https://dx.doi.org/10.22161/ijeab.46.16 *ISSN: 2456-1878*

Influence of tillage and straw mulching on purple nutsedge (*Cyperus rotundus* L.) in Olive Orchards

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Abstract**—** *A weed control trial was conducted in order to investigate the effect of tillage and straw mulching on Cyperus rotundus infestation in olive orchards. Tillage was applied on six olive trees and straw mulching was applied on six olive trees. Observations on C. rotundus were carried out 30 and 90 days after treatments after application of tillage and straw mulching. Results showed that the average tillage efficacy recorded 80.3±3.5% of visual efficacy rating at 30 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 57.8±3.4%. The average tillage efficacy recorded 71.8±3.4% of visual efficacy rating at 90 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 43.8±4.8%. C. rotundus infestation increased at 90 days after tillage compared to 30 days after tillage. The average tillage efficacy recorded 62.3±3.5% on C. rotundus dry biomass reduction at 90 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 34.8±5.3%. Thus, frequent tillage could be recommended to prevent C. rotundus re-infestation in Olive Orchards.*

Keywords**— Tillage, straw mulching, purple nutsedge, Cyperus rotundus, Olive Orchards, Morocco.**

I. INTRODUCTION

The olive tree plays an important socio-economic role in the Mediterranean basin. Olive tree has multiple functions of controlling erosion, reclaiming agricultural land and increasing the income of populations in mountain areas. It is the main tree fruit cultivated in Morocco covering an area of 784 000 ha with a total production of 1 500 000 tons of olives (Berrichi, 2002; MADRPMEF, 2019). It is present in different agricultural areas of Morocco except the coast. Weeds are among the constraints of olive tree production are. They compete with olive trees for water, nutrients, and sunlight. Orchard productivity is affected and young orchards may take longer to come into production (G. Steven Sibbett & Louise Ferguson). Weeds can also enhance the activities of other insects and diseases, and cause a fire hazard in the summer. Perennials are common weeds in olive orchards in Morocco. Their mode of multiplication is mainly vegetative by rhizomes, stolons, bulbs, suckers or tubers (Baudry, 2001). These methods of multiplication make their control difficult and limit the effectiveness of control methods (Bensellam, 1997). The purple nutsedge (*Cyperus rotundus* L.) is among the most harmful weed of olive orchards in Morocco. In Marrakech region of Morocco, *C. rotundus* infestations in olive orchards become a serious constraint for many olive farmers. Herbicides are a very effective tool against *C. rotundus* infestation in olive orchards. However, they should be combined with preventive methods in order to achieve the best weed control. Tillage and straw mulching is among the preventive methods applied in Marrakech region. This study aims to evaluate Tillage and straw mulching in their effect on *C. rotundus* infestation in olive plantation.

II. MATERIAL AND METHODS

A trial of weed control using preventive methods on *C. rotundus* was conducted in SAADA INRA research station in Marrakech region of Morocco during 2013-2014 growing season. Preventive methods consist on tillage and straw mulching. Tillage was applied on six olive trees and straw mulching was applied on six olive trees. Tillage and straw mulching were applied on January 10 April 2014. Observations were carried out at 30 and 90 after application of tillage and straw mulching. Observations concerned visual rating of efficacy at 30 DAT (days after treatment) on *C. rotundus* following a scale ranging from 0 to 100% (where 0% is ineffective while 100% is a total destruction of weeds) and biomass reduction. *C. rotundus* dry biomass reduction percentage= [*C. rotundus* dry biomass weight in control plots – *C. rotundus* dry biomass weight in treated plots] x 100 / [*C. rotundus* dry biomass weight in control plots]. Calculation of dry *C. rotundus*

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biomass were made by collecting *C. rotundus* in each plot using a quadrant of 1m x 1m. Samples were dried in an oven at 75 ° C for 48 hours. Then, dry plant material in each plot was weighed with a precision balance. Statistical analyzes were performed with IBM SPSS Statistics, version 21.0. To find out the differences in *C. rotundus* efficacy, we applied the Student's independent *t*-test at *P* = 0.05.

III. RESULTS AND DISCUSSION

1. Effect on visual efficacy rating at 30 DAT

Data in Table 1 show that the average tillage efficacy recorded 80.3±3.5% of visual efficacy rating at 30 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 57.8±3.4%. Indeed, the value of *t*-statistic was 11.15 with a *P*-value lower than significance level of 0.05. Thus, we conclude that there are statistical differences at significance level of 0.05 between the averages of tillage efficacy and the averages of straw mulch efficacy in favor of tillage, which has shown the best efficacy. Figure 1 shows the obtained results.

Table 1: Effect of tillage and straw mulching on Visual efficacy rating of C. rotundus at 30 DAT[*]

	Visual efficacy rating (%) 30 DAT[*]	*t*-statistic[**]	*P*-value
Tillage	80.3±3.5		
Straw mulching	57.8±3.4	11.150	<0.001

Data represented are mean ± standard deviation for (n=6). [*] DAT: Days after treatments. [**] Independent t-test.

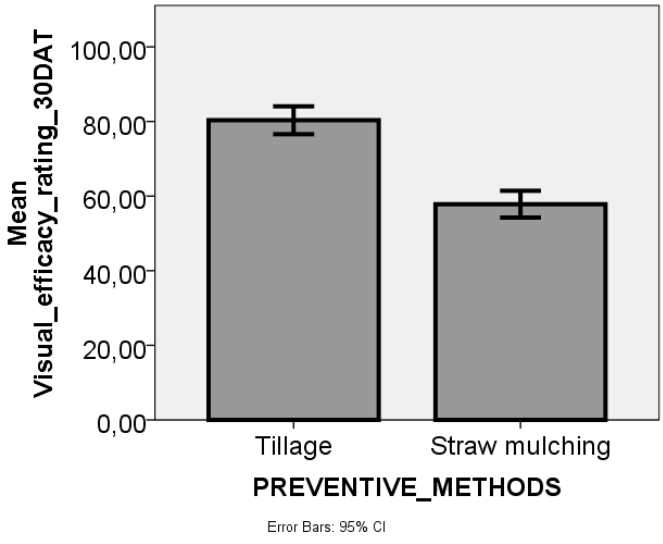

Fig.1: Effect of tillage and straw mulching on Visual efficacy rating of C. rotundus at 30 DAT[*]
[*] DAT: Days after treatment

2. Effect on visual efficacy rating at 90 DAT

Data in Table 2 show that the average tillage efficacy recorded 71.8±3.4% of visual efficacy rating at 90 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 43.8±4.8%. Indeed the value of *t*-statistic was 11.4 with a *P*-value lower than significance level of 0.05. Thus, we conclude that there are statistical differences at significance level of 0.05 between the averages of tillage efficacy and the averages of straw mulch efficacy in favor of tillage, which has shown the best efficacy. Figure 2 shows the obtained results.

Table 2: Effect of tillage and straw mulching on Visual efficacy rating of C. rotundus at 90 DAT[*]

	Visual efficacy rating (%) 90 DAT[*]	*t*-statistic[**]	*P*-value
Tillage	71,8±3,4		
Straw mulching	43,8±4,8	11.4	<0.001

Data represented are mean ± standard deviation for (n=6). [*] DAT: Days after treatment. [**] Independent t-test.

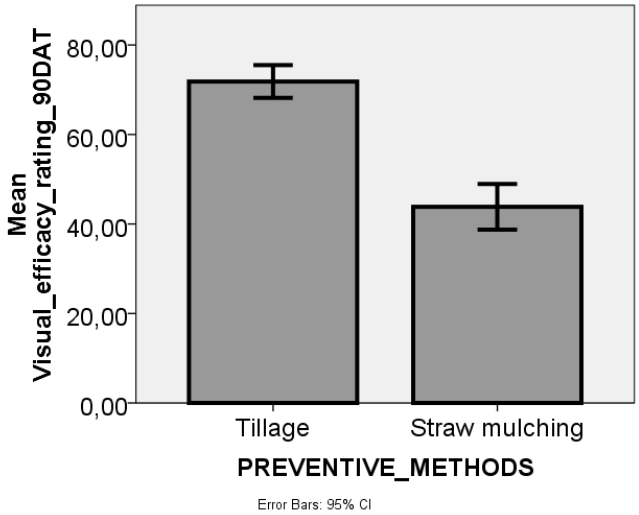

Fig. 2: Effect of tillage and straw mulching on Visual efficacy rating of C. rotundus at 90 DAT[*]
[*] DAT: Days after treatment

3. Effect on *C. rotundus* dry biomass reduction at 90 DAT

Data in Table 2 show that the average tillage efficacy recorded 62.3±3.5% on *C. rotundus* dry biomass reduction at 90 DAT, which is higher than the efficacy of straw mulching that recorded an efficacy of 34.8±5.3%. Indeed the value of t-statistic was 10.4 with a *P*-value lower than significance level of 0.05. Thus, we conclude that there are statistical differences at significance level of 0.05 between the averages of tillage efficacy and the averages of straw mulching efficacy in favor of tillage, which has shown the best efficacy(Fig. 2). Some authors reported that frequent

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tillage could be effective in reducing *C. rotundus.* However season-long management was essential to prevent *C. rotundus* proliferation over time (Sanjeev K. Bangarwa & *al*., 2008). In fact, Tillage led to a breakup of tubers from aerial shoots, roots, and other tubers in chains. In addition, it brings them close to the soil surface where they are exposed to carbohydrate starvation, desiccation and cold injury (Glaze 1987). However, it is important to mention that tillage in olives can damage shallow roots and may increase erosion in the mountain areas where there is many olive plantations in Morocco.

*Table 3: Effect of tillage and straw mulching on C. rotundus dry biomass reduction at 90 DAT**

	Biomass (%) 90 DAT	*t*-statistic	*P*-value
Tillage	62.3±3.5		
Straw mulch	34.8±5.3	10.4	<0.001

*Data represented are mean ± standard deviation for (n=6). * DAT: Days after treatment. ** Independent t-test.*

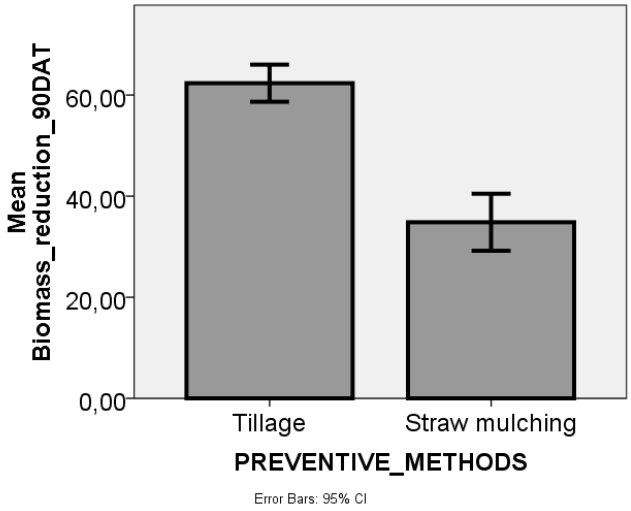

*Fig.3: Effect of tillage and straw mulching on C. rotundus dry biomass reduction at 90 DAT**
** DAT: Days after treatment*

IV. CONCLUSION

This study has shown that tillage gave the best control of *C. rotundus*. Straw mulching showed weak to medium efficacy on *C. rotundus*. In fact, *C. rotundus* infestation increased at 90 days after tillage compared to 30 days after tillage. Thus, frequent tillage is necessary to prevent *C. rotundus* re-infestation. This study should be repeated in different sites on different perennial weeds to evaluate the effect of tillage on weed infestation.

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