

RESEARCH ON THE IMPACT OF THE MULCHING SYSTEM ON STRAWBERRY YIELD

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Abstract

The research followed the impact of the mulching system on strawberry yield in the Giurgiu County area in 2022. Mulching provides a physical barrier between the soil and the plant, with positive effects on decreasing the degree of weediness, water losses, and attack by harmful organisms. The biological material taken in the study was of the varieties Magic and Alba. Two types of mulch were used, black polyethylene mulch and wheat straw-based organic mulch. In comparison to the control, where the yield was 25 t/ha, the Alba variety produced the highest yields, 40 t/ha in the black polyethylene mulching system variant and 30 t/ha in the wheat straw mulching system variant. In the Magic variety, the yield was higher in the wheat straw mulching system variant 35 t/ha compared to the black polyethylene mulching system variant 25 t/ha and the control 20 t/ha. The research showed that in Alba, the black polyethylene mulching system provided the highest yields, while in Magic, the wheat straw mulching system was more suitable. The results of the experiment demonstrate that the use of mulching systems is effective in increasing yield, with the best system differing by variety.

Key words: strawberry, variety, mulching system, yield.

INTRODUCTION

One of the most valuable fruits in the world is the cultivated strawberry (*Fragaria x ananassa* Duch). Romania's strawberry production has increased annually since 2014 by 0.6%. With 22,620 tons produced, the country produced the 29th-most strawberries in the world in 2019. Israel, which was ranked 28th with 24,622 tons, surpasses Romania, and Serbia comes in second place with 19,608 tons. With 3,221,557 tons in 2019, up 5% from 2018, China tops the list. In this ranking, the United States came in second, followed by Mexico and Turkey, and finally, the United States. The 5-year average growth rate for Moldova was +23.3% per year, while Kenya had the worst performance at -33.7% per year (FAO, 2019).

The strawberry crop is known to grown in numerous Romanian regions, but Hotarele, Giurgiu, one of the country's major strawberry producers, is particularly significant economically. In this region, over 200 hectares of strawberries were grown just in 2017 (Zmaranda, 2017). Strawberry fruits offer a

significant financial advantage to the grower when compared to other crops and consumers like them because of their flavorful organoleptic characteristics and nutritional value. Due to the presence of vitamin C, strawberry fruits are highly regarded for their flavor, aromatic balance, and nutritional value. They are also valued for their high levels of polyphenols and ellagic acid, the latter of which is regarded as an anticancer agent (Temocico et al., 2019). There are many factors that influence strawberry yield and quality. Studies on this subject have demonstrated that, in addition to genetic characteristics, which are a significant factor, inadequate cultivation technology can also have a negative impact on plant development and fruit quality (Saygi, 2022). The main factors that are important in production are the varieties selected for each region, the use of irrigation, the control of diseases and pests and the observation of culture technology, all with the objective of increasing financial income.

The application of the mulching system is a method that growers have been using for a long

time to protect the plant and the soil surface and to produce higher quality fruit. The use of wheat straw or polyethylene film mulch is one of the most crucial cultural measures to prevent strawberry fruit infections with *Botrytis cinerea* because it helps to prevent direct contact with the soil and the same time of the pathogen with the fruit (Țane, 2022). The most popular mulching method is polyethylene film mulch (Santin et al., 2020). Researchers only recommend using black polyethylene mulch in agricultural systems because it is much more effective at blocking sunlight than transparent or colored mulch (Chang et al., 2016). Mulching can improve soil conservation by reducing water evaporation losses, regulating soil temperature, reducing weed growth, and enhancing microbial activities (Iqbal et. al., 2020). Numerous studies show that the use of a mulching system leads to appreciable increases in production for a variety of crops (Daugaard, 2008; Gao et al., 2019; Lamont and William, 2017; Singh et al., 2006). Organic material like wheat straw is another option for mulching soil. The benefits of wheat straw as a mulching system for the soil, including improved fertility, moisture retention and weed control, are cited by researchers as reasons to use it (Jabran and Chauhan, 2018; Ramakrishna et al., 2006). The objective of this paper was to evaluate the impact of several mulching techniques on the production of strawberries in Hotarele, Giurgiu.

MATERIALS AND METHODS

The present work was carried out in Hotarele, Giurgiu, located in the latitude 44,10° N, longitude 26,22° E and altitude of 29 meters. The climatic parameters for the area under study are: the average annual temperature 11.1°C; the absolute maximum daily temperature 40.5°C; the absolute minimum daily temperature -30.2°C; the average temperature of the summer months 20.4-23.2°C and the average temperature of the winter months 3 ... -3.2°C. The average annual precipitation values are 556.1 mm, the relative air humidity has values between 72-74% and the average value of potential evapotranspiration is 729 mm. Global radiation recorded values between 122.5 and 127.5

kcal/cm², and the multiannual mean amplitude is 25.5°. The experimental field is located on a cambic chernozem where the water table is at approximately 2 m and the morphological profile is of the type An -Bv -Cca with accumulations of good quality humus and a large amount of organic substances. The pH of the soil is generally neutral or weakly alkaline with values of 7-7.5. Alba and Magic, were the strawberry cultivars used in this experiment. The plants were imported from a Dutch nursery for the Alba variety and from a Romanian nursery for the Magic variety. Magic is a very productive variety with medium-vigorous, dense, globular bush that is resistant to low temperatures. It produces a moderate amount of stolons. The fruit is glossy, uniformly red and conical in shape, weighing 10 to 15 g. The pulp has a consistent red color, is firm and is transport-resistant. It ripens at the end of May and the harvest lasts until the middle of June. It is one of the most popular and widely used strawberry varieties by growers because of its high production, high frost resistance (up to -25°C) and low soil requirements. Alba is a variety of strawberry adapted to the climatic conditions of our country. The plant is vigorous and productive, with large leaves. The fruit has a distinctive commercial appearance, is large (on average over 20 g), conical-elongated and has high firmness. It has a good flavor and a sweet-sour aroma. It is a very early variety; typically, the first harvest occurs between May 5 and 7.

The crop was established with refrigerated stolons in the first decade of July (July 10). In order to have a good production from the first year, the inflorescences that formed during this period were removed. The planting was done manually with spoon-shaped planters, on the irrigated area one or two days before. It is very important that when planting, the central bud (heart) is not buried because it leads to the death of the plant. After planting, the plants were watered. Planting distances: 1 m between rows and 0.30 m between plants per row. In the Alba variety, the cultivation is carried out on matted row system in equidistant rows, and in the Magic variety, the cultivation is carried out in the classic system in simple rows.

To control weeds, the herbicide Sultan 50 SC (metazachlor 500 g/l) was applied, pre-

emergent for annual monocotyledonous and dicotyledonous weeds from seed (0.5 l/ha in 300 liters of water). Additionally, during the vegetative period, a total of six soil-working methods were applied, three mechanical and three manual. The recommended irrigation rates during the vegetative period were 50-60 m³/ha every two days.

The majority of the fertilization was done through fertigation (Table 1), which was done weekly based on the electrical conductivity of the soil and by analyzing the nutrient elements in the petiole of the leaves.

Table 1. Fertilization scheme

Phenological stage	Fertilizer	Dose (g/plant)	Application number
In the early stages of development BBCH 40 - 50	Phosphorus	1	1/week
Before blooming BBCH 55 - 60	Magnesium sulphate	0.2-0.5	
Full flowering, fruit formation BBCH 65 - 70	Calcium nitrate	0.1-0.12	
Fruit development BBCH 70 - 80	Urea	0.6	

In the experiment two mulching types were used: polyethylene film mulch and wheat straw mulch. Different stages of the mulching system's application were used. The following steps were taken in relation to the polyethylene film mulching system (Figure 1) the soil was modeled in the hill system, the drip irrigation system was installed, the black mulching film was applied, then the planting was carried out.



Figure 1. Black polyethylene mulching system

For the wheat straw mulching system (Figure 2), the soil was traditionally prepared in equal-distance rows, the drip irrigation system was installed, the planting operation was completed, while the wheat straw mulch was applied at the start of the flowering phenophase.



Figure 2. Wheat straw mulching system

The plants were planted on September 15. The fruit harvest began in May 7 and finished in June 15. The fruits were harvested at commercial maturity and shortly after, fruits were counted and weighed with a digital balance. Data on average fruit weight and total yield per plant were collected during vegetative growth and fruiting time.

Results were statistically analyzed by ANOVA and Tukey using the GraphPad Prism version 7.00 for Windows, GraphPad Software (La Jolla California USA).

RESULTS AND DISCUSSIONS

The results showed that Alba variety with polyethylene mulching film presented a bigger average weight by plant, as well as a bigger mean weight for fruit and production, when compared with Magic variety on the same mulching type. One of the most significant observations was that the polyethylene film mulching system significantly reduced the production of the Magic variety per plant because this variety is more sensitive to high temperatures than other varieties and the presence of the black polyethylene film which captures even more light, lead to an increase in temperature at the plant level, resulting in poor plant development and by default to poor fruit

development. On the other hand, the wheat straw mulching system significantly improved the production for Magic variety. When compared, the production of the Alba variety, the polyethylene film mulching system recorded slightly increased values than the wheat straw mulching system (Figure 3).

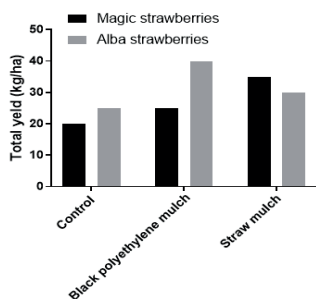


Figure 3. Total yield per hectare

As seen in Figure 4, in terms of the average weight fruit, significant variations were registered. At the Magic variety, the highest average fruit weight was registered in wheat straw mulching system, the difference from the control being significantly different ($p < 0.0001$) and two times higher (14.87 g) than this. No difference was observed in polyethylene film mulching system comparing to control ($p = 0.95$). This could be explained due the increase sensitivity of this variety to high temperatures than others in the presence of the black polyethylene film.

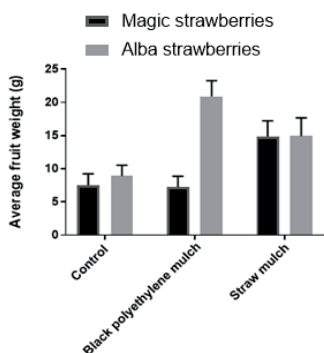


Figure 4. Effect of mulching types on average fruit weight

Alba variety registered the maximum average fruit weight of plant (20.92 g per fruit) from the treatment in the black polyethylene film mulching system, the difference from the control being significantly different ($p < 0.0001$).

Strawberry grown under black polythene mulch produced higher yield per plant due to larger fruits produced by improved plant growth due to a favorable hydrothermal regime of the soil and a completely weed-free environment. Comparing to other topic research, results confirmed a similar observation of increased yield with larger fruits after mulching with black polythene (Bakshi et al., 2014). Adnan et al. (2017) obtained the highest fresh weight of fruits (23.01 g fruit⁻¹) in black polythene mulch. Pandey et al. (2015) found that among the various mulches tested, black polythene outperformed yield parameters (fruit fresh weight 36.74 g and fruit yield/plant 536.55 g). Angrej et al. (2007) also presented as results how polyethylene film improves the number of fruits per plant, average weight and size (length and width), and fruit yield. The increase of yield using black plastic mulch is reported also by Laugale et al. (2010). As I mentioned above, researchers have recommended polyethylene film mulch in numerous studies, but according to data collected on the Magic variety, which is a fairly cultivated variety in Romania, it only has good results in the presence of wheat straw mulch.

As seen in Figure 5 significant variation between varieties in terms of the total yield per plant were registered. At the Magic variety, the highest total yield per plant was registered in wheat straw mulching system, the difference from the control being significantly different ($p < 0.0001$) and two times higher (1.2 kg per plant) than this. No difference was observed in polyethylene film mulching system comparing to control ($p = 0.66$).

Alba variety registered the maximum total yield per plant (1.75 kg per plant) from the treatment in the black polyethylene film mulching system, the difference from the control and wheat straw mulching system being significantly different ($p < 0.0001$).

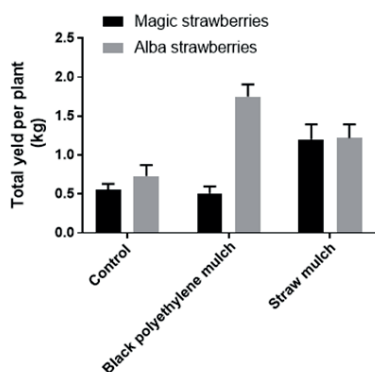


Figure 5. Effect of mulching types on total yield per plant

Regarding the control, the production was significantly reduced compared to the two types of mulching, because it did not control the weeds and direct contact of the fruit with the soil led to gray rot infections.

CONCLUSIONS

When mulching systems were used, both the Alba variety and the Magic variety experienced considerable production gains. The Alba variety works best with the method of mulching with polyethylene film, while the Magic variety works best with the system of mulching with wheat straw.

Mulching systems are crucial in strawberry cultivation because, in addition to highly increasing yields, they also help prevent the growth of weeds that can serve as hosts for different pathogens and, by avoiding direct soil contact with the fruit, they also ensure protection against numerous soil pathogens.

It is important to keep in mind that a high level of production is not mainly attributable to the mulching system applied, but rather to its harmonic integration with appropriate technology while taking into account the preferences of the selected variety.

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