

Physiological studies on growth yield and quality of some strawberry cultivars

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Two field experiments were carried out during the two successive seasons of 2007/2008 and 2008/2009 in a private sector farm at EL-Dair village, Kalubia governorate in sandy clay soil, to investigate the effect of fertigation by NPK mineral fertilizers, spray with Hammer®, Pepton® and calcium and potassium salts (CaCl_2 , $\text{Ca}(\text{NO}_3)_2$, KNO_3 and KH_2PO_4) on vegetative growth, chemical constituents of plant foliage, fruit yield and its quality of strawberry plants for cvs. Festival and Sweet Charlie. The study included two experiments as follows: 1. First experiments: This experiment included 15 treatments resulted from the combination of 3 levels of NPK mineral fertilizers, i.e., 75% of recommended dose (150kg N + 60kg P₂₀₅ + 180kg K₂₀/fed.), 100% of the recommended dose, (200 kg N + 80 kg P₂₀₅ + 240kg K₂₀/fed) and 125% of the recommended dose (250 kg N + 100 kg P₂₀₅ + 300 kg K₂₀/fed). as well as spray treatments, i.e., spray with Hammer® at 1 and 2 g/liter, and Pepton® at 0.5 and 1.0g/liter in addition to the control treatment without spray. A split plot design with four replicates was adopted where the mineral fertilizer treatments were distributed in the main plots while the spray treatments were located randomly in the sub plots. All other agricultural treatments required for fresh plantation were done as commonly followed in the district. Obtained results can be summarized as follows: 1. Vegetative growth: a. Application of mineral fertilizers at 125% of the recommended dose (250kg N + 100kg P₂₀₅ + 300kg K₂₀) reflected the highest values of all measured growth traits expressed as plant height, number of leaves and secondary crown/plant as well as average leaf area, crown diameter, fresh and dry weight per plant. In addition, no significant differences were found among using mineral fertilizers at the recommended dose and using it at 75% of the recommended dose (150kg N + 60kg P₂₀₅ + 180kg K₂₀/fed.) in all studied growth characters. b-Spraying strawberry plants with both Hammer® as a source of humic acid at 1 and 2 g/liter and peptone as a source of amino acids at 0.5 and 1 g/liter six times during the growing season starting 20 days after transplanting increased all measured growth parameters compared with the control treatments. Moreover, Pepton® at the higher rate (1g/liter) was superior in this respect. c-Fertilizing the plants with 125% of the recommended dose (250 kg N + 100 kg P₂₀₅ + 300 kg K₂₀/fed) of NPK mineral fertilizers and spray the plants with Peptone at 1g/liter six times during the growing seasons exhibited the highest values in all measured growth aspects during both seasons of study. 2. Chemical constituents of plant foliage: a- Application of mineral fertilizers at 125% of the recommended dose (250 kg N + 100kg P₂₀₅ + 300 kg K₂₀/fed) reflected the highest values of total nitrogen, phosphorus, potassium and total carbohydrate content in plant foliage. b-Spraying the plants with the highest used concentrations for both Hammer and Peptone resulted in the highest concentration of total nitrogen, phosphorus and potassium as well as total carbohydrates in plant foliage compared with other tested concentrations and the control treatment. c-Fertilizing the plants with the highest level of NPK mineral fertilizers (250 kg N + 100kg P₂₀₅ + 300kg K₂₀/fed.) combined with spray the plant with higher concentration of both Hammer and Peptone reflected the highest concentration of all assayed macroelements and carbohydrates in plant foliage. 3- Fruit yield and its components: a- Application of mineral fertilizers (NPK) at 125% of the recommended dose (250 kg N + 100 kg P₂₀₅ + 300 kg K₂₀/fed) resulted in the highest total fruit yield and its components expressed as early, exportable and marketable yield per feddan. In addition, no significant differences were noticed in

total yield and its components in case of using mineral fertilizers at 100% (200 kg N + 80 kg P₂O₅ + 240kg K₂O/fed) and 75% (150kg N + 60kg P₂O₅ + 180kg K₂O/fed.) of the recommended dose except in marketable yield where 100% of the recommended dose (200 kg N + 80 kg P₂O₅ + 240kg K₂O/fed) was superior.

b- Spraying the plants with Peptone at 0.5 and 1.0 g/liter six times during the growing season, starting 20days after transplanting and every 10 days intervals resulted in the highest produced yield and its components compared with other tested spray treatments and the control.

c- Fertilizing the plants with 125% of the recommended dose (250 kg N + 100 kg P₂O₅ + 300 kg K₂O/fed) for NPK mineral fertilizers combined with spray the plants with Pepton® at 1.0g/liter exhibited the highest values for total produced yield and its components compared with other interactions.

4- Physical fruit quality:

a-Fertilizing the plants with mineral fertilizes (NPK) at 125% of the recommended dose (250 kg N + 100 kg P₂O₅ + 300 kg K₂O/fed) significantly increased all the studied physical fruit parameters, i.e., average fruit length, diameter and weight except fruit firmness which was not significantly affected.

b-Spray the plants with the higher concentrations of both Pepton® as a source of amino acids (1g/liter) and Hammer® as a source of humic acid at (2g/liter) significantly increased average fruit weight, length and diameter as well as fruit firmness without significant differences among them compared with other tested spray treatments and the control one.

c-supplying the plants with mineral fertilizers at 125% of the recommended dose (250 kg N + 100 kg P₂O₅ + 300 kg K₂O/fed) and spray the plants with higher concentration of Pepton® (1g/liter) six times recorded the highest average fruit length, diameter, weight and fruit firmness compared with other tested interactions.

5- Chemical fruit quality:

a- Fertilization with the higher level of mineral fertilizers at 125% of recommended dose of NPK (250 kg N + 100 kg P₂O₅ + 300 kg K₂O/fed) recorded the highest values in all assayed chemical constituents of fruits, i.e., TSS, vitamin C, total acidity, reducing and total sugars and anthocyanins concentration. However, no significant differences were found in such chemical constituents at 100% of recommended dose (200 kg N + 80 kg P₂O₅ + 240kg K₂O/fed) and 75% (150kg N + 60kg P₂O₅ + 180kg K₂O/fed.) of it.

b-Spraying the plants six times with the higher levels of both Pepton® (1g/liter) and Hammer® (2g/liter) reflected the higher values in all assayed chemical constituents except total acidity which was highest in case of the control treatment.

c-Supplying the plants with mineral fertilizers at 125% of the recommended dose (250 kg N + 100 kg P₂O₅ + 300 kg K₂O/fed) and spray the plants six times during the growing season with Pepton® or Hammer® at the higher level of them resulted in the higher chemical constituents content except total acidity which was higher in fruits produced from the control treatments.

CONCLUSION Under such conditions it could be concluded that fertigation of strawberry plants with the highest level of NPK fertilizers (250 kg N + 100kg P₂O₅ + 300kg K₂O/fed) combined with foliar spraying the plants with Hammer® as a source of humic acid at 2g/l or Pepton® a source of amino acids at 1.0g/l six times during the growing season starting 20days after transplanting and 10 days by intervals are recommended to increase the vegetative growth, total produced early, marketable exportable and total yield with best quality.

Second experiment: This experiments included 10 treatments resulted from the interaction between two cultivars, i.e., Festival and Sweet Charlie and five spray treatments as follows:

1. Foliar spray with calcium chloride at 0.5%
2. Foliar spray with calcium nitrate at 1.0%
3. Foliar spray with potassium nitrate at 1.5%
4. Foliar spray with mono potassium phosphate at 1.0%
5. Control treatment.

A split plot design with four replicates was adopted where the main plots were determined for cultivars and sub plot for spray treatments. The plants were sprayed with the solutions of mineral salts six times during the growing season started at blooming stage and every 15 days intervals. Obtained results can be summarized as follows:

1- Vegetative growth characters:

a- There were significant differences among the studied cultivars in all studied growth parameter expressed as plant height, number of leaves and secondary crowns, average leaf area, fresh and dry weight per plant. In this regard, cv. Festival reflected the highest values in all measured growth parameters.

b- Spraying strawberry plants with solutions of mineral salts increased all the studied growth parameters compared with the control treatment. In this respect. Using mono potassium phosphate at 1.0% exhibited the highest values in all measured growth parameters except plant height which was highest in case of using KNO₃.

c- Spraying the plants of cv. Festival with mono potassium sulphate at 1.0% six times during the growing seasons reflected the highest values in all determined morphological characters.

2- Chemical constituents of

plant foliage: a- Total nitrogen, phosphorus, potassium and total carbohydrates were significantly different among the tested cultivars. In this regard, plants of cv. Festival recorded the highest content of all assayed chemical constituents. b- Spraying the plants with mineral salts at different tested concentration increased all determined chemical constituents. In this regard, the highest values were recorded in case of using mono potassium phosphate at 0.01%.

c- Spraying plants of cv. Festival with mono potassium phosphate at 1.0% six times during the growing season reflected the highest values in all assayed chemical constituents.

3- Fruit yield and its components: a- No significant differences were recorded between the tested cultivars in total and marketable fruit yield. However, cv. Festival recorded the highest values of total produced yield and its components except in case of early fruit yield which was higher in case of cv. Sweet Charlie. b- Spraying the plants with mineral salts for both calcium and potassium significantly increased total produced yield and its components compared with the control treatment. In this connection, the highest values of early and exportable yield were recorded in case of using mono potassium phosphate while the highest marketable and total yield for both plants and feddan were recorded in case of using potassium nitrate during the first season. On the other hand, spraying the plants with potassium nitrate and mono potassium phosphate exhibited the highest values of produced yield and its component without significant differences among them during the second season. c- Spraying the plants of cv. Sweet Charlie by mono potassium phosphate at 1.0% produced the highest early yield while spraying plants of cv. Festival with both potassium salts reflected the highest produced yield and its component during both seasons of study.

4- Fruit physical quality: a- There were significant differences in fruit indices i.e. average fruit weight, diameter and length as well as fruit firmness among the tested cultivars. In this regard, fruit of cv. Festival show the highest values of average fruit weight, length and firmness compared with fruit produced by cv. Sweet Charlie plants. b- Spraying the plants with both calcium and potassium salts at different tested concentrations positively affected average fruit weight, length, diameter and firmness. In this regard, spray the plants with mono potassium phosphate and potassium nitrate during the first season and calcium nitrate during the second one reflected the highest values in all aforementioned fruit traits except fruit firmness which was highest in case of spray plants with CaCl₂ only. c- Spraying the plants of cv. Festival with potassium nitrate at 1.5% reflected the highest values in average fruit weight, length and diameter during the first season and spray the plants with Ca(NO₃)₂ during the second season. Moreover, CaCl₂ treatment via cv. Festival exhibited the highest values of fruit firmness.

5- Fruit chemical quality: a- Chemical fruit constituents expressed as total soluble solids, total acidity, vitamin C, reducing and total sugars as well as anthocyanin concentrations were significantly differed among the tested cultivars. In this connection, fruits of cv. Sweet Charlie exhibited the highest concentration of TSS, Vit C, and reducing sugars, while fruits of cv. Festival reflected the highest titratable acidity and anthocyanine content. b- Spraying the plants with both potassium and calcium salts statistically affected all assayed chemical constituent in fruits. In this respect, the highest values were obtained in case of using potassium nitrate and mono potassium phosphate. However, using calcium chloride resulted in higher acidity content and reduced all other chemical constituents compared with other used mineral salts treatment and the control. c- Spraying the plants of cv. Sweet Charlie with mono potassium phosphate six times during the growing seasons reflected the highest fruit content of TSS, vit. C, reducing and total sugars. On the other hand, using CaCl₂ salt increased total titratable acidity in fruit of both tested cultivars and the higher value was noticed in case of cv. Festival.

CONCLUSION Under such circumstances, advice can be planted cv. Festival and spray with mono potassium phosphate at 1% or potassium nitrate at 1.5% for the best vegetative growth and total yield as well as export yield with the best quality. Also it could be recommended for cultivation of Sweet Charlie cultivar and spraying with the same concentrations of potassium salts to obtain the highest early fruit yield for exportation.