

EFFECT OF SOME SOIL MULCHING SYSTEMS ON WEED CONTROL AND PRODUCTION OF STRAWBERRY IN NEW EL SALHIA REGION

I. M. Khater¹ and Mona M. A. Hassan²

ABSTRACT

On weed infestation area in New El Salhia, six soil mulching systems, were investigated to estimate the ability of mulch types to combat weed infestation. The bare soil and corn stalks showed a weed infestation which increased and appeared in few weeks later after cultivation, compared with other others covering systems. While a significant reduction in weed infestation with black and white sheets treatments was occurred. In the 1st period on 2nd of October, no remarkable weeds infestation was appeared, it was 43.10 g/m² in all treatments. On 2nd of November, a remarkable existence of the weeds was found, it was 210 g/m² for bare soil, while it was 19 g/m² for black sheet treatment. Through the last period on 2nd of December, the weed infestation was clearly found, the bare soil, corn stalks and rice straw were represented the higher values as compared with the other treatments, the conventional treatment of bare soil was represented by 310 g/m². The highest yield was in the treatment of black sheet due to the lowest infestation of weeds by 40 Mg/ha, compared with the white sheet and transparent sheet treatments which were 25 and 22 Mg/ha, respectively. Comparing the water use efficiency under the investigated treatments it can be observed that treatment of black sheet was the one where water use efficiency was the highest being with an average value nearly 11.17 kg/m³. Plastic mulches are now an indispensable part of the modern vegetable production system, specially that the black sheets, than natural covering such as corn stalks and rice straw.

INTRODUCTION

Strawberry is one of the most popular vegetable crops in Egypt, it occupies an important attitude among the untraditional vegetable crops due to its varied use as local fresh consuming, food processing and exportation. The crops is ordinarily grown in sandy soils

¹Associate Prof. in (Agri- Mechanization Unit) Soil conservation Dept. Desert Research Center

²Associate Prof. of Agric. Eng., Fac. of Agric., Zagazig Univ.

for getting early yield and good fruit fineness. Mulching is a popular agronomic pursuit in agriculture and it has many merits which include: to prevent loss of soil moisture, to control weeds by tent them and diseases by preventing soil contact with the plant foliage, to control soil temperature, either by keeping it cool or keeping it warm, to add to soil richness and increase soil organic matter content when organic mulch is used and retro gradation takes place. Some mulch materials such as the reflective mulches are efficient in hold off insects (AVRDC, 1990). The influence of organic mulches on crop yield is incommensurate. Mulching improves plant growth, yield and yield quality (Sharma & Sharma, 2003; Singh *et al.*, 2007). Some mulches (straw, peat, sawdust) may negatively affect crops by drying up soil nitrogen due to a wide C:N ratio (Johnson *et al.*, 2004; Sønsteby *et al.*, 2004). Mulch progresses soil conditions, especially reduces water evaporation from soil and helps to maintain steady soil temperature (Ji and Unger, 2001; Kar and Kumar, 2007). There are three major colors of plastic mulch used in merchant vegetable production: black, clear and white mulches. White mulch can cause a a little lower soil temperature in comparison with bare soil because the mulch suck less radiant energy and it reflects back into the plant shade most of the incoming solar radiation (Ham *et al.*,1993 and Lamont, 2005). The black mulch is being the predominant color used for vegetables (Gordon *et al.*, 2010; Hochmuth *et al.*, 2012). In relation to the effect of mulching types on the cucumber yield, the results showed that the cucumber yield values were 5.57, 9.34, 11.65,12.52 and 12.77 Mg/ha. under soil bare, straw, black, yellow and transparent respectively. With plastic mulch, the high soil temperature in the planting bed will enhance faster crop growing and early yield (El- Shaikh *et al.*,2008). The present investigation was carried out to study the effect of different mulching material on soil temperature, growth, and yield of strawberry and weed control.

MATERIALS AND METHODS

Field experiments were carried out during the autumn season of 2016 at a private farm in New El Salhia (Long 32° 05' 29" – Lat 30° 48' 18") . The soil of the experimental plots was classified as sandy loam (63.49% sand, 29.07 % silt and 7.44 % clay). Particle size distribution of soil was determined according to (Klute 1986). Experiments were performed in an

infested site by annual weeds such as *Eleusineindica* and *Cynodondactylon*.

The variety " Florida " of strawberry was used in this experiment. The irrigation system was applied using drip irrigation with a discharge rate of 4 lit/h. and volume of applied water was 3578 m³/ha . The local climate is like semiarid/Mediterranean with mild winters and hot, rainless summers. The mean monthly temperatures are 30 °C (October), 24 °C (November) and 18 °C (December).

Six treatments were tested in this work as follow :back sheet, white sheet, transparent sheet, rice straw, corn stalks and bare soil. The experiments were designed in a randomized complete blocks with three replicates to evaluate the different mulching types.

Weed dry biomass was estimated by sampling the aerial part of the plants at three random square sampling areas in each plot. Squares had dimensions of 50 cm. The dry weed mass were weighed and samples were oven dried at 220 °C for 48 h. The samples were taken three times during the season, after 7, 30 and 60 days of transplanting. The plot size was 3m by 15 m. During autumn, plots were 6 m wide and 6 m long with four double row beds with 150 cm apart with 35 cm inter-row spacing and 33cm plants spacing to give a density of 15.8 plants/m². plots were covered with 5 types of covering, black, white and transparent plastic sheets (30 micron thick). Corn stalks and rice straw(15 cm thick) from October 2, to December 2, 2016.

Seedlings were transplanted by making holes of 5 cm diameter on the plastic sheet, corn stalks , rice straw and bare soil.

Soil temperature measurement

Soil temperature was taken during the experiment with the help of digital soil thermometer. Soil temperature was taken at 5 and 10 cm depth by inserting sensor rod of digital soil thermometer below the soil surface. Observation was recorded to know the effect of different mulches on soil temperature which indirectly affect the crop production. The daily records of soil temperature were taken at 9:00 am and 2:00 pm.

Water use efficiency:

The water use efficiency (WUE) was determined as follows:

$$\text{WUE (kg/m}^3\text{)} = \text{Yield (kg/ha)} / \text{Volume of applied water (m}^3\text{/ha)}$$

RESULTS AND DISCUSSION

Effect of mulch types on dry mass of weeds:

There were significant differences in total weed dry mass among the treatments. In general, weed dry mass were significantly higher at bare soil and corn stalks mulch compared to the others treatments. Fig. (1) shows that In the bare soil plots, there was a significant amount of weeds and a new infestation appeared few weeks later and the problem persisted throughout the whole growing period. Despite the significant reduction in weed infestation with corn stalks and rice straw covers, there were also serious weed problems during the period of development of the crop. In the plots of white and transparent sheet plastics, the weeds were generally more than black sheets. In this method, a few of weeds persisted in the field after applying the planting operation. In the 1st period on 2nd of October, no remarkable weeds infestation was happened, dry mass of the weeds was 43.10 g/m² in all treatments, during the 2nd period of the strawberry production on 2nd of November, a remarkable existence of the weeds was found, it was 210 g/m² under treatment of bare soil, while it was 120 g/m² for others treatments.

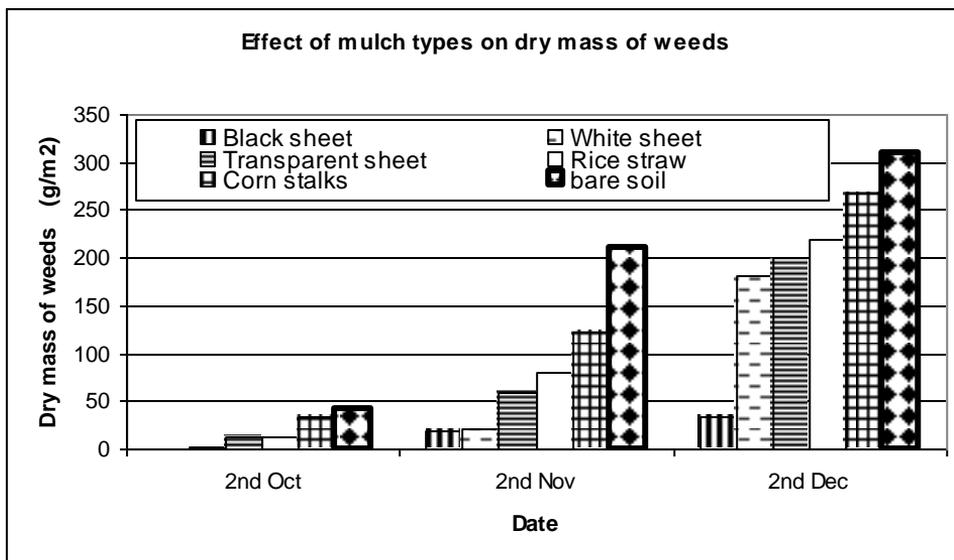


Fig. (1): Effect of mulch types on dry mass of weeds.

Through the last period of the field operations and before harvesting the weed infestation was clearly found, the conventional treatment of bare

soil was represented the higher value as compared with the other treatments, it was 310 g/m², while the by black sheet was 33 g/m². The other covering treatments were in near value ranged between 181 and 266 g/m². Data collected were similar as clarified by **(Giovanni and Antonino, 2005)**. Organic mulches are not effective in controlling weeds as plastic mulch **(Bushnell and Welton,1993)**. Black polyethylene mulch most effective in weeds and clear polyethylene mulch has an adverse effect on weed control **(Johnson and Fenimore, 2005)**.

Effect of mulch types on soil temperature:

Table (1) shows the soil temperature through October, November and December 2016 into soil depths of 5 and 10 cm. Data collected revealed that, using transparent sheets showed the largest soil temperature for both soil depths through the cultivated season. This was due to the effect of green house effect which led to increase of the soil temperature. On the other hand, using corn stalks for covering showed the lowest soil temperature for both soil depths through the cultivated season as compared with all treatments. This was due to large voids between the corn stalks which facilitate air exchange and decrease heat conservation. In case of bare soil, recorded soil temperatures showed higher records than corn stalks, rice straw and white sheet because of direct expose to sun radiation through all periods as compared with other treatments which they have relative shadow to prevent the sun light to raise the soil temperature. In the black sheet plots, there was a significant amount of soil temperature, which were higher than all treatments except the transparent sheet treatment. Using black sheets appear a relative heat conservation effect because of the black color ability to absorb more heat than other colors, which increase the soil temperature by convection heat transfer effect. In all previous cases, October was the highest month in all recorded temperature as compared with November and December respectively, While the recorded data at period of 14:00 were higher than taken at 9:00 because of the more sun radiation after noon as compared with in morning. From other point, the temperature at 5 and cm soil depths, were noticed to be gradually increased for the 2 depths on the morning, then decreased gradually after noon, that's may be due to the

heat transfer phenomena through soil voids specially in the fine texture soils.

Table (2): Effect of mulch types on soil temperatures:

Month	02-Oct				02-Nov				02-Dec			
Period	At 9:00		At 14:00		At 9:00		At 14:00		At 9:00		At 14:00	
soil depth (cm)	5	10	5	10	5	10	5	10	5	10	5	10
Trans. sheet	42.0	42.5	47.5	45.5	35.0	35.5	41.5	39.5	28.0	28.8	35.5	33.5
Black sheet	36.5	37.5	43.5	43.0	29.5	30.5	37.5	37.0	22.5	23.5	31.5	31.0
bare soil	34.5	35.5	41.5	41.0	27.5	28.5	35.5	35.0	20.5	21.5	29.5	29.0
White sheet	33.5	34.0	41.0	40.0	26.5	27.0	35.5	35.0	19.5	20.5	29.0	28.5
Rice straw	32.5	34.0	40.5	40.0	25.5	27.0	35.0	34.0	18.5	20.0	29.0	28.0
Corn stalks	31.5	33.0	39.0	38.5	24.5	26.0	33.0	32.0	18.0	19.0	28.0	27.0

Effect of mulch types on crop yield:

A significant yield increasing was found when a reduction of weed infestation was happened in all treatments except the bare soil (Fig 2). The highest yield was in the treatment of black sheet due to the lowest infestation of weeds by 40 Mg/ha, compared with the white sheet and transparent sheet treatments which were 25 and 22 Mg/ha, respectively. In the treatments of rice straw and corn stalks, 20 and 16 Mg/ha were achieved respectively, because soil cover conditions allowed to appear greater weeds competition with the strawberry, which cause probably factors that led to this yield reduction. In general it can be seen that during harvest the black sheet technique gave the higher yields than all the other treatments. Data represented was in familiar with(Stapleton, 2000).

Effect of mulch types on water use efficiency:

Regarding to water use efficiency under the investigated study, Fig (3), showed that through different covering systems that there is a better improvement in the water use efficiency with respect to that recorded on bare soil as conventional practice. Comparing the water use efficiency under the investigated treatments it can be observed that treatment of black sheet was the one where water use efficiency was the highest being with an average value nearly 11.17 kg/m³. These data fully support those obtained by (Samia *et al.*, 2017). The presented data also indicate that the yield production is highly affected by the type of covering systems. This is clearly demonstrated by considering the variations in the yield between

different treatments. This is again confirmed by considering the yield in treatment of bare soil being the lowest hence no cover was included in the soil management.

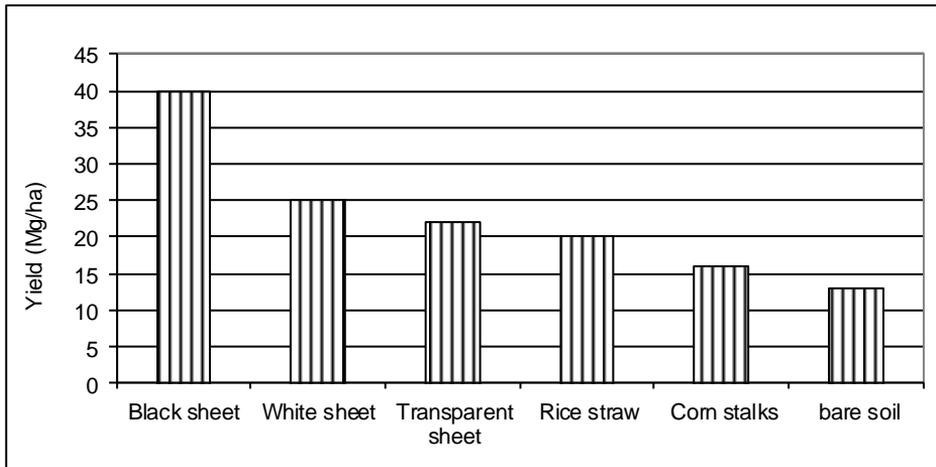


Fig. (2): Effect of mulch types on crop yield.

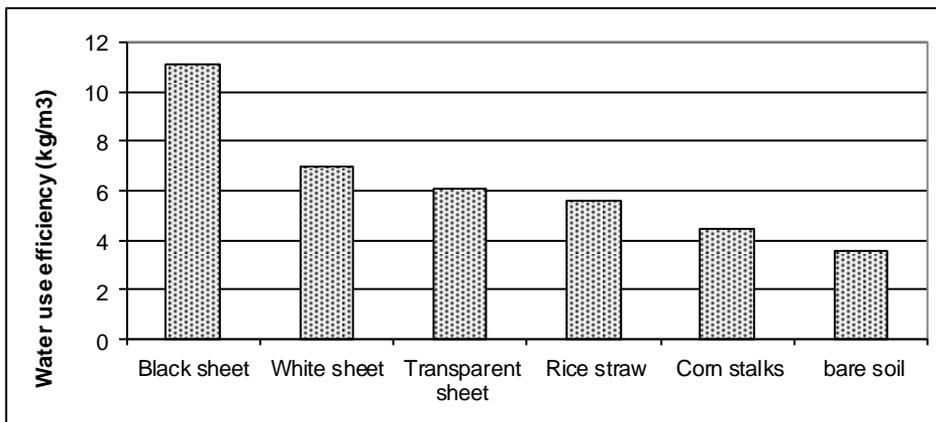


Fig. (3): Effect of mulch types on water use efficiency.

CONCLUSION

In order to validate some covering systems, experimental results of six treatments were examined to estimate ability of covering systems to combat weed infestation which widely used in New El Salhia region. The bare soil and corn stalks showed a weed infestation which increased and appeared in few weeks later after cultivation, compared with other covering systems. While a significant reduction in weed infestation during black and white sheets treatments was occurred. In the 1st period on 2nd of October, no remarkable weeds infestation was happened, dry

mass of the weeds was 43.10 g/m² in all treatments, on 2nd of November, a remarkable existence of the weeds was found, it was 210 g/m² for bare soil, while it was 80 g/m² for corn stalks and rice straw treatments. Through the last period on 2nd of December, the weed infestation was clearly found, the bare soil, corn stalks and rice straw were represented the higher values as compared with the other treatments, it was 218 g/m², while the conventional treatment of bare soil was represented by more than 310 g/m². The crop yield values under studied treatments were ranged between 13 to 40 Mg/ha under studied treatments. Comparing the water use efficiency under the investigated treatments it can be observed that treatment of black sheet was the one where water use efficiency was the highest being with an average value nearly 11.17 kg/m³. Plastic mulches are now an indispensable part of the modern vegetable production system, specially that the black sheets, than natural covering such as corn stalks and rice straw.

REFERENCES

- AVRDC (Asian Vegetable Research Development Centre),(1990).** Vegetable Production Training Manual. AVRDC Shanhua Talnau, Taiwan.;182.
- Bushnell J.and F.A.Welton,(1993).**Some effects of straw mulch on yield of potatoes.J.Agric.Res.43:837-845.
- El- Shaikh, A. and T. Fouda (2008).** Effect of Different Mulching Types on Soil Temperature and Cucumber Production Under Libyan Conditions. Misr J. Ag. Eng., 25(1): 160- 175.
- Giovanni M. and Antonino L. (2005).** Application of soil solarization, to control branched broomrape (*Orobanche ramosa*) and improve the yield of greenhouse tomato. Weed Science 53: 877-883.
- Gordon, G. G., W. G. Foshee, S. T. Reed, J. E. Brown and E. L. Vinson (2010).** The effects of colored plastic mulches and row covers on the growth and yield of okra. Hort Tech. 20(1): 224-233.
- Ham, J. M., G. J. Huitenberg and W. J. Lamont (1993).**Optical properties of plastic mulches affect the field temperature regime. J. Amer. Soc. Hort. Sci. 118: 188-193.

- Hochmuth, G. J., R. C. Hochmuth and S. M. Olson (2012).** Polyethylene mulching for early vegetable production in North Florida. Univ. of Florida, IFAS Extension. Cir 805: 1-6.
- Johnson M.S. and S.A. Fenimore, (2005).** Weed and crop response to colored plastic mulches in strawberry production. HortScience. 40(5):1371-1375.
- Ji S., Unger P.W. (2001).** Soil water accumulation under different precipitation, potential evaporation and straw mulch conditions. Soil Science Society of America journal, 65: 442–448.
- Kar G., Kumar A. (2007).** Effects of irrigation and straw mulch on water use and tuber yield of potato in eastern India. Agriculture Water Management, 94: 109–116.
- Klute, A. (ed.) (1986).** Methods of Soil Analysis. Part 1. Physical and Minerological Properties. Am. Soc. Agron. Inc., Agronomy Series 9. USA. 1173 pp.
- Johnson, J. M., Hough-Goldstein, J. A. & Vangessel, M. J. (2004).** Effects of Straw Mulch on Pest Insects, Predators, and Weeds in Watermelons and Potatoes. Environ. Entomol. 33, 1632– 1643.
- Lamont, Jr. W. J. (2005).** Plastics: Modifying the microclimate for the production of vegetable crops. Hort Tech. 15(3): 477-481.
- Samia E., Atef S., Nasr A., Hamada A., Fouad K., Manal E., Nemat A. and Mohamed H. (2017).** ATLAS for Water consumption (ETc) & amount of irrigation water used (IR) for Egyptian crops over three decades (1985-2015). Rep. Part 1 : North Nile Delta Region.
- Sharma, R.R. & Sharma, V.P. (2003).** Mulch influences fruit growth, albinism and fruit quality in strawberry (*Fragaria x ananassa* Duch.). Fruits 58, 221–227.
- Singh, R., S., Sharma, R.R. & Goyal, R.K. (2007).** Interacting effects of planting time and mulching on “Chandler” strawberry (*Fragaria x ananassa* Duch.). Sci. Hortic. 111, 344–351.
- Sónstebj, A., Nes, A. & Måge, F. (2004).** Effects of bark mulch and NPK fertilizer on yield, leaf nutrient status and soil mineral nitrogen during three years of strawberry production. Acta. Agric. Scand. Sect. B, Soil and Plant 54, 128 – 134.
- Stapleton J. (2000).** Soil solarization in various agricultural production systems. Crop Protection 19: 837–841.

الملخص العربي

تأثير بعض نظم تغطية للتربة على مكافحة الحشائش وإنتاج الفراولة في منطقة الصالحية الجديدة

د.اسلام محمد منير خاطر^١ و د. منى محمود عبدالعزيز حسن^٢

تم استخدام خمسة معاملات مختلفة لتغطية التربة في ارض موبؤة بالحشائش بمنطقة الصالحية الجديدة ومقارنتها بالطريقة التقليدية وهي التربة بدون تغطية من أجل الوصول الى افضل الطرق لتقليل انتشار الحشائش وزيادة انتاجية المحصول والحصول على اعلى كفاءة في استخدام المياه عند زراعة شتلات الفراولة. وتم استخدام انواع التغطية التالية: ثلاث اغطية بلاستيكية شفافة واسود وابيض وغطاءين لمواد عضوية وهي قش الأرز وحطب الذرة مع المعاملة التقليدية وهي التربة بدون تغطية وقد اظهرت النتائج الاتي:

لم يكن استخدام عيدان الذرة وقش الارز كافيا لخفض انتشار الحشائش وكذا ايضا المعاملة التقليدية السائدة بالمنطقة وهي بدون تغطية. في حين كان هناك انخفاض كبير في كمية الحشائش عند استخدام معاملات التغطية باللونين الأسود والأبيض. وفي الفترة الأولى (٢ أكتوبر ٢٠١٦) لم تكن هناك اصابة واضحة في اغلب المعاملات باستثناء المعاملة بدون تغطية حيث كانت الكتلة الجافة للحشائش ٤٣.١٠ جم/م^٢ و في ٢ نوفمبر ٢٠١٦، كانت كمية الحشائش ٢١٠ جم/م^٢ للتربة بدون تغطية، في حين كانت ٨٠ جم/م^٢ في معاملات عيدان الذرة وقش الأرز. وفي خلال الفترة الأخيرة في ٢ ديسمبر ٢٠١٦، كانت كمية الحشائش كبيرة بشكل واضح في معاملات التربة بدون تغطية، عيدان الذرة وقش الأرز والتي مثلت القيم الأعلى بالمقارنة مع المعاملات الأخرى، حيث كانت كمية الحشائش ٢١٨ جم/م^٢، في حين كانت المعاملة التقليدية للتربة بدون تغطية ٣١٠ جم/م^٢.

وقد ارتفعت درجة حرارة التربة على اعماق مختلفة مع استخدام الاغطية البلاستيكية مقارنة بالانواع الاخرى وكانت اعلى قيم لدرجات الحرارة مع الغطاء الشفاف يليه الغطاء الاسود واقل قيم مع حطب الذرة مما اثر على نمو الحشائش وبالتالي انتاج المحصول. كان إنتاج محصول الفراولة عند استخدام التغطية السوداء اكبر من باقى المعاملات حيث وصل الى ٤٠ ميغاجرام / هكتار في حين كانت المعاملة بدون تغطية هي الاقل في الانتاج حيث اعطت ١٣ ميغاجرام / هكتار .

وقد ادى استخدام الاغطية البلاستيكية الى اعلى كفاءة في استخدام مياه الري حيث كانت كفاءة استخدام المياه الاعلى مع الغطاء الاسود ١١.١٧ كجم/م^٢ في حين كانت اقل كفاءة مع التربة المكشوفة حيث كانت ٣.٦٣ كجم/م^٣.

وبشكل عام، وجد أن الأغطية البلاستيكية وخاصة السوداء كانت أكثر فاعلية في تقليل انتشار الحشائش أكثر من الاغطية النباتية مثل عيدان الذرة وقش الأرز في ظل ظروف منطقة الصالحية الجديدة.

^١ أستاذ باحث مساعد. الهندسة الزراعية بقسم صيانة الاراضى، شعبة مصادر المياه والاراضى الصحراوية ، مركز بحوث الصحراء .

^٢ أستاذ مساعد - قسم الهندسة الزراعية، كلية الزراعة ، جامعة الزقازيق.