

Productive Performance of Washington Navel Orange Trees in Relation to Foliar Application of Barley Seed Sprout and Royal Jelly

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Abstract: This study was carried out during 2013 and 2014 seasons to examine the impact of spraying barley seed sprout at 0.25 to 2.0 % either alone or in combination with royal jelly at 0.0125% on growth, tree nutritional status, yield as well as physical and chemical characteristics of Washington Navel orange fruits. The trees received four sprays of these natural extracts at the first week of March and at 45 day intervals. Treating the trees four times with barley seed sprout at 0.25 to 2.0% singly or in combination with royal jelly at 0.0125% was very effective in enhancing the leaf area, total chlorophylls, leaf content of N, P, K and Mg , fruit retention %, yield and fruit quality relative to the check treatment. The promotion on such parameters was materially in proportional to the increase in barley seed sprout concentrations. Negligible stimulation on these characters was observed when concentration was increased from 1.0 to 2.0 %. For producing healthy and vigour Washington Navel orange trees, maximizing yield and promoting fruit quality, it is advised to treating the trees four times with a mixture of natural nutrients containing barley seed sprout at 1% besides royal jelly at 0.012%.

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1. Introduction

Poor yield of Washington Navel orange trees grown under Minia region conditions is considered a serious problem facing citrus growers. Unsuitable environmental conditions as well as malnutrition and unbalancing ratios between various mineral and organic foods rank the main causes for the yield decline. Recently, many attempts were accomplished for searching new means for overcoming such problems without pollution of environment such as foliar application of crop seed sprouts and royal jelly.

Recently, crop seed sprouts were used for amending the trees with their requirements from essential organic nutrients without pollution of our environment crop seed sprouts characterized by their higher own content from essential amino acids, vitamins, macro and micro nutrients, fats, organic acids, antioxidants and natural hormones (Cazuola *et al.*, 2004, Cairney, 2005 and Biommeron, 2007). Their high nutritional values as previously mentioned surely reflected on improving fruiting of fruit crops (Abdallah *et al.*, 2000; Abdallah, 2008; Mohamed, 2008; Anwar *et al.*, 2009; Darwish, 2009; Al-Shereif *et al.*, 2013; El-Khawaga and Mansour, 2014 and El-Sayed – Faten, 2014).

Royal jelly is secreted from the heads of queen bees from pollen grain, water and honey silva, hormones and vitamins. It contains 66% water and 34% dry matter. Dry matter in royal jelly contains 48.2% proteins, 7.8% carbohydrates , 10.4% lipids ,

2% ash and 1.6 % vitamins B₁, B₂, B₅ , B₆, B₇, B₈ and B₉, vitamins C, 17 amino acids, mineral such as K, Mg, Ca, Fe , Mn, and Si and sex hormones (Heyl, 1951 and Nation and Robinson, 1991).

Studies on the effect of royal jelly on fruit crops are very rare except those carried out by Al-Wasfy (2013) who confirmed the beneficial effects of royal jelly on growth and fruiting of Sakkoti date palms. The same trend was observed by Gad El-Kareem and Abada (2014) who mentioned that using royal jelly at 25 ppm three times effectively enhanced growth, leaf content of N, P, K, Mg and total chlorophylls , yield and fruit quality of Flame seedless grapevines over the check treatment.

This study was designed to evaluate the effect of barley seed sprout and royal jelly on fruiting of Washington Navel orange trees grown under Bany Suef region conditions.

2. Material and Methods

This study was initiated during 2013 and 2014 seasons on 36 uniform in vigour 15-years old Washington Navel orange trees onto sour orange rootstock. The selected trees are grown in a private orchard located at El-Fashen district, Bany Suef Governorate. The selected trees are planted at 5x5 meters apart. The texture of the soil is clay and the water table depth is not less than two meters. Soil analysis was done according to the procedures that outlined by Wilde *et al.*, (1985).

Table(1): Analysis of the tested soil

Constituents	Values
Sand %	5.0
Silt %	15.0
Clay %	80.0
Texture	Clay
O.M. %	2.40
pH (1 :2.5 extract)	7.9
EC (1 :2.5 extract) (mmhos /cm /25°C)	0.95
CaCO ₃ %	1.30
Total N %	0.09
Available P (Olsen,ppm)	3.9
Available K (ammonium acetate , ppm)	451.3

The thirty – six selected trees were subjected to the common horticultural practices that already applied in the orchard. Surface irrigation system was followed using Nile irrigation water.

This experiment included the following nine treatments:

- 1- Control.
- 2- Spraying barley seed sprout at 0.25%.
- 3- Spraying barley seed sprout at 0.5 %.
- 4- Spraying barley seed sprout at 1 %.
- 5- Spraying barley seed sprout at 2 %.
- 6- Spraying barley seed sprout at 0.25% + royal jelly at 0.0125%.
- 7- Spraying barley seed sprout at 0.5 % + royal jelly at 0.0125%.
- 8- Spraying barley seed sprout at 1 % + royal jelly at 0.0125%.
- 9- Spraying barley seed sprout at 2 % + royal jelly at 0.0125%.

Each treatment was replicated four times, one tree per each. Barley seed sprout was prepared by cleaning the seeds from all impurities and subjecting for sprout production by sowing in open trays and left under shade conditions till 12 days, then the sprouts were removed. Generally, sprouts of barley were homogenized with distilled water at 1 : 10 using an electric blender for five minutes , then filtrated and kept under 4C° in the refrigerator till use . For preparing 0.25, 0.50 , 1 % and 2% may take 25 ,50, 100 and 200 ml sprout extract / L water . Royal jelly taken immediately from freezer was thawed and used. Spraying of barley seedsprout and royal jelly was carried out four times started at the first week of March and at 45 day intervals. Triton B as a wetting agent at 0.05% was added to all the sprayed solutions. Chemical analysis of barley seed sprout was illustrated in Table (2).

Table (2): Analysis of the tested barley seed sprout

Constituents	Values (mg/ 100 g F.W.)
Asparatic acid	2.1
Arginine	3.5
Alanine	2.9
Glutamic acid	4.7
Isoleucin	2.0
Lysine	1.9
Methionene	2.2
Thiamin (B ₁)	2.5
Riboflavine (B ₂)	3.0
Pyrodoxine (B ₆)	1.9
Vitamin E	0.61
K	600
P	510
Mg	281
Ca	280
Fe	181
Ze	150

At the end of each season, the following parameters were measured:

- 1- Leaf area in cm² (**Ahmed and Morsy, 1999**).
- 2- Total chlorophylls in the fresh leaves of Spring growth cycle (1st week of Sept.) as mg/100 g F.W. (**Von- Wettstein, 1957**) was recorded by summation of chlorophylls a & b.
- 3- In the first week of Sept. leaves of Spring growth cycle in the non fruiting shoots (**Summer, 1985**) were dried for determination of N, P, K and Mg (according to **Wilde et al., 1985**).
- 4- Percentage of fruit retention.
- 5- Yield expressed in weight and number of fruits / tree.
- 6- Fruit quality characteristics namely fruit weight (g.), fruit peel weight %, fruit peel thickness (cm.); percentage of juice, T.S.S., total acidity (as g citric acid/ 100 ml juice).total reducing and non – reducing sugars (**A.O.A.C, 2000**), as well as vitamin C (mg /100 ml juice) and T.S.S./acid.

Statistical analysis was done and the new L.S.D. test at 5% was used to differentiate among the various treatment means (**Mead et al., 1993**).

3. Results and Discussion

1- leaf area and its content of total chlorophylls N,P, K and Mg

It is clear from the data in Tables (3 & 4) that treating Washington Navel orange trees four times with barley seed sprout at 0.25 to 2% either alone or in combination with royal jelly at 0.0125% significantly stimulated the leaf area and its content of total chlorophylls, N, P, K and Mg comparing to the check treatment. The promotion was significantly associated

with increasing barley seed sprout concentration from 0.25 to 2%. Combined application of barley seed sprout and royal jelly was significantly superior than using barley seed sprout alone in enhancing their parameters. Increasing concentrations of barley seed sprout either applied alone or using with royal jelly from 1 to 2 % had meaningless influence on these characters. The maximum values of leaf area (32.4 & 33.3 m²); total chlorophylls (12.6 & 13.1 mg /100 g F.W.) ;N (2.17 & 2.23 %), P (0.45 & 0.42 %), K (1.76 & 1.74) and Kg (0.80 & 0.81 %) during both seasons, respectively were presented on the trees that received four sprays of barley seed sprout at 2% + royal jelly at 0.0125 %. The control trees produced the lowest values. These results were true during both seasons.

2- Percentage of fruit retention

It is evident from the obtained data in Table (4) that treating the trees four times with barley seed sprout at 0.25 to 2% singly or in combined with royal jelly at 0.0125 % significantly was followed by improving the percentage of fruit retention as well as yield expressed in number of fruits / tree and weight

(kg.) rather than the control treatment. There was a gradual promotion on these parameters with increasing concentration of barley seed sprout concentrations from 0.25 to 2.0 %. Significant differences on the percentage of fruit retention and yield/ tree were observed among all concentrations of barley seed sprout except between the higher two concentrations namely 1.0 and 2.0 %. Combined application of barley seed sprout and royal jelly significantly surpassed the application of barley seed sprout alone in this respect. Economically point of view, treating the trees with barley seed sprout at 1% plus royal jelly at 0.0125 % gave the best results with regard to the yield. Under such recommended treatment, yield per tree reached 70.6 and 71.4 kg compared to the yield of the untreated trees which reached 48.9 and 49.8 kg during both seasons, respectively. The percentage of increase on the yield due to using the recommended treatment over the check treatment reached 44.4 and 43.4 % during both seasons, respectively. Similar results were announced during both seasons.

Table (3): Effect of spraying barley seed sprout and royal jelly on the leaf area, total chlorophylls and percentages of N, P and K in the leaves of Washington Navel orange trees during 2013 and 2014 seasons.

Treatment	Leaf area (cm ²)		Total chlorophylls (mg/ 100 F.W.)		Leaf N %		Leaf P %		Leaf K %	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Control (untreated trees)	24.3	25.0	8.3	8.4	1.63	1.64	0.18	0.14	1.19	1.22
Barley seed sprout at 0.25%	25.5	26.2	9.0	9.4	1.71	1.75	0.22	0.20	1.37	1.36
Barley seed sprout at 0.50 %	26.7	27.4	9.6	10.0	1.81	1.85	0.26	0.24	1.43	1.41
Barley seed sprout at 1 %	28.3	29.0	10.5	10.9	1.90	1.94	0.31	0.27	1.50	1.48
Barley seed sprout at 2 %	28.4	29.1	10.6	11.0	1.91	1.95	0.32	0.28	1.51	1.49
Barley seed sprout at 0.25% + royal jelly	29.3	30.0	11.7	11.5	1.97	2.01	0.37	0.33	1.61	1.59
Barley seed sprout at 0.50 % + royal jelly	31.0	31.8	12.0	12.1	2.07	2.12	0.41	0.37	1.67	1.64
Barley seed sprout at 1 % + royal jelly	32.3	33.1	12.5	13.0	2.15	2.22	0.44	0.41	1.75	1.73
Barley seed sprout at 2 % + royal jelly	32.4	33.3	12.6	13.1	2.17	2.23	0.45	0.42	1.76	1.74
New L.S.D. at 5%	1.0	0.9	0.3	0.3	0.06	0.07	0.03	0.03	0.05	0.05

3- Quality of the fruits

Data in Tables (4 & 5 & 6) clearly show that treating the trees with barley seed sprout at 0.5 to 2% either alone or in combination with royal jelly at 0.0125 % had significant promotion on fruit quality in terms of increasing fruit weight , juice %, T.S.S. %, total and reducing sugars %,T.S.S./acid and vitamin C content and decreasing fruit peel weight and thickness and total acidity % over the check treatment . These treatments had no significant effect on the percentage of non- reducing sugars. The promotion on fruit quality was significantly associated with increasing barley seed sprout concentrations from 0.25 to 2%. Increasing concentration of barley seed sprout from 1 to 2% had no significant effect on both physical and chemical characteristics of the fruits. Combined application of both barley

seed sprout and royal jelly was significantly favourable than using barley seed sprout alone. The best results with regard to fruit quality were obtained due to treating the trees four times with barley seed sprout at 1.0% (since no measurable promotion was observed among the higher two concentrations) plus royal jelly at 0.0125%. Unfavourable effects on fruit quality were observed on untreated trees. These results were true during both seasons.

Table (4): Effect of spraying barley seed sprout and royal jelly on the percentage of magnesium in the leaves and fruit retention %, yield expressed in number of fruits / tree and weight (kg.) and fruit weight(g.) of Washington Navel orange trees during 2013 and 2014 seasons.

Treatment	Leaf Mg %		Fruit retention %		No. of fruits / tree		Yield/ tree (kg.)		Fruit weight (g.)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Control (untreated trees)	0.51	0.47	0.91	0.88	260.0	262.0	48.9	49.8	188.1	190.0
Barley seed sprout at 0.25%	0.55	0.56	0.97	0.93	267.3	268.0	52.1	52.8	195.0	197.0
Barley seed sprout at 0.50 %	0.60	0.61	1.02	0.98	275.0	276.0	55.3	56.3	201.0	204.0
Barley seed sprout at 1 %	0.66	0.66	1.07	1.04	281.0	282.0	58.7	59.5	209.0	211.0
Barley seed sprout at 2 %	0.67	0.68	1.08	1.05	282.0	283.0	59.2	60.0	210.0	212.0
Barley seed sprout at 0.25% + royal jelly	0.71	0.71	1.12	1.11	290.0	291.0	62.4	64.0	215.0	220.0
Barley seed sprout at 0.50 % + royal jelly	0.75	0.75	1.17	1.16	296.0	297.0	66.0	67.4	223.0	227.0
Barley seed sprout at 1 % + royal jelly	0.79	0.80	1.22	1.21	303.0	304.0	70.6	71.4	233.0	235.0
Barley seed sprout at 2 % + royal jelly	0.80	0.81	1.23	1.22	304.0	305.0	71.1	72.0	234.0	236.0
New L.S.D. at 5%	0.03	0.03	0.04	0.04	6.0	6.9	2.0	1.9	4.9	5.0

Table (5): Effect of spraying barley seed sprout and royal jelly on some physical and chemical characteristics of the fruits of Washington Navel orange trees during 2013 and 2014 seasons.

Treatment	Fruity peel weight %		Fruit peel thickness (cm.)		Juice %		T.S.S. %		Total acidity %	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Control (untreated trees)	26.3	25.9	0.47	0.49	40.0	40.7	13.3	13.2	1.661	1.661
Barley seed sprout at 0.25%	25.0	24.8	0.43	0.44	40.9	41.9	13.6	13.5	1.640	1.637
Barley seed sprout at 0.50 %	23.3	23.1	0.41	0.42	42.3	43.1	13.9	13.7	1.608	1.605
Barley seed sprout at 1 %	21.2	20.9	0.41	0.41	44.0	44.9	14.1	14.0	1.580	1.577
Barley seed sprout at 2 %	21.0	20.8	0.40	0.39	44.1	45.0	14.2	14.0	1.579	1.576
Barley seed sprout at 0.25% + royal jelly	19.0	18.8	0.38	0.37	45.1	46.1	14.5	14.3	1.541	1.538
Barley seed sprout at 0.50 % + royal jelly	18.4	18.1	0.35	0.35	46.3	47.2	14.7	14.5	1.520	1.517
Barley seed sprout at 1 % + royal jelly	17.9	17.5	0.33	0.33	47.5	48.0	14.8	14.7	1.491	1.488
Barley seed sprout at 2 % + royal jelly	17.8	17.4	0.32	0.32	47.6	48.1	14.9	14.8	1.490	1.486
New L.S.D. at 5%	0.4	0.5	0.02	0.02	0.5	0.4	0.2	0.2	0.018	0.016

Table (6): Effect of spraying barley seed sprout and royal jelly on some chemical characteristics of the fruits of Washington Navel orange trees during 2013 and 2014 seasons.

Treatment	T.S.S. / acid		Total sugars %		Reducing sugars		Non- reducing sugars %		Vitamin C (mg/ 100 ml/ juice)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Control (untreated trees)	8.0	7.9	8.9	9.0	3.3	3.1	5.6	5.9	41.1	41.0
Barley seed sprout at 0.25%	8.3	8.2	9.2	9.3	3.5	3.6	5.7	5.7	41.7	42.0
Barley seed sprout at 0.50 %	8.6	8.5	9.5	9.6	3.7	3.8	5.8	5.8	43.0	42.4
Barley seed sprout at 1 %	8.9	8.9	9.8	9.9	4.0	4.1	5.8	5.8	44.0	44.5
Barley seed sprout at 2 %	9.0	8.9	9.9	10.0	4.1	4.1	5.8	5.9	44.1	44.6
Barley seed sprout at 0.25% + royal jelly	9.4	9.3	10.1	10.2	4.4	4.5	5.7	5.7	46.0	46.4
Barley seed sprout at 0.50 % + royal jelly	9.7	9.6	10.4	10.5	4.7	4.8	5.7	9.7	47.3	47.5
Barley seed sprout at 1 % + royal jelly	9.9	9.9	10.6	10.7	5.0	5.0	5.6	5.7	49.0	49.2
Barley seed sprout at 2 % + royal jelly	10.0	10.0	10.7	10.8	5.1	5.1	0.6	5.7	49.1	49.3
New L.S.D. at 5%	0.2	0.2	0.2	0.2	0.2	0.2	NS	NS	0.4	0.4

4. Discussion:

The positive action of barley seed sprout on fruiting of Washington Navel orange trees might be attributed to its higher own content of essential amino acids, vitamins and essential nutrients (Table 2). The beneficial effects of sprouting in enhancing the activity of enzymes that are responsible for breakdown of starch and proteins to soluble sugars and amino acids give good evidence (Cazuola et al., 2004; Cairney, 2005 and Biomerson, 2007). These results are in harmony with those obtained by Abdallah et al., (2000); Abdallah (2008); Mohamed (2008); Anwar et al., (2009); Darwish (2009) and El- Sayed- Faten (2014).

The great benefits of royal jelly in fruiting of Washington Navel orange trees might be attributed to its higher own content from carbohydrates proteins, lipids, mineral such as Mg, Ca, Fe, Mn and Si, vitamins B₁, B₂, B₆, B₈ and B₉ and C, amino acids and six hormones (Heyl, 1951 and Nation and Robinson, 1991). These results are in agreement with those obtained by Al- Wasfy (2013) and Gad El-Kareem and Abada (2014).

5. Conclusion

Treating Washington Navel orange tree four times with a mixture of barley seed sprout at 1% plus royal jelly at 0.0125 % gave the best results with regard to yield and fruit quality.

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