Scientific Papers. Series B, Horticulture. Vol. LXIII, No. 1, 2019
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

# THE INFLUENCE OF FERTILIZATION AND MULCH TYPE ON STRAWBERRY FRUIT SET AND YIELD

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***Abstract***

*In 2018, organic strawberry culture is becoming more and more important but knowledge concerning best practices is still contradictory. The behavior of 4 four strawberry cultivars - 'Alba', 'Asia', 'Clery' and 'Joly' under two different types of mulch (agrotextile and polyethylene) and three fertilization treatments (poultry manure, poultry manure combined with liquid NPK, and liquid NPK) has been studied in climate conditions from Satu-Mare, Romania. Observations were made on fruits set and yield at end of the first growing season. The size of the fruit was related to the rank of the flower from which the fruit was developed. The best behaviors among the tested varieties undergoing the various treatments had 'Clery' and 'Joly' showing high productivity.*

***Key words****: variety, fertilization, mulch, strawberry, yield.*

## INTRODUCTION

Strawberry (*Fragaria x ananassa Duch*.) is among the most delicious and refreshing fruits. It is characterized by specific flavor and high content of vitamins and minerals (Sharma, 2002). Mature fruits of strawberries are high in water (90%), total soluble substances (10%) and many dietary components (Jin *et al*., 2011). Following numerous studies in determining the volatile components of the strawberry (Goff and Klee, 2006) it was found that strawberry flavor is given by 360 volatile substances (Pineli *et al*., 2011). According to the National Institute of Statistics, 3272 ha of strawberries were grown in Romania in 2017, of which 1414 ha are in Satu Mare County.

From economic point of view, this crop offers very rapid and widespread economic production, due to the fact that these plants can produce even in the year of planting, but also because they are the first appearing on the market. Strawberries are known and preferred by consumers and can be eaten both fresh and in the form of preparations. Can be used in confectionery or even juices, as fresh or dried fruit.

Performances of conventional and organic systems in terms of fruit productivity and quality depends on a large number of factors (Vallverdú-Queralt, Lamuela-Raventós, 2015). Palomaki et al. (2002) in their studies observed that, the level of growth of the plants, in organic system were smaller compared to those in the conventional one. Farmers use strawberry growing in organic system in order to maintain healthy soil, increase fruits quality and yield, and improve environmental sustainability. Some of the most important factors that influence the growth and productivity of strawberries are mulching and nutrients (Amanjot Singh *et al.,* 2018). Mulching helps to increase soil temperature by 5-7°C. Other benefits of mulching are: reduction of weed growth, maintenance of moisture, pest control, better yield and more efficient use of soil nutrients (Kyrikou and Briassoulis, 2007, Kasirajan and Ngouajio, 2012).

Potassium (K) is one of the most important nutrients for strawberries, with a great influence on fruit yield and quality (Kaya, Kirnak, Higgs & Saltali, 2002).

The main objective of this study was to compare and evaluate the results obtained in two growth systems (organic and conventional) undergoing different fertilization treatments, different mulching methods and the interaction of strawberry varieties with the experimental

factors regarding the percentage of binding and the yield on the surface unit.

## MATERIALS AND METHODS

The research has been carried out in a commercial farm, established in spring of 2018 at Satu-Mare, Romania.

The runners used in the experiment was purchased from Italy, from Salvi Vivai (http://www.salvi.it). The varieties used for this experiment were stored at low temperatures. They are short day varieties and they produce fruits at the end of spring (May-June), but only for a few weeks. All varieties used are patented in Italy (Cesena, Consorzio Italiano Vivaisti and Centro Innovazione Varietale). 'Alba' and 'Clary' are very early varieties, and 'Asia' and 'Jolly' are semi-early, with a ripen delay of the fruits of 3-4 days compared with the first varieties.

The runners were planted in a hill system covered with black foil with a drip irrigation system underneath. The hill system was divided into two rows, with a distance of 30 cm between the rows and 35 cm between the plants in a row.

The height of the hill system was 35 centimeters and the distance between rows of 1 m. In the agrotextile mulch experiment, the culture was established at the same distance for planting, but without soil modeling. Plant density per ha was about 35 thousand plants.

The experimental design was a full factorial experiment with three factors (3x3x3); factor A is the type of mulch (black foil and agrotextile). The data were taken in three repetitions, and for each rehearsal, five plants were analyzed. The second experimental factor was the fertilization type. The treatments applied were (poultry manure, poultry manure + NPK, NPK), and the third experimental factor was the strawberry varieties used ('Alba', 'Asia', 'Clery' and 'Joly').

The place where the experiment has been carried out was chosen because of the suitable soil type suitable for strawberry culture, typical LVti luvosol (SRTS 2012). In order to determine the soil composition, three soil samples were taken from three different sites and analyzed. The results are summarized in the table below (Tab. 1.):

Table 1. Soil composition in the experimental field

| Soil horizons | Ao | El | EB | BE | Bt |
|---|---|---|---|---|---|
| Depth (cm) | 0-17 | 17-32 | 32-45 | 45-57 | 57-86 |
| Coarse sand (2,0 – 0,2 mm) % | 3,5 | 5,4 | 3,3 | 1,3 | 2,1 |
| Fine sand (0,2 – 0,02 mm) % | 34,0 | 37,0 | 32,2 | 29,9 | 30,0 |
| Dust (0,02 – 0,002 mm) % | 31,8 | 35,2 | 32,2 | 28,2 | 28,5 |
| Clay (sub 0,002 mm) % | 20,8 | 22,3 | 32,3 | 40,6 | 39,4 |
| Texture | LL | LP | LL | TT | TT |
| pH in $H_2O$ | 5,65 | 5,55 | 5,35 | 5,20 | 5,35 |
| Humus (%) | 1,55 | 0,78 | - | - | - |
| Total nitrogen (%) | 0,075 | 0,035 | - | - | - |
| Phosphorus (ppm) | 8 | 6 | - | - | - |
| Potassium assimilable (ppm) | 75 | 55 | - | - | - |
| $Na^+$ (% din T) | - | - | - | - | - |

During this experiment the fruit set percentage and fruit production were monitored in the first growing season. The data obtained were analyzed by ANOVA and mean separation was performed using Fisher's Protected LSD when appropriate using IBM SPPS 19 software.

## RESULTS AND DISCUSSIONS

The highest average fruit set percentage in 'Clery' mulched with black foil, fertilized with poultry manure (45.67%) was recorded followed by the same variety, with NPK fertilization treatment, also on black foil (45.33%) as shown in Tab. 2.

Table 2. The influence of mulch type, fertilization way and variety on strawberry fruits set (%)

| | FRUIT SET (%) | | |
|---|---|---|---|
| Type of mulch | Poultry manure | Poultry manure +NPK | NPK |
| | *Fragaria x ananassa* 'Alba' | | |
| Agrotextile | 29.63±0.25 bB | 30.03±0.14 bA | 28.53±0.23 bC |
| Polyethylene film | 39.33±0.26 aB | 44.00±1.95 aA | 39.33±0.52 aB |
| | *Fragaria x ananassa* 'Asia' | | |
| Agrotextile | 28.10±0.18 bC | 29.33±0.25 aB | 31.27±0.23 aA |
| Polyethylene film | 41.33±0.26 aA | 32.43±0.25 aC | 39.00±0.45 aB |
| | *Fragaria x ananassa* 'Clery' | | |
| Agrotextile | 40.27±0.83 aA | 32.13±0.34 bC | 38.03±0.36 aB |
| Polyethylene film | 45.67±1.13 aA | 41.77±1.36 aB | 45.33±0.68 aA |
| | *Fragaria x ananassa* 'Joly' | | |
| Agrotextile | 31.13±0.30 bB | 31.33±0.29 bB | 34.30±0.26 aA |
| Polyethylene film | 39.67±0.26 aA | 38.33±0.68 aB | 31.10±0.08 bC |

The values shown are means ± standard error. Different lowercase letters indicate significant differences between mulching undergoing the same fertilisation treatments. Capital letters indicate significant differences between the means undergoing different fertilisation treatments but same mulching according to Fishers Protected LSD test, $P<0.05$.

The results show that mulch types significantly influenced the percentage of fruit set; the best results being achieved on the black foil mulching system.
Fertilization treatments also had a great impact on fruit set percentages. In this context, the best results have been registered in strawberries undergoing the poultry manure fertilization treatments.
The lowest average fruit set percentage was recorded in 'Asia', grown on agrotextile, and fertilized with poultry manure (28.10%), followed by 'Alba' undergoing NPK fertilization, but the same mulching system (28.53%).
Regarding strawberry production, the highest average production (t/ha) was recorded in 'Alba', grown on black foil, and fertilized with poultry manure + NPK (29.67 t/ha), followed by 'Asia' fertilized with poultry manure + NPK, also on black foil (29.40 t/ha). Types of mulch have significantly influenced fruit production; the best results have been reported on black foil. Fertilization treatments significantly influenced fruit production; the best results being obtained in strawberries undergoing the NPK+ poultry manure fertilization.

Table 3. The influence of mulch type, fertilization way and variety on strawberry fruits production (t/ha)

| FRUIT PRODUCTION (t/ha) | | | |
|---|---|---|---|
| Type of mulch | Poultry manure | Poultry manure +NPK | NPK |
| | *Fragaria x ananassa* 'Alba' | | |
| Agrotextile | 20.23±0.74 bB | 27.47±0.14 aA | 27.47±0.37 aA |
| Polyethylene film | 24.67±0.27 aC | 29.67±0.40 aA | 26.87±0.21 aB |
| | *Fragaria x ananassa* 'Asia' | | |
| Agrotextile | 18.83±0.43 aB | 22.77±0.51 aA | 23.03±0.14 aA |
| Polyethylene film | 20.10±0.22 aC | 29.40±0.39 aA | 23.23±0.44 aB |
| | *Fragaria x ananassa* 'Clery' | | |
| Agrotextile | 18.97±0.81 aC | 24.63±0.34 aA | 23.93±0.27B |
| Polyethylene film | 22.93±0.16 aC | 27.73±0.51 aA | 25.00±0.18B |
| | *Fragaria x ananassa* 'Joly' | | |
| Agrotextile | 17.63±0.11 bB | 27.23±0.42 aA | 27.17±0.30 aA |
| Polyethylene film | 24.30±0.32 aC | 28.07±0.57 aA | 26.20±0.39 aB |

The values shown are means ± standard error. Different lowercase letters indicate significant differences between mulching undergoing the same fertilisation treatments. Capital letters indicate significant differences between the means undergoing different fertilisation treatments but same mulching according to Fishers Protected LSD test, P<0.05.

The lowest average production (t/ha) was recorded in 'Joly', mulched with agrotextile, and fertilized with poultry manure (17.63 t/ha), followed by 'Asia' that has been fertilized with poultry manure undergoing the same mulching system (18.83 t/ha).
Fruit weight has also been investigated in this study. Our results show that the highest average fruit weight (g) was recorded in 'Asia' grown on both mulching systems (agrotextile and black foil) undergoing the same fertilization treatments consisting of poultry manure + NPK (33.43 g and 32.93 g, respectively). The results show, that fruit weight was not significantly influenced by the mulching system but the fertilization treatments. Therefore, the best results were obtained in strawberries fertilized with in poultry manure + NPK, increasing fruit weight by 6.79% as compared to the other treatments applied.
The lowest average fruit weight (g) was recorded in 'Alba' on both mulching systems with both poultry manure and NPK fertilization treatments (26.20 g).

Table 4. The influence of mulch type, fertilization way and variety on strawberry fruit weight (g)

| FRUIT WEIGHT (g) | | | |
|---|---|---|---|
| Type of mulch | Poultry manure | Poultry manure +NPK | NPK |
| | *Fragaria x ananassa* 'Alba' | | |
| Agrotextil | 26.30±0.12 aC | 29.00±0.43 aA | 27.47±0.37 aB |
| Perforated foil | 26.20±0.12 aB | 29.80±0.32 aA | 26.20±0.31 bB |
| | *Fragaria x ananassa* 'Asia' | | |
| Agrotextil | 31.57±0.27 aB | 33.43±0.16 aA | 30.33±0.09 aC |
| Perforated foil | 30.60±0.22 bB | 32.93±0.23 aA | 30.03±0.05 aB |
| | *Fragaria x ananassa* 'Clery' | | |
| Agrotextil | 30.63±0.23 aA | 30.07±0.07 aA | 30.03±0.09 aA |
| Perforated foil | 30.27±0.25 aA | 30.40±0.75 aA | 30.07±0.07 aA |
| | *Fragaria x ananassa* 'Joly' | | |
| Agrotextil | 29.27±0.21aA | 29.70±0.31 aA | 29.00±0.38 aA |
| Perforated foil | 28.87±0.11 aB | 30.97±0.32 aA | 30.37±0.33 aA |

The values shown are means ± standard error. Different lowercase letters indicate significant differences between mulching undergoing the same fertilisation treatments. Capital letters indicate significant differences between the means undergoing different fertilisation treatments but same mulching according to Fishers Protected LSD test, P<0.05.

## CONCLUSIONS

The results of our experiment revealed that among the investigated cultivars the most suitable to be grown in Satu-Mare are the cultivars 'Alba' and 'Asia' because of their high productivity and high fruit quality in

comparison with other cultivars. Our results also show that yield and quality of different varieties of strawberry are highly influenced by the genetic background of each variety.

Types of mulch and fertilization treatments have significantly influenced fruit production.

The study by Capocasa F. *et al*., in 2017, in an organic farm in the Marche region of Italy classify the varieties as follows: 'Alba' (19.6 t/ha), 'Clery' (16.8 t/ha), 'Asia' (20.9 t/ha) and 'Joly' (22.4 t/ha), while Marjan Cuderman in 2013, Gorenjska region, from Slovenia classify the varieties as follows: 'Clery' (21.9 t/ha), 'Asia' (18.0 t/ha) and 'Joly' (16.2 t/ha).

In the experiment conducted in 2018, in the Satu Mare region of Romania, the results obtained with the varieties fertilized with organic fertilizers and mulch with black foil obtained the following values: 'Joly' (24.3 t/ha), 'Alba' (24.2 t/ha), 'Clery' (22.9 t/ha) and 'Asia' (20.1 t/ha).

Our findings indicate that strawberry if it is grown in a workmanlike manner, could be a promising candidate for organic agriculture.

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