

EFFECT OF DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM FERTILIZATION ON FRUIT PRODUCTION AND QUALITY OF STRAWBERRY CV. CHANDLER.

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ABSTRACT

This study was carried out to elucidate the response of strawberry cv. Chandler to 2 levels of P-Fertilizer (31 and 62Kg P₂O₅/Fed.) and 3 levels of K fertilizer (240 Kg K₂O/Fed. as soil application (SA), 120 Kg K₂O as soil application (SA) + 120 Kg K₂O as foliar spray (FS), and 240 Kg K₂O (SA) + 120 K₂O (FS)/Fed. as well as their combinations.

Obtained results show that P-application had favorable influences on plant growth and early and total yield/Fed. P-supply at 31Kg P₂O₅/Fed increased fruit weight, whereas P- supply at 62Kg P₂O₅/Fed increased fruit firmness and total soluble solids, it also increased K% but did not on N% in fruit.

Results also show that applying K-fertilizer at 240 Kg K₂O (SA) or 120 Kg K₂O(SA) + 120Kg K₂O (FS)/Fed. gave the highest early and total yield/Fed. K supply at 240 Kg K₂O (SA)/Fed increased fruit firmness in March harvesting whereas K application at 120 Kg K₂O (SA) + 120Kg K₂O (FS)/Fed. gave the highest values concerning fruit T.S.S% and total acidity (TA)%. K-fertilization at the rate 240 Kg K₂O (SA)/Fed gave the highest levels of N,P and K contents of fruit comparing with other K levels used.

Obtained data indicated that application of 62 Kg P₂O₅+240 Kg K₂O as soil application /Fed. gave the highest early and total yield with fruits of high firmness which increase the fruit ability to shipping and marketing. Such result could be recommended.

INTRODUCTION

Strawberry cv. Chandler is a new imported variety of US origin. Its planted area in Egypt increased up 30% of the total strawberry cultivated area. SO, this study aimed to recognize the exact P and K fertilization needs of such new variety under the local environmental conditions, through studying its response to different rates of phosphorus and potassium fertilization either they applied alone or combining together in an attempt to achieve high quantity and quality fruit production. Pal and pandey (1986) on strawberry found that application of N,P, and K as urea, potassium dihydrogen orthophosphate and potassium sulphate, respectively each of 0.5% concentration, led to increases in plant spread, and number of leaves, runners and crowns/plant. They also added that NPK application gave the highest increases in strawberry yield (45.3-46.5q /ha) and it enhanced fruit quality as well comparing with NP application.

Potassium nutrient was found to be important to get strawberry fruits at good color and sugar content. However, P nutrient was found to be important for good vegetative growth and runnering (Jookla *et al.*1986;

Haynes and Goh, 1987; Reckruhm and Dluhosch, 1988; Pomares *et al*, 1994, Kopanski, and Kaweck, 1994 on Strawberry).

Becerril and Barrientos, 1982 found fertilization of strawberry plants with phosphorus at 40 and 80 Kg P₂O₅/ha, increased total yield to 1.082 and 1.142 Kg/plant, respectively. They also added that both P and K application increased fruit firmness and soluble solids contents and improved fruit texture as well.

MATERIALS AND METHODS

Two field experiments were carried out at the experimental farm of Barrage Horticultural Research Station, Kaliobia Governorate in two successive seasons of 1997/1998 and 1998/1999. Strawberry *Fragaria X-ananassa*. Variety Chandler was the plant material used in the present investigation. This experiment included 6 treatments which were the combinations of 2 phosphorus levels i.e 31 and 62 Kg P₂O₅/Fed. with 3 levels of potassium as follows :

- 1- 240 Kg K₂O as soil application (SA) /Fed.
- 2- 120 Kg K₂O as soil application (SA) +120 Kg K₂O as foliar spray (FS) /Fed.
- 3- 240 Kg K₂O as soil application (SA)+120 Kg K₂O as foliar spray (FS) /Fed.

Potassium sulphate 48% K₂O was used as a source of K₂O while calcium superphosphate (15.5 % P₂O₅) was used as a source of P₂O₅. Nitrogen was added to all treatments at rate of 205 Kg N/fed in form of ammonium sulphate.

The experimental design used was a split plot design where phosphorus levels occupied the main plots while potassium levels were established at the sub plots. Treatments were distributed randomly in 3 replicates. The experimental plot included 3 rows, 5 meter length and 0.7 meter width, its area was 10.5 m². Transplants of strawberry cv. chandler were planted in Sept. 17 and 16 in 1997 and 1998, respectively. All agricultural practices were carried out as commonly followed in strawberry fields at the district of Barrage. Chemical and physical analysis of soil was determined (Table 1) according to Jackson method (1973).

The amount of fertilizers was added in 10 equal portion starting one month after planting, Three weeks intervals along the plant growth period.

Data recorded :

1-Vegetative Growth Characteristics :

A sample of 5 plants were randomly taken at the beginning of harvesting period to determine plant height (cm), foliage weight (g) and number of leaves.

2-Fruit Yield :

Early yield (ton/Fed) was recorded beginning from 8 and 12 February till the end of March during the two seasons, respectively. Total

fruit yield (ton/Fed) was also recorded for each treatment at the end of each growing season.

3-Fruit Quality :

Ten fruits were randomly taken from each plot to determine the following data, fruit weight (gm), fruit firmness (g/cm^2): Chatillon penetrometer (N.Y.,USA) was used to determine fruit firmness, Total soluble solids (T.S.S) using a hand refractometer .total titratable acidity (T.A) as gram citric acid/100 gram Juice, according to A.O.A.C. (1990) and fruit dry matter % .

Table (1) : The physical and chemical properties of the soil.

| | |
|----------------------------------|-----------|
| Physical properties : | |
| Clay % | 32.5 |
| Silt % | 22.5 |
| Fine sand % | 41.14 |
| Coarse sand % | 1.32 |
| Soil type | Clay loam |
| Chemical analysis : | |
| PH | 7.60 |
| E.C. | 1.58 |
| Organic matter % | 2.10 |
| Total N % | 0.120 |
| Available N | 45.0 ppm |
| Available P_2O_5 | 7.4 ppm |
| Available K | 80.0 ppm |
| Zn | 1.3 ppm |

Chemical Fruit Constituents :

A sample of 250 g fruits were taken from each plot then dried and grounded to determine the following parameters:

- a- Nitrogen % was determined according to Kock and McMeekin (1924).
- b- Phosphorus % was determined according to Troug and Meger (1939).
- c- Potassium % was determined according to Brown and Lilleland (1946).

The obtained data were statistically analyzed and treatment means were compared at 5% of LSD according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Vegetative Characteristics

Data of Table (2) show clearly that applying phosphorus fertilization at 31 Kg P_2O_5 /Fed. seemed to have stimulate effect on plant height as well as fresh weight and number of leaves/plant comparing with the highest used level of P fertilizer (62 Kg P_2O_5 /Fed). Similar trend of response was found when fertilizing plants with potassium fertilization at (120 Kg K_2O as soil application + 120 Kg K_2O as foliar spray/Feddan). Concerning the interaction effect between P and K fertilizers levels, data of the same table revealed

clearly that P supply at 31 Kg P₂O₅/Fed combining with application of K at 120 Kg K₂O/Fed. as soil application + 120 Kg K₂O as foliar spray/Fed. gave the highest values regarding all the morphological parameters records, comparing with the other interaction treatments. Increases found on plant height in the first season due to P and/or K application didn't reach the level of significance.

Table (2): Effect of different rates of phosphorus and potassium fertilizers on vegetative growth of strawberry cv. Chandler.

| Treatments | | Plant height (cm) | | Plant fresh wt. (g) | | No. leaves/plant. | |
|-----------------|-----------------|-------------------|-----------|---------------------|-----------|-------------------|-----------|
| P Kg/Fed | K Kg/Fed | 1997/1998 | 1998/1999 | 1997/1998 | 1998/1999 | 1997/1998 | 1998/1999 |
| 31 | 240 SA | 20.16 | 21.16 | 30.0 | 31.5 | 10.0 | 10.6 |
| | 120 SA +120 FS | 20.30 | 22.0 | 43.6 | 45.0 | 16.0 | 15.6 |
| | 240 SA + 120 FS | 18.30 | 19.16 | 41.6 | 42.3 | 12.6 | 13.0 |
| 62 | 240 SA | 17.3 | 18.16 | 37.5 | 38.5 | 9.0 | 9.3 |
| | 120 SA +120 FS | 18.0 | 18.5 | 35.0 | 36.16 | 12.0 | 12.3 |
| | 240 SA + 120 FS | 19.0 | 19.16 | 27.5 | 30.5 | 8.33 | 8.0 |
| L.S.D 5% | | N.S. | 0.68 | 2.5 | 1.00 | N.S. | N.S. |
| 31 | | 19.58 | 20.77 | 38.4 | 39.60 | 12.86 | 13.06 |
| 62 | | 18.1 | 18.61 | 33.33 | 35.05 | 9.77 | 9.86 |
| L.S.D 5% | | N.S. | 0.41 | N.S. | N.S. | 1.91 | 2.12 |
| 240 SA | | 18.73 | 19.66 | 33.75 | 35.0 | 9.5 | 9.95 |
| 120 SA +120 FS | | 19.15 | 20.25 | 39.30 | 40.58 | 14.0 | 13.95 |
| 240 SA + 120 FS | | 18.65 | 19.16 | 34.55 | 36.4 | 10.46 | 10.5 |
| L.S.D 5% | | N.S. | N.S. | N.S. | 2.13 | N.S. | 1.81 |

SA = Soil application

FS = Foliar spray

Obtained results are in agreement with those mentioned by Martin *et al.* (1981), Haynes and Goh (1987); Recleruhm and Dluhosch, (1988) on strawberry who found that leaf development, crown and root growth and vegetative growth were found to increase with increasing rate of potassium application. Obtained results also in accordance with those reported by khanizadeh *et al.*(1995) on strawberry who found that P supply at all levels used increased total dry and fresh shoot weight, leaf area and number of leaves/plant.

Early and total yield

Data of Table (3) show clearly that increasing P level up to 62 Kg P₂O₅/Fed. led to increases in both early and total yield/Feddan. Such stimulating effect was significant. Data of the same table also show that application of K at (240 Kg K₂O/Fed as soil application) or at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed) gave the highest values concerning early and total yield/Fed. However, application of K at (240 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed) gave the lowest values in this regard.

Table (3): Effect of different rates of phosphorus and potassium fertilizers on early and total yield/Fed of strawberry cv. Chandler.

| Treatments | | Early yield Ton/Fed. | | Total yield Ton/Fed. | |
|-----------------|-----------------|----------------------|---------------|----------------------|---------------|
| P Kg/Fed. | K Kg/Fed | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 |
| 31 | 240 SA | 0.893 | 0.93 | 7.56 | 8.13 |
| | 120 SA +120 FS | 1.050 | 1.08 | 8.43 | 8.58 |
| | 240 SA + 120 FS | 0.980 | 0.99 | 7.36 | 7.68 |
| 62 | 240 SA | 1.140 | 1.22 | 8.95 | 8.98 |
| | 120 SA +120 FS | 1.030 | 1.03 | 8.53 | 8.67 |
| | 240 SA + 120 FS | 0.780 | 0.83 | 8.10 | 7.82 |
| L.S.D 5% | | 0.01 | 0.049 | 0.22 | N.S. |
| 31 | | 0.97 | 0.99 | 7.78 | 8.13 |
| 62 | | 0.98 | 1.02 | 8.52 | 8.49 |
| L.S.D 5% | | N.S. | N.S. | 0.318 | N.S. |
| 240 SA | | 1.02 | 1.07 | 8.25 | 8.55 |
| 120 SA +120 FS | | 1.04 | 1.05 | 8.48 | 8.63 |
| 240 SA + 120 FS | | 0.88 | 0.91 | 7.73 | 7.75 |
| L.S.D 5% | | 0.129 | 0.104 | 0.465 | 0.497 |

SA = Soil application

FS = Foliar spray

Concerning the interactional influence between P and K fertilizers data of the same table show clearly that application of P at 62 Kg P₂O₅/Fed combining with K supply with 240 Kg K₂O as soil application/Fed gave the highest early and total yield/Fed. in the two growing seasons. Obtained results are in agreement with those found by Becerril and Barrientos (1982), Reckruhm and Dluhosch (1988) and Miner *et al.* (1997) on strawberry.

Fruit Characteristics :

a- Fruit weight :

Data of Table (4) show clearly that application of P at 31 Kg P₂O₅/Fed gave the highest values concerning fruit weight in all harvesting months. No significant differences were detected in this regard between the 2 used levels of P fertilizer with exception of May harvesting period in the 2nd season of 1999. Data of the same table also show that fertilizing plants with P at 31 Kg P₂O₅/Fed Combining with K supply with (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed) gave the highest fruit weight in all harvesting months comparing with the other interactional treatments. Obtained results are in agreement with those mentioned by Jookla *et al.* 1986 on Strawberry.

b. Fruit Firmness:

Data of Table (5) show clearly that fruit firmness significantly increased as P fertilizer level increased up to 62 Kg P₂O₅/Fed in Feb. harvesting period in both growing seasons. However, differences between the two P-levels used in March, April and May harvesting periods did not reach the level of significance in this concern.

Table (4): Effect of different rates of phosphorus and potassium fertilizers on Fruit weight of strawberry cv. Chandler.

| Treatments | | Average Fruit Weight (g) | | | | | | | |
|-----------------|-----------------|--------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| P Kg/Fed | K Kg/Fed | February | | March | | April | | May | |
| | | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 |
| 31 | 240 SA | 17.7 | 18.5 | 17.0 | 19.4 | 22.3 | 23.3 | 16.46 | 17.36 |
| | 120 SA +120 FS | 18.9 | 19.8 | 18.2 | 20.0 | 25.0 | 25.26 | 16.3 | 16.66 |
| | 240 SA + 120 FS | 17.66 | 18.6 | 15.9 | 18.0 | 20.0 | 22.16 | 15.0 | 15.83 |
| 62 | 240 SA | 18.0 | 19.16 | 17.8 | 19.8 | 17.0 | 20.0 | 13.8 | 14.16 |
| | 120 SA +120 FS | 16.16 | 17.3 | 15.0 | 17.3 | 15.3 | 18.0 | 15.8 | 13.5 |
| | 240 SA + 120 FS | 18.3 | 19.3 | 17.6 | 19.5 | 16.0 | 18.8 | 16.2 | 13.8 |
| L.S.D 5% | | N.S. | 0.526 | 0.872 | 0.441 | N.S. | 0.67 | 0.385 | N.S. |
| 31 | | 18.08 | 18.96 | 17.03 | 19.13 | 22.43 | 23.57 | 15.92 | 16.61 |
| 62 | | 17.48 | 18.58 | 16.8 | 18.87 | 16.1 | 18.93 | 15.26 | 13.82 |
| L.S.D 5% | | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | 1.16 |
| 240 SA | | 17.85 | 18.83 | 17.4 | 19.6 | 19.65 | 21.65 | 15.13 | 15.76 |
| 120 SA +120 FS | | 17.53 | 18.55 | 16.6 | 18.65 | 20.15 | 21.63 | 16.05 | 15.08 |
| 240 SA + 120 FS | | 17.98 | 18.95 | 16.75 | 18.75 | 18.0 | 20.48 | 15.6 | 14.82 |
| L.S.D 5% | | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | 0.722 |

SA = Soil application

FS = Foliar spray

Table(5): Effect of different rates of phosphorus and potassium fertilizers on Fruit Firmness (g/cm²) on Strawberry cv. Chandler.

| Treatments | | Fruit Firmness (g/cm ²) | | | | | | | |
|-----------------|-----------------|-------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| P Kg/Fed | K Kg/Fed | February | | March | | April | | May | |
| | | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 |
| 31 | 240 SA | 215 | 211.6 | 220 | 225 | 236.6 | 230 | 133.3 | 141.6 |
| | 120 SA +120 FS | 250 | 240 | 250 | 255 | 250 | 255 | 160.3 | 165 |
| | 240 SA + 120 FS | 235 | 226.6 | 230 | 235 | 245 | 241.6 | 174.3 | 176.6 |
| 62 | 240 SA | 260 | 268.3 | 280 | 275 | 235 | 230 | 150.0 | 158.3 |
| | 120 SA +120 FS | 230 | 221.6 | 225 | 228.3 | 226.6 | 220 | 168.3 | 170 |
| | 240 SA + 120 FS | 240 | 230 | 200 | 215 | 225 | 215 | 156.6 | 160 |
| L.S.D 5% | | 8.751 | 4.125 | 10.346 | 5.107 | N.S. | 4.686 | N.S. | 4.092 |
| 31 | | 233.3 | 226.06 | 233.3 | 238.33 | 245 | 242.2 | 155.96 | 161.06 |
| 62 | | 243.3 | 239.96 | 235.0 | 239.43 | 225 | 221.66 | 158.3 | 162.76 |
| L.S.D 5% | | 7.171 | 12.649 | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| 240 SA | | 237.5 | 239.95 | 250 | 250 | 235.8 | 230 | 141.65 | 149.95 |
| 120 SA +120 FS | | 240.0 | 230.8 | 237.5 | 241.65 | 238.3 | 237.5 | 164.3 | 167.5 |
| 240 SA + 120 FS | | 237.5 | 228.3 | 215 | 225.0 | 235 | 228.3 | 165.45 | 168.3 |
| L.S.D 5% | | N.S. | 8.736 | 21.910 | 10.814 | N.S. | N.S. | 14.695 | 8.665 |

SA = Soil application

FS = Foliar application (spray)

Potassium application at 240 Kg K₂O as soil application/Fed. was found to give the highest fruit firmness in March harvesting period followed by application of K at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed).

Concerning the interactional effect of P and K nutrients, data of Table (5) show clearly that application of P at 62 Kg P₂O₅/Fed. combining with K supply with (240 Kg/K₂O as soil application) gave the highest fruit firmness in March harvesting period in both growing seasons comparing with other harvesting months. On the other hand, obtained data show also that the application of P at 31 Kg P₂O₅/Fed combining with K level at 240 Kg K₂O as soil application/Fed gave the lowest fruit firmness values in May harvesting period. Other interactional treatments used gave intermediate results in this regard.

Obtained results are in agreement with those mentioned by Becerril and Barrientos (1982) who found the both K and P application increased strawberry fruit firmness but disagree with those mentioned by Albregls *et al.*(1996) who found that fruit firmness was not significantly affected by K application.

c. Total soluble solid (T.S.S)%:

Data in Table (6) indicate that increasing P-level up to 62 Kg P₂O₅/Fed significantly increased fruit T.S.S% in March and May harvesting periods, However, it had no remarkable effect in both Feb. and April harvesting period. Application of P at 62 Kg P₂O₅/Fed gave the highest fruit T.S.S% in March harvesting period comparing with other harvesting months.

Table (6): Effect of different rates of P and K fertilizers on Total soluble solid of Strawberry fruits cv. Chandler.

| Treatments | | Fruit T.S.S % | | | | | | | |
|-------------|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| P Kg/Fed | K Kg/Fed | February | | March | | April | | May | |
| | | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 | 1997/ 1998 | 1998/ 1999 |
| 31 | 240 SA | 9.5 | 9.8 | 9.16 | 9.5 | 7.0 | 7.3 | 6.16 | 6.8 |
| | 120 SA +120 FS | 10.16 | 10.5 | 9.5 | 10.0 | 8.56 | 9.0 | 7.0 | 7.5 |
| | 240 SA + 120 FS | 7.33 | 7.8 | 8.3 | 9.0 | 7.6 | 8.0 | 6.9 | 7.16 |
| 62 | 240 SA | 8.5 | 9.3 | 9.0 | 9.6 | 7.2 | 7.5 | 6.7 | 7.0 |
| | 120 SA +120 FS | 11.0 | 12.0 | 10.5 | 11.16 | 8.9 | 9.6 | 8.16 | 8.5 |
| | 240 SA + 120 FS | 8.3 | 8.8 | 9.6 | 10.16 | 8.16 | 8.8 | 6.7 | 7.1 |
| L.S.D 5% | | 0.229 | 0.305 | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| 31 | | 8.99 | 9.36 | 8.98 | 9.5 | 7.72 | 8.1 | 6.68 | 7.15 |
| 62 | | 9.26 | 10.03 | 9.7 | 10.30 | 8.08 | 8.63 | 7.18 | 7.53 |
| L.S.D 5% | | N.S. | N.S. | 0.632 | 0.717 | N.S. | N.S. | 0.471 | N.S. |
| | 240 SA | 9.0 | 9.55 | 9.08 | 9.55 | 7.1 | 7.4 | 6.43 | 6.9 |
| | 120 SA +120 FS | 10.58 | 11.25 | 10.0 | 10.58 | 8.73 | 9.3 | 7.58 | 8.0 |
| | 240 SA + 120 FS | 7.81 | 8.3 | 8.95 | 9.58 | 7.88 | 8.4 | 6.8 | 7.13 |
| L.S.D 5% | | 0.484 | 0.647 | N.S. | 0.815 | 0.791 | 0.733 | N.S. | 0.437 |

SA = Soil application

FS = Foliar (spray)

Application of K fertilizer at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed.) gave the highest T.S.S% values in all harvesting months Comparing other K levels used. Fruit harvesting in February seemed to give the highest T.S.S% value in strawberry fruits.

Concerning the interactional effect of K and P levels data of Table (6) also show that application of P at 31 Kg P₂O₅/Fed. combining with K at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed. gave the highest T.S.S% values in fruits.

Obtained results are in coincidence with those recorded by Becerril and Barrientos (1982) and Jookla *et al.*(1986) on strawberry.

d. Titratable acidity (TA) :

Data of Table (7) show clearly that increasing P-level up to 62 Kg P₂O₅/Fed. had no significant influence on titratable acidity content of fruits. Data also show that application K at 120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray/Fed. gave the highest values of TA in strawberry fruits in both growing season. Concerning the interaction effect between P and K nutrients, obtained results show clearly that application of P at 62 Kg P₂O₅ /Fed combining with application of K at 120 Kg K₂O as soil application +120 Kg K₂O as foliar spray/Fed. gave the highest TA values in fruit, however, application of P at 31 Kg P₂O₅ /Fed interacting with K at (240 Kg K₂O as soil application + 120 Kg K₂O as foliar spray) /Fed gave the lowest values in this regard. Obtained results are in accordance with those mention by Jookla *et al.*(1986).

Table (7): Effect of P and K rates of fertilizers on fruit dry matter % and titratable acidity in strawberry cv. Chandler.

| Treatments | | Titratable acidity (TA) (g.citrracid / 100g. Juice) | | Dry matter % of fruit | |
|--------------|-----------------|--|--------------|-----------------------|-------------|
| P Kg/Fed. | K Kg/Fed | 1997/1998 | 1998/1999 | 1997/1998 | 1998/1999 |
| 240 SA | | 0.85 | 1.0 | 9.16 | 7.97 |
| 31 | 120 SA +120 FS | 0.75 | 0.88 | 9.8 | 8.66 |
| | 240 SA + 120 FS | 0.52 | 0.61 | 9.6 | 8.5 |
| | 240 SA | 0.85 | 1.06 | 9.5 | 8.4 |
| 62 | 120 SA +120 FS | 1.1 | 1.2 | 8.9 | 8.03 |
| | 240 SA + 120 FS | 0.64 | 0.83 | 8.6 | 7.8 |
| L.S.D 5% | | 0.031 | N.S. | N.S. | N.S. |
| | 31 | 0.71 | 0.83 | 9.52 | 8.37 |
| | 62 | 0.86 | 1.03 | 9.0 | 8.07 |
| L.S.D 5% | | N.S. | N.S. | N.S. | N.S. |
| | 240 SA | 0.85 | 1.03 | 9.33 | 8.16 |
| | 120 SA +120 FS | 0.92 | 1.04 | 9.35 | 8.34 |
| | 240 SA + 120 FS | 0.58 | 0.72 | 9.1 | 8.15 |
| L.S.D 5% | | 0.067 | 0.134 | N.S. | N.S. |

SA = Soil application

FS = Foliar spray

e. Fruit dry matter%:

Data presented in Table (7) show clearly that no significant differences were observed between the effects of P or K nutrients either they applied each alone or in combinations on dry matter % of fruit.

Application of P at 31 Kg P₂O₅/Fed combining with K at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray) /Fed. gave the highest dry matter % of fruit.

Chemical Constituents of fruit :

a. Nitrogen % of fruit:

Data of Table (8) show clearly that increasing P level up to 62 Kg P₂O₅/Fed. had no significant effect on N% of fruit. However, application of K at 240 Kg K₂O/Fed level gave the highest N% in fruit comparing with other K levels uses. Concerning P x K interaction effect on N% of fruit, data of the same table show that application of P at 31 or 62 Kg P₂O₅/Fed combining with K level at 240 Kg K₂O as soil application gave the highest N% of fruit comparing with other treatments of interaction.

Table (8): Effect of different rates of P and k fertilizers on mineral content of fruits in strawberry cv. Chandler.

| Treatments | | Mineral contents of fruit | | |
|--------------|-----------------|---------------------------|---------------------------|--------------------------|
| P Kg/Fed. | K Kg/Fed | Nitrogen % 1998/1999 | Phosphorus % 1998/1999 | Potassium % 1998/1999 |
| 31 | 240 SA | 1.53 | 0.486 | 4.13 |
| | 120 SA +120 FS | 0.76 | 0.275 | 2.7 |
| | 240 SA + 120 FS | 1.13 | 0.339 | 3.03 |
| 62 | 240 SA | 1.43 | 0.325 | 3.87 |
| | 120 SA +120 FS | 0.93 | 0.347 | 3.3 |
| | 240 SA + 120 FS | 1.17 | 0.381 | 3.8 |
| L.S.D 5% | | 0.066 | 0.006 | 0.185 |
| 31 | | 1.14 | 0.366 | 3.29 |
| 62 | | 1.18 | 0.351 | 3.66 |
| L.S.D 5% | | N.S. | 0.001 | 0.313 |
| | 240 SA | 1.48 | 0.405 | 4.0 |
| | 120 SA +120 FS | 0.845 | 0.311 | 3.0 |
| | 240 SA + 120 FS | 1.15 | 0.360 | 3.42 |
| L.S.D 5% | | 0.046 | 0.004 | 0.131 |

SA = Soil application

FS = Foliar spray

b. Phosphorus % of fruit:

Data presented in Table (8) show clearly that P- application at 31 Kg P₂O₅/Fed level gave higher P % in fruit comparing with P- application at 62 Kg P₂O₅/Fed level.

Potassium application level at 240 Kg K₂O as soil supply gave the highest P % in fruit followed by K application level at (240 Kg K₂O as soil application +120 Kg K₂O as foliar spray) /Fed.

Concerning (P x K) interactional effect, data of the same Table show that application of P at 31 Kg P₂O₅ combining with K level at (240 Kg K₂O as soil application) /Fed gave the highest P% in fruit.

c. Potassium % in fruit:

Data of Table (8) show clearly that increasing P. level up to 62 Kg P₂O₅/Fed significantly increased K % of fruit from 3.29 % up to 3.60 %. K-

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supply at 240 Kg K₂O/Fed as soil application gave the highest K % value comparing with other used levels of potassium.

Regarding the (P x K) interaction effect, obtained results indicated that applying P at 31 Kg P₂O₅/Fed. combining with K at 240 Kg K₂O/Fed as soil application gave the highest K % in fruit. However, applying P at 31 Kg P₂O₅/Fed combining with K at (120 Kg K₂O as soil application + 120 Kg K₂O as foliar spray) /Fed. produced the lowest K % in fruit. Other used (P x K) combinations gave intermediate results.

CONCLUSION

Accordingly, Obtained results indicate that applying 62 Kg P₂O₅ + 240 Kg K₂O as soil application /Fed gave the highest early and total yield with fruits of high firmness which lead to increasing fruit ability for shipping and marketing. Such result could be recommended.

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تأثير بعض المعدلات السمادية من الفوسفور والبوتاسيوم على إنتاج وجودة ثمار الفرولة صنف شاندر

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أجريت تجربتان فى الموسم الشتوى ١٩٩٨/٩٧، ١٩٩٩/٩٨ بمحطة بحوث البساتين بالقناطر الخيرية لدراسة تأثير مستويان من التسميد الفوسفاتى (٦٢، ٣١ كجم فوسفات/أه /فدان) ، ٣ مستويات من التسميد البوتاسى (٢٤٠ كجم بوزا /أه إضافة أرضية) ، (٢٠ كجم بوزا /أه إضافة أرضية + ١٢٠ كجم بوزا أرشا على المجموع الخضرى) ، (٢٤٠ كجم بوزا /أه إضافة أرضية + ٢٠ كجم بوزا أرشا على المجموع الخضرى) /فدان وكذلك التفاعل بينهما على إنتاج وجودة محصول الفرولة صنف شاندر.

أظهرت النتائج الأتى :

- التسميد الفوسفاتى شجع النمو الخضرى للنبات كما زاد من المحصول المبكر والكلى/فدان . زيادة التسميد للفوسفاتى حتى ٦٢ كجم فوسفات/أه /فدان زاد من نسبة صلابة الثمار ونسبة المادة الجافة بها خلال شهر مارس ومايو فى حين لم يكن للتسميد الفوسفاتى تأثير يذكر على الحموضة الكلية ونسبة المادة الجافة بالثمرة . وتشير النتائج أن زيادة التسميد الفوسفاتى حتى ٦٢ كجم فوسفات/أه /فدان لم يؤثر على نسبة النتروجين بالثمرة بينما زاد من نسبة البوتاسيوم بها .
- أشارت النتائج أيضا إلى أن التسميد البوتاسى بمعدل (٢٠ كجم بوزا /أه أرضيا + ٢٠ كجم بوزا أرشا) /فدان شجع النمو الخضرى للنبات بينما أدى التسميد بمعدل ٢٤٠ كجم بوزا /فدان أرضيا الى زيادة صلابة الثمار فى حصاد مارس . إضافة للبوتاسيوم بمعدل (٢٠ كجم بوزا /أه أرضيا + ٢٠ كجم بوزا أرشا) /فدان زاد من نسبة المواد الصلبة الكلية والحموضة الكلية بالثمرة فى حين لم تتأثر نسبة المادة الجافة بالثمرة بإضافة السماد البوتاسى . وتشير النتائج أيضا إلى أن إضافة البوتاسيوم بمعدل ٢٤٠ كجم بوزا /فدان أعطى أعلى القيم لنسب النتروجين والفوسفور والبوتاسيوم بالثمرة مقارنة بمستويات التسميد البوتاسى المستخدمة .
- أظهرت النتائج أن التسميد بمعدل (٦٢ كجم فوسفات/أه + ٢٤٠ كجم بوزا /أه كإضافة أرضية) /فدان أعطى أعلى محصول مبكر وكلى/فدان وإتصفت الثمار الناتجة بالصلابة العالية . والدراسة توصى باستخدام المعدل السمادى المذكور للحصول على أعلى محصول مبكر وكلسى مع صلابة للثمار عاليه مما يسهم فى زيادة قدرة الثمار الناتجة على تحمل الشحن والتسويق .