^2$, respectively compared to 32.4, 18.5, 22.9 and 10.3 gram in control.

**Table (5): Influence of Solid Olive processing waste (SOPW) on fresh weeds (gm. /pot) in wheat.**

| OPW (kg /$m^2$) | Weed species | | | |
|---|---|---|---|---|
| | Mean 7,14, 21 and 28 days from sowing | | | |
| | *Malava* sylvestris | *Portulaca oleracea* | *Phalaris minor* | *Echinochloa crusgalli* |
| 0.0 | 32.40 a | 18.50 a | 22.90 a | 10.30 a |
| 3.0 | 27.90 b | 16.80 a | 19.50 b | 8.60 a |
| 4.5 | 5.10 c | 3.80 b | 5.90 c | 2.90 b |
| 6.0 | 1.10 d | 1.00 b | 3.50 c | 1.80 b |
| LSD 0.05 | 3.12 | 3.02 | 3.21 | 3.15 |

Weed control was significant influenced by SOPW at 4.5 and 6 kg/ $m^2$, where the percentages of weeds control were 84.3, 79.5, 74.2 and 71.8 % & 96.6, 94.6, 84.7 and 82.5 % with Malava sylvestris, Portulaca oleracea, Phalaris minor and Echinochloa crus-galli, respectively (Table 6).

**Table (6): Effect of Solid Olive processing waste (SOPW) on % fresh weed reduction in wheat.**

| OPW (kg /$m^2$) | Weed species — Mean 7,14, 21 and 28 days from sowing | | | |
|---|---|---|---|---|
| | ***Malava* sylvestris** | ***Portulaca oleracea*** | ***Phalaris minor*** | ***Echinochloa crusgalli*** |
| 3.0 | 13.90 c | 9.20 c | 14.80 b | 16.50 c |
| 4.5 | 84.30 b | 79.50 b | 74.20 ab | 71.80 b |
| 6.0 | 96.60 a | 94.60 a | 84.70 a | 82.50 a |
| **LSD 0.05** | 4.25 | 4.20 | 45.11 | 4.34 |

## DISCUSSION

Our results show that Soild olive processing waste (SOPW) had a great herbicidal effect on some important weed species occurring in summer (sunflower) and winter (wheat) crops under greenhouse conditions at Desert Research Center of Egypt. In addition, apart from some germination inhibition, SOPW showed no further toxic effects on sunflower. It only affected wheat in the initial growth stages. Introduction of some phenolic compounds to soil, as well as increased soil pH and salinity by SOPW treatment (Aydın *et al.*, 2001) may be considered as the main factors responsible for the herbicidal effect.

The high germination inhibition produced by Soild olive processing waste (SOPW) was probably caused by phenolic compounds. Reigosa *et al.* (1999) reported a very strong (close to 100%) inhibition of A. retroflexus radicle growth at concentration of several phenols (coumaric, hydroxybenzoic, vanillic and ferulic acids) all present in olive mill wastes (Obied *et al.*, 2005).

Similar recommendations were made also following some other studies. In earlier studies, it was observed that SOPW reduced the number of P. oleracea significantly (Albay and Boz, 2003; Boz *et al.* 2003, 2009). In another study, water extracts of olive mill waste reduced the germination of A. retroflexus by more than 90% and the germination of S. nigrum by 48–90%, whereas the germination of C. album and S. halepense was not decreased (Cayuela *et al.* 2008). Ghosheh *et al.* (1999) demonstrated that OPW could be used for control of an important parasitic weed species, Orobanche spp., in pot experiments. In a recent study Boz *et al.* (2009) showed that OPW suppresses effectively some important winter and summer weeds, including A. retroflexus, and that OPW showed no harmful effect on V. faba, so that the results recorded here confirm those in the other studies.

Based on the results of this study and previous ones, it has been reported that OPW is useful for weed control, but the applied dose and the composition of OPW are thought to be important factors influencing the herbicidal effects of this substance. In general it was observed that the growth of crop plants is stimulated by adding OPW, the finding which can be attributed to the mineral-rich content of OPW. Several studies suggest that OPW and its compost could be used as fertilizer in crops, such as olive (Puskulcu *et al.* 1995), trifolium (Vassilev *et al.*1998), rice (Tejada and Gonzalez 2004), pepper (Alburquerque *et al*. 2006), and beet (Paredes *et al*. 2005).

The results presented herein indicate that SOPW can be utilized in agriculture for weed control, where in this case a product that is typically regarded as waste can be beneficial and useful. OPW can be utilized to suppress certain weeds. In addition, SOPW, which is cheap, plentiful, and readily available, was found to assist in the growing of some crops. Farmers can indeed obtain SOPW at any time of the year because olive oil production plants have an evaporation pool where OPW is kept as it dries out.

Although, the results of this greenhouse study demonstrated the high potential of Olive processing waste (OPW) as biobased herbicide against several species of weeds. Further studies are still needed on the use of Olive processing waste (OPW) to control different weeds in different crops under different field conditions.

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**استخدام مخلفات عمليات عصر الزيتون لمكافحة الحشائش**

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درس التأثير الابادي الحشائشي لمخلفات عمليات عصر الزيتون الصلبة علي بعض أنواع الحشائش في عباد الشمس والقمح تحت ظروف الصوب الزجاجية بمركز بحوث الصحراء ، القاهرة – مصر في الفترة مابين 2010-2011 . وضعت مخلفات عمليات عصر الزيتون في أصص (25 × 18 × 10سم) بجرعات 0 ، 3 ، 4.5 ، 6 كجم/ م$^2$ مخلوطة بالتربة لعمق 10سم. زرع في هذه التجربة 25 بذرة من حشائش الخبيزة والرجلة والفلارس والدنيبة بالإضافة إلي 10 بذور من عباد الشمس أو القمح. تم عد نباتات الحشائش والمحصول لتقييم تأثير مخلفات عمليات عصر الزيتون عل أنواع الحشائش والمحاصيل.

أوضحت النتائج أن مخلفات عمليات عصر الزيتون قد خفضت من أجمالي أنواع الحشائش في عباد الشمس بنسبة 76.1 ، 78.7 ، 64.5 ، 65.8 % & 96.1 ، 95.3 ، 83.5 ، 85.2 % عند جرعات 4.5 ، 6 كجم/ م$^2$ مع كل الحشائش المذكورة أعلاه علي الترتيب. أيضا بمحصول القمح – كانت نسبة مكافحة الحشائش 84.3 ، 79.5 ، 74.2 ، 71.8 % & 96.6 ، 94.6 ، 84.7 ، 82.5 % مع نفس الجرعات ونوعيات الحشائش السابقة علي الترتيب.

أظهرت التجربة أنه لا يوجد تأثير سام من مخلفات عمليات عصر الزيتون علي عباد الشمس ، بينما القمح قد تأثر في المرحلة الابتدائية ولكن لم توجد أي تأثيرات معاكسة أو غير ملائمة في مراحل النمو الأخرى.

يمكن اعتبار أن التأثير الابادي الحشائشي لمخلفات عمليات عصر الزيتون من الخيارات البديلة الآمنة لمكافحة الحشائش بدلا من المكافحة الكيميائية الملوثة للبيئة وذلك في بعض المحاصيل الصيفية كعباد الشمس ولمكافحة الحشائش في القمح الشتوي.

**قام بتحكيم البحث**

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