

INFLUENCE FERTILIZATION SYSTEM UPON YIELD AND THE FRUIT QUALITY IN STRAWBERRY

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Abstract. In recent years concern for organic food and combat drought in crops received increasingly higher attention. Under assessment was the productive value of 6 foreign strawberry cultivars : ‘Alba’, ‘Aprica’, ‘Clery’, ‘Joly’, ‘Fortuna’ and ‘Malling. The cultivars were evaluated in terms of productive value in organic and chemical fertilization. It was noted that organic fertilization has a high influence.

Keywords: strawberry, poultry manure, yields, mulch system.

INTRODUCTION

Organic food is attracting more and more consumer interest because it is perceived to be healthier than conventional and environmentally sustainable agriculture (Hughner et al., 2007; Canavari and Olson, 2007; Stolz et al., 2011 ; Carlson and Jaenicke, 2016; Mie et al., 2016; EC, 2017). Organic products, once only available in a few specialty stores, are now widely available in most supermarkets, and a large percentage of consumers are aware of them. According to IFOAM (2019), in 2017, globally, organic farming was practiced in 181 countries, on a total of about 68.8 million hectares (1.4% of agricultural land), and the size of the organic market reached \$ 97 billion. In the last decade, the demand for organic products has increased steadily (despite the recent economic crisis). In Romania, the area of agricultural land was 258.471 ha (1.98% of agricultural land) according to FiBL Statistics.

Strawberry (*Fragaria ananassa Duch.*) has been cultivated in almost all regions of the world both for market and home use.

It is proved that from the "Rosaceae" family, the strawberry is the most delicious and refreshing fruit. It is characterized by specific flavor and high content of vitamins and minerals. Mature strawberries are high in water (90%), total soluble substances (10%) and many dietary components. Strawberry has a unique, highly desirable taste, colour and flavour and great amounts of bioactive compounds such as folate, which is known to have protective effects against cardiovascular disease, colorectal cancer and neural tube defects such as spina bifida (Stralsjo, Witthoft, Sjolholm, & Jagerstad, 2003a), vitamin C and other antioxidants including flavonoids which are capable of scavenging several different reactive oxygen species and may promote health benefits in liver protection, anti-cancer and coronary heart disease (Patil, Madhusudhan, Babi, & Raghavaro, 2009).

Given that they are highly perishable fruits, is necessary to use mulch (Riffat et al., 2011) both for keeping under control weeds and for obtaining clean fruits. Fear and

Nonnecke (1989) observed that the both vegetative and reproductive strawberry plant responses can be modified by the different type organic mulches.

The use of organic fertilizers and compost can be an alternative to mineral fertilizers (Shehata et al., 2011), while increasing soil content in organic substances and improving its quality (Wright et al., 1998).

Stefano Conti et al. (2014) states that organic crops produced better quality fruit, but lower yields than conventional crops during greenhouse tests. However, both SM fumigation and soil treatment of soil applied to conventional or organic crops, respectively, have led to effective control of soil-borne diseases. Therefore, the lower productivity of organic crops can be attributed to the lower efficiency of organic manure compared to conventional mineral fertilizer. Because soil solarization treatment has combined a lower cost with an environmental impact, this could be considered a possible alternative to conventional chemical fumigation.

Fresh plants are better suited to the conventional system than those stored cold, because they provide a shorter crop cycle and previous production, which economically compensates for lower yields; In addition, compared to biennial cultivation, the annual duration of the crop results in heavier fruits, which are more profitable on the conventional market. In contrast, cold-stored plants better meet the requirements of the organic system than fresh plants, because consumers do not expect early production. In addition, cold storage propagation material allows organic farmers for cost-effective biennial crops, because the latter is less costly in terms of saving plants, as well as site preparation and, moreover, the price of the product is more stable over time, compared to conventional strawberries.

The purpose of the studies was to evaluate the yield of strawberries grown organically and conventionally, in the first season of vegetation under the climatic conditions in Satu-Mare, Romania.

MATERIAL AND METHOD

The research was conducted in the spring of 2018 in a commercial farm, in Satu-Mare, Romania. The biological material used was in the form of Frigo seedlings, from category A +, imported from Italy.

To determine the DM of the sample certain amount of sample was weighed and dried until constant weight (24 h) at 105°C. DM was then calculated with the following equation percentage is given in %w/w:

$$[(DM]_{(105^{\circ})}[\%] = (m \text{ out}) / (m \text{ in}) * 100$$

DM_(105°)[%]: dry matter

m in [g]: weight in quantity of substrate before drying

m out [g]: weight out the quantity of substrate after drying

Brix degree (°Brix), as a measure of total soluble solids (TSS), was determined through refractometry.

The experimental project was a complete multifactorial Latin rectangular design. The first experimental factor was the cultivation with 6 graduates ("Alba", "Aprica", "Clery", "Joly", "Fortuna" and "Malling). The strawberries were planted in

unique rows. The second experimental factor was the fertilization treatments (bird waste and liquid NPK 24: 8: 16, also containing microelements 2.2% Mg, S 2%, B 0.03%, 0.1% Fe, 0.1%, Mn 0.05% and Zn 0.025%).

The planting system chosen for the experimental plot was 40 cm between rows and 33 cm between plants in a row. To correspond to such a poly-factorial model, 60 variants were formed in three replicates. The observation was made on the percentage of fruit set and yield in the first season of vegetation.

The obtained results were processed using the analysis variant of the multifactorial model of the divided plots. To analyze the data, Duncan's multiple comparison test was used.

RESULTS AND DISCUSSIONS

Table 1 introduces data referring to the influence of fertilizer type and cultivar on yield. We can observe that the best cumulative yield was obtained in variant NPK fertilization system (9.99 t/ha) followed by the poultry manure system (9.63 t/ha) with differences statistically assured between these two types of fertilization. The best cumulative yield gave 'Fortuna' (9.99 t/ha) and the lowest 'Alba' (1.75 t/ha). Regarding the combined influence of two experimental factors, the best cumulative yield was obtained at 'Fortuna' (9.99 t/ha) in the NPK fertilization system and the lowest at 'Alba' (1.75 t/ha) in NPK system.

The research carried out by Shehata et al. (2011) confirm this, through significantly higher yields obtained by using these fertilizers. Similar results are also found in the studies of Lai et al. (2005), where it is emphasized that the application of organic fertilizers has led to better growth and development of the plants, the production obtained being significantly higher than in the case of mineral fertilization. A study by Klaas et al. (2009) on the influence of fertilization and removal of stolons shows that in the fertilized variants the first production increased by 2.5-4.8%, depending on the fertilizer used.

Albregts and Howard (1981) recorded increased yield at 27.5 mt/ha with the use of poultry manure at 18 mt/ha in the first year and reported that 36 mt/ha poultry manure caused plant damage and reduction in marketable yield due to fruit rot.

Knight and Wallace (1932) reported that treated with FYM were more vigorous than with chemical fertilizers. Nitrogen applied at the rate of 100 and 140 lbs. per ha gave excessive plant growth (Linberry et al., 1944).

Wallace (1936) observed more yield with organic manures in strawberry. The chemical fertilizers mainly contain NPK which are leached down to sub-soil, thus contaminate it, whereas organic manures are slowly available to plants and are eco-friendly, increases yield and soil fertility (Kaul, 1998).

Knight and Wallace (1932) found dung much superior to chemical fertilizer in increasing yields and the best results were obtained with a light annual dressing of dung at 12- 13 tonnes/acre. The manure applied was 20 tonnes FYM; check no manure fertilizer at 40 kg N, 150 kg P₂O₅, 50 kg K₂O, however, a yield of 227.21 kg was recorded where FYM was added in combination with fertilizers. The plant grown in

soil deficient or not receiving nitrogen or phosphoric acid shows varied relative yield (about 2.000 quartz/ acre) but satisfactory yields (4000 quartz or more) were obtained when fertilizer contained 160 lbs P₂O₅ (Linberry et al., 1944). The manure as a whole i.e. averaging the effects of dung and chemical showed an increase of about 12 percent, dung gave a somewhat larger increase than chemical about 8 percent approximately with improved fruit size and quality. An application of 30 tonnes /acre increased the yield of d over 12 tonnes /acre.

Table 1

The influence of fertilizer type and cultivar on yield

Cultivars	Fertilization system		
	NPK	Poultry manure	Mean cultivar
Alba	1.75 a	1.99 a	1.87 D
Aprica	2.66 bc	2.24 ab	2.45 D
Clery	8.28 f	7.78 e	8.03 B
Joly	3.14 cd	3.04 cd	3.15 C
Fortuna	9.99 h	9.63 h	9.81 A
Malling	8.88 g	7.53 e	8.20 B
Mean fertilization system	5.78 X	5.36 Y	
LSD5% cvs 0.34 – 0.39	LSD5% fertilization system 0.15	LSD5% interaction fertilization system x cultivar 0.46 – 0.57	

Note * = the difference between any two values followed by at least one common letter is not significant

Table 2.

The influence of fertilizer type and cultivar on total soluble dry matter, (%)

Cultivars	Fertilization system		
	Poultry manure	NPK	Mean cultivar
Alba	13.52 a	11.89 d	12.70 B
Aprica	11.98 d	11.86 d	11.92 D
Clery	13.15 ab	12.46 bc	12.81 B
Joly	13.12 ab	13.29 a	13.20 A
Fortuna	13.22 a	13.43 a	13.33 A
Malling	12.76 bc	12.32 b	12.54 C
Mean fertilization system	13.0 K	12.6 K	
LSD5% cvs 0.34 – 0.39	LSD5% fertilization system 0.15	LSD5% interaction fertilization system x cultivar 0.46 – 0.57	

Note * = the difference between any two values followed by at least one common letter is not significant

In the present research, regardless of cultivar between the two types of fertilizer, there were no statistically assured differences. In the last column of Table 2, the influence of the cultivar regardless of the type of fertilizer can be observed. Thus, the cultivar 'Fortuna' (13.33%) records the highest content in total dry matter followed by a significant difference from the cultivars 'Joly' (13.20%). The lowest values of the total dry matter content were recorded by the cultivars 'Aprica' (11.92%).

The research carried out by Shehata et al. (2011) demonstrate that the compost fertilization has led to the development of better-developed plants, higher-weight fruits with higher anthocyanin content and soluble dry matter.

Similar results are also found in the studies of Lai et al. (2005), which talks about comparisons between the unfertilized or fertilized variants with urea, in which both the sugar content and the acidity increased from 23.7% to 28.7% in the case of sugar and from 16.5% to 21.2%, in the case of acidity.

Table 3 introduces data referring to the influence of fertilizer type and cultivar on solids content . We can observe that the best cumulative solids content was obtained in variant poultry manure fertilization system (12,4 °Brix) followed by the poultry manure system (12,25° Brix) with differences statistically assured.

From the interaction of the two factors (fertilizer x cultivar), the lowest values were recorded both in the NPK fertilized variant by the 'Alba' cultivar (10.82%) respectively (10.84%), by the 'Aprica' cultivar without statistically assured differences. The highest content was recorded in the cultivar 'Fortuna' in the poultry manure fertilized version (12.40%), followed by the cultivar 'Alba' (12.34%) in the poultry manure fertilization system.

Capocasa et al., 2018, studied Yield and fruit quality of strawberry cultivars grown in organic farming in the mid-Adriatic area. ‘Albion’ variety presents fruits that combine a good firmness and a sugar content (6.8 °Brix), higher than the average of the field. ‘Garda’ variety also had a sugar content higher than the average, mainly because both cultivars have produced few fruits plant-1. In the early ripening period, some cultivars such as ‘Alba’ and ‘Madeleine’ showed a poor sugar content, even for a fairly high acid content (>11.0 meq NaOH 100 g-1), conferring a poor fruit taste.

Table 3.

The influence of fertilizer type and cultivar on soluble solids content (°Brix)

Cultivars	Fertilization system		
	Poultry manure	NPK	Mean cultivar
Alba	12.34 a	10.82 d	11.58 C
Aprica	10.97 d	10.84 d	10.91 B
Clery	12.11 b	11.47 c	11.79 CD
Joly	12.25 a	12.07 ab	12.16 D
Fortuna	12.40 a	11.94 bc	12.17 D
Malling	11.70 bc	11.28 bc	11.49 C
Mean fertilization system	9.9 K	11.5 L	
LSD5% cvs 0.34 – 0.39	LSD5% fertilization system 0.15	LSD5% interaction fertilization system x cultivar 0.46 – 0.57	

Note * = the difference between any two values followed by at least one common letter is not significant

CONCLUSIONS

The best cumulative yield was obtained in the NPK fertilization variant (9.99 t/ha), followed by the bird waste system (9.63 t/ha), with statistically assured differences between these two types of fertilization. The best cumulative yield gave "Fortuna" (9.99 t/ha) and the lowest "Alba" (1.75 t/ha). Regarding the combined influence of two experimental factors, the best cumulative yield was obtained in

"Fortuna" (9.99 t/ha) in the NPK fertilization system and the lowest in "Alba" (1.75 t/ha) in the NPK system.

Regardless of cultivation between the two types of fertilizers, there were no statistically assured differences. The "Fortuna" cultivator (13.33%) has the highest total dry matter content, followed by a significant difference from the "Joly" cultivators (13.20%). The lowest values of the total content of dry matter were recorded by the cultivators "Aprica" (11.92%).

The best content of cumulative solids was obtained in the fertilization variant of the bird litter (12.4 °Brix), followed by the system of poultry litter (12.25 °Brix) with statistically assured differences.

From the interaction of the two factors (fertilizer x cultivar), the lowest values were recorded both in the fertilized NPK variant of cultivar "Alba" (10.82% respectively) (10.84%), of cultivar "Aprica" without statistically assured differences. The highest content was recorded at the "Fortuna" cultivation in the fertilized version for bird litter (12.40%), followed by the "Alba" cultivator (12.34%) in the bird fertilization system.

The experiment revealed that among the cultivars evaluated, the most useful for cultivation was the cultivation of "Fortuna" and "Joly", due to the high productivity and the high quality of the fruits.

The current study indicated that strawberry is a suitable and prospective crop for organic cultivation.

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