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RESEARCH ARTICLE

Effect of the intercropping on growth and productivity of Balady Orange trees in Upper Egypt

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Abstract

This field trial was carried out during three successive seasons 2018,2019 and 2020. On 12 years old of Balady orange trees. To evaluate the effect of intercropped orange trees by Pea, Pumpkin, Egyptian Clover plants on growth and productivity under Assiut conditions. The experiment was set up in a complete randomized block design. The results indicated that Pea intercropping significantly increased in physical properties in fruit such as weight, size, Juice volume and weight, carbohydrate and nitrogen percentage in leaves. followed by Pumpkin, then Clover, respectively. On the other hand, the highest values of soluble solids (T.S.S.) were obtained with the Pea, and Clover treatment, but acidity level decreased. Pumpkin covering treatment gave a slight increase in vitamin C. But highest values of the total crop were with the Pea treatment and covering with Pumpkin. According to the results the lowest amount of yield, fruit physical and chemicals was observed in control treated. These results showed that growing Balady orange trees with Pea intercropping and covering with Pumpkin is recommended over any other such as Egyptian clover, during three studied seasons.

Keywords: Balady Orange; Citrus; Pea; Pumpkin; vitamin C.

1. Introduction

Citrus (*Citrus* spp.) one of the most important fruit crops grown in many tropical and subtropical countries. At the moment there is about 1.5 million hectares of citrus fruits cultivated for commercial scale in the world yielded nearly 40 million metric tons of oranges, lemons, limes, etc., it is an important cash crops and rich source of Ascorbic acid. Mulinge *et al.* (2017), reported that citrus (*Citrus spp.*) fruits are the most important fruit in both production and they are important sources of income to the resource-poor farmers, employment in rural areas and human nourishment. Primary sources of essential natural products such as vitamin C carotenoids, lignin, phenolic and essential oils. According to Agricultural Statistics bulletin (2021), total of area were 493925 feddan, yield and production for the varieties fruits in old and new Lands were 4503226 ton and average production were 9.117 ton/fed.

Weeds are among the major constraints to any crop production system, reducing productivity and profitability. Herbicides are among the most effective methods to control weeds, and reliance on herbicides for weed control has increased significantly with the advent of herbicide resistant crops. Unfortunately, over-reliance on herbicides leads to environmental- health issues and herbicide-resistant weeds, causing human health and ecological concerns. Crop diversification can help manage weeds sustainably in major crop production systems (Sharma *et al.*, 2021). These results are in line with those obtained by (Aurello Scavo *et al.*, 2022) who showed the cover crops are a promising and sustainable agronomic practice to ameliorate soil health and crop

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performances. Cover cropping is a helpful practice in improving the physical, chemical, and biological soil properties, optimizing nutrient use efficiency and reducing the dependency of crops on external supplies of nutrients. A positive effect of the solving the problem of weeds and chemical control using saver treatments for human and the environment. Its aims to improve soil
properties and productivity also reduce production costs and increase farm income.

2. Material and methods

The work was conducted on fruitful trees, Twelve-year-old, Balady orange budded on Sour Orang rootstock, planted at 4 x 5 meters apart under flooding irrigation surface, at Experimental Farm, at the Selim coast, Assiut governorate, during 2018/2019 and 2020 seasons. Experimental soil was fertile loam in texture. The aim of this study was to introduce and evaluate the impact of cover crops (Pumpkin), legume (Egyptian Clover) and intercropping (pea) plus the fallow as control. These plants were cultivated with three cultivation methods, between rows, within rows and between and within rows. The experiment consisted of twelve plots in total (four treatments and three replications. The experiment was conducted on Balady orange trees, the number of (48 tree), the harvest date for the fruits is December.

2.1. Experimental design and treatments

1-Trifliom (Egyptian clover), was planted in mid-October, and after 2 to 3 months, the (Egyptian Clover) was mowed and then turned into the soil.
2-Pumpkin (*Cucarbitaceae*) cultivation in April and May on terraces, after 4 months and before flowering the vegetative growth is stuffed and turned into the soil.
3-Pea (*Pisum sativum* L.) cultivation in September planting in the middle of the lines after 3 months and before flowering and fruiting, the pods are collected.
4-Plus the fallow as control treatment. The measurements are follows-:

2.2. Characteristics of natural fruiting quality.

- The average fruit weight (g).
- The average size of the fruit by offset.
- The average weight of the juice (g).
- The average size of the juice (cm).
- Yield weight per tree (kg)
- The number of fruits per tree. Characteristics of chemical fruit quality:
- Total soluble solids percentage (T.S.S.) was determined using a hand refractometer.
- Total acidity was estimated according to (AOAC, 1984).
- (T.S.S.) was determind using a hand refractometer.
- Vitamin C content (mg &100g of fruit fresh weight) was estimated by the titration method according to AOAO (2000).

Analysis of the (carbohydrates) content of tree leaves. Analysis of The Nitrogen content of tree leaves.
Analysis of the percentage of organic matter in the soil (0-30 cm), before cultivation by taking a sample from several sectors of the field at a distal, and analysis after cultivation and turned into the soil.
Soil organic matter (O.M) (Table 1) according to Walkly and Black methods as described by Hesse (1991).

Table 1. Soil organic matter (O.M%).

Planting pea without turned into the soil	Planting pumpkin without turned into the soil	Planting pumpkin and turned into the soil	Planting clover without turned into the soil	Planting clover and turned into the soil	Control (Before planting)
2.8	2.6	2.9	2.7	2.85	2.6

The experiment was laid out in a randomized complete block design (RCBD) with three replications.
4 treatments & 3 sectors & 4 trees = 48 trees. The collected data on Balady orange and pea, Pumpkin and clover were subjected according to the

procedure outlined by Snedecor and Cochran (1980).

3. Results

3.1. Effect of the intercropping on fruit weight and fruit size

Data in table (2) show that significant effect in the average weight of orange fruit. It was observed from the results in the first, second and third seasons that the average fruit weight increased significantly and maximum values were with Pea intercropping treatment followed covering by Pumpkin, followed by intercropping Clover compared to the control. Also, in the three-season table (3) all treatments the increase was significant in the fruit size, which was on the same line with the increase in the weight of the fruit compared to the control. This is in agreement with results of Kumar *et al.* (2022), the aim of the effect of different intercrops on the average fruit weight were significantly affected by mulch and without mulch treatment. Also, among different intercropping systems tried, mango + guava +cowpea exhibited better performance which has been reflected in the form of panicle production, fruit weight and fruit yield.

Table 2. Effect of the intercropping on fruit weight of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	228.00	260.33	237.20
Pumpkin	186.00	194.43	174.97
Clover	162.73	156.20	162.57
Control	137.10	125.83	135.77
LSD 0.05	8.47	26.36	12.30

Table 3. Effect of the intercropping on fruit size in cm of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	230.00	240.00	237.20
Pumpkin	174.97	167.20	174.97
Clover	169.77	151.10	162.67
Control	147.00	118.97	135.77
LSD 0.05	22.53	22.97	21.71

3.2. Effect of the intercropping on juice weight and juice size

In the first seasons, table (4) in our study observed there was increase significant in the Juice size of the fruit with the treatment of Pea intercropping compared to the control. In the second and third season, the results showed that the highest values obtained for the volume of Juice were with Pea, then Pumpkin, then Clover, respectively. In a study by Kumar *et al.* (2022) stated that the effect of different intercrops mulch and without mulch on juice were significantly affected by mulch intercrops treatments. Table (5) revealed that significant effect in the average juice weight of orange fruit. In the first season, it was found that the increase significant in the average weight of the Juice in the Fruit with the Pea, while it was no significant between Clover intercropping and covering with Pumpkin but in the second and third season that the increase significant between Pumpkin and Clover treatment.

Table 4. Effect of the intercropping on juice size in cm of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	82.67	75.00	75.77
Pumpkin	60.13	66.97	66.97
Clover	61.10	65.97	65.97
Control	43.53	44.73	45.40
LSD 0.05	15.42	19.52	19.52

Table 5. Effect of the intercropping on juice weight (g) of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	83.33	79.33	78.17
Pumpkin	53.00	70.50	71.97
Clover	50.10	68.87	68.13
Control	48.63	48.97	47.43
LSD 0.05	14.62	16.4	17.25

3.3. Effect of the intercropping on (T.S.S.) and Acidity

In the three seasons of the experiment, table (6) our results indicated that the highest values for of soluble solids (T.S.S.) were obtained with the Pea and Clover treatment compared to the control. Data in table (7) in the first, second and third, it was observed that treatment of intercropping with Pea and Clover the acidity level decreased significantly compared to the control. Indeed, these results are in line with those obtained by Aisha *et al.* (2017) found that Intercropped peas and clover which enhanced increased berry quality, TSS content, while reduced the total acidity in berries. Also, Kumar *et al.* (2022), indicate that TSS were significantly affected, reduced acidity by without mulch intercrops treatments. Swain *et al.* (2012), among different intercropping systems, (mango + guava +cowpea followed by mango + guava + French bean). The mango plants, under study, exhibited better performance has been in quality parameters such as TSS and acidity in fruits.

Table 6. Effect of the intercropping on total soluble solids (T.S.S.) of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 season.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	13.20	13.33	13.00
Pumpkin	11.87	11.67	11,67
Clover	12.00	12.07	12.00
Control	9.87	10.67	10.00
LSD $_{0.05}$	1.06	0.87	1.03

Table 7. Effect of the intercropping on Acidity of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	0.355	0.363	0.363
Pumpkin	0.622	0.620	0.730
Clover	0.455	0.484	0.584
Control	0.724	0.804	0.798
LSD 0.05	0.19	0.11	0.10

3.4. Effect of the intercropping on Vitamin C (V.C).

It was observed from the study that table (8) the significant increase with Pea treatment followed by its Clover, while Pumpkin covering treatment gave a slight increase in vitamin C. compared to the control. Our study agreement with). Kumar *et al.* (2022) Who showed that ascorbic acid (mg/100ml juice) were significantly affected by without mulch intercrops treatments.

3.5. Effect of the intercropping total Yield of kg/tree (Fruits weight) and total number of fruits/tree.

It was also found that in table (9) the pea and Pumpkin treatment gave the highest number of fruits for each tree, while, the Clover treatment had a slight increase compared to the control. In the First and Second Season table (10) highest values and maximum increase in the weight of the total crop for each tree were with the Pea treatment and covering with Pumpkin, while the Yield decreased with Clover. Similar results were observed by Shoeib (2012), and Aisha *et al.* (2017). Indicated that %. Average yield (ton)/fed. of vines, intercropping with Clover decreased the yield by about 7.4 %. On the other hand, yield of vines intercropping increased with Peas. Rifat Bhat (2015), the results obtained revealed that the intercrops of leguminous nature like (pea, red clover, frensh bean) resulted in higher productivity, better quality fruits.

Also, Salama *et al.* (2019) pointed out that fruit yield and quality attributes of squash significantly improved than control treatment. These results are in line with those obtained by Kumar *et al.* (2022) found that the number of fruits per tree, yield were significantly affected by mulch and without mulch treatments. Intercropped peas increased yield with maximum number of fruits (920), fruits weight (161.11g) and yield. Soni *et al.* (2021). Intercropping showed positive effect on the fruit yield of Kinnow was significantly improved by intercrops as compared to sole Kinnow.

Table 8. Effect of the intercropping on V.C. (mg/100ml juise) of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	80.21	77.92	76.25
Pumpkin	67.92	68.33	68.93
Clover	77.92	74.85	85.50
Control	61.88	65.05	65.63
LSD 0.05	6.46	11.48	15.22

Table 9. Effect of the intercropping on total number 0f fruits/tree of Balady orange trees in Upper Egypt conditions during 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	548.33	470.00	516.67
Pumpkin	533 .33	450.00	440.00
Clover	363.33	393.33	390.00
Control	316.67	333.33	340.00
LSD 0.05	43.83	31.77	47.21

Table 10. Effect of the intercropping on total yield of kg/tree of Balady orange trees in Upper Egypt conditions 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	94.67	90.33	86.33
Pumpkin	85.33	75.67	61.67
Clover	68.67	58.33	70.67
Control	50.00	50.00	53.67
LSD 0.05	18.92	14.88	17.27

3.6. Effect of the intercropping on nitrogen (N) content percentage in leaf trees.

In table (11) in this study, it was noted that in the three seasons there was a significant increase the percentage of Nitrogen (N) with Pea and Clover treatment compared to the control. Aisha *et al.* (2017) reported that all intercropped peas and clover as seedless grapevines vines nutritional status increased N and organic matter (O.M.) in the soil, which enhanced increased in the leaves. Similar results were observed by Shoeib (2012) pointed out that intercropped vines with Peas, Clover have maximum values in N leaf petiole%. Rifat Bhat (2015) and Swain *et al*. (2012). Stated that the results obtained revealed that the intercrops of leguminous nature like (pea, red clover, french bean) resulted indicated that increased leaf nutrient content in apple as compared to heavy feeder (requiring high level of soil nutrients and among different intercropping systems the leaf analysis N content of mango leaf were found to be maximum under mango + guava + cowpea intercropping system. While El- Mehy –Amira and El-Badawy (2017) the obtained results from three trials revealed that intercropping legume crops with Washington navel orange trees increased available N (mg kg-1) content in soil trees as effect of the intercropping on nitrogen(N) content percentage.

Table 11. Effect of the intercropping on nitrogen content percentage in leaf trees of Balady orange in Upper Egypt conditions 2018, 2019 and 2020 seasons.

Methods of the intercropping	2018 season	2019 season	2020 season
Pea	3.88	3.73	3.55
Pumpkin	3.32	3.18	3.08
Clover	3.65	3.65	3.56
Control	3.00	3.09	2.92
LSD 0.05	0.63	0.53	0.62

3.7. Effect off the intercropping on Carbohydrate percentage in leaf trees.

Regarding to in the first and second seasons, the maximum increase significant with the Clover treatment, followed the treatment with Pea, while, the increase was nonsignificant with Pumpkin compared to the control. Pointed out that Cowpea treated orange trees recorded the lowest in organic carbon increase in the topsoil and sub-soils. (Table 12).

Aisha *et al.* (2017) reported that all intercropped peas and clover as seedless grapevines vines organic matter (O.M.) in the soil. The results obtained revealed that the intercrops of leguminous nature like (pea, red clover, french bean) resulted indicated that increased leaf nutrient content in apple as compared to heavy feeder (requiring high level of soil nutrients). Abdelazize *et al.* (2008) resulted that soil organic carbon and soil moisture content, were enhanced. The cultivation methods with the Egyptian clover gave the best results without significant differences between them soil fertility. Dabney *et al.* (2001), estimated that cover crops increase solar energy harvest and carbon flux into the soil, providing food for soil macro and microrganisms. Cover crops increase soil quality by improving biological, chemical and physical properties including: organic carbon content, cation exchange capacity, aggregate stability, and water infiltrability. Legume cover crops contribute a nitrogen (N) to subsequent crop.

Table 12. Effect of the intercropping on carbohydrate percentage of Balady orange trees in Upper Egypt conditions 2018, 2019 and 2020 seasons.

Methods of the Intercropping	2018 season	2019 season	2020 season
Pea	18.64	17.32	16.12
Pumpkin	16.45	15.05	14.55
Clover	15.15	14.16	13.87
Control	11.42	11.58	11.41
LSD 0.05	6.97	5.90	5.09

4. Discussion

Dabny (2001) evaluated the Cover crops grow during periods when the soil might otherwise be fallow. While actively growing, cover crops increase solar energy harvest and carbon flux into the soil, providing food for soil macro and microrganisms, while simultaneously increasing evapotranspiration from the soil. Cover crops reduce sediment production from cropland by intercepting the kinetic energy of rainfall and by reducing the amount and velocityofrun off. Covercrops increase soil quality by improving biological, chemical and physical properties including: organic carbon content, cation exchange capacity, aggregate stability, and water infiltrability. Legume cover crops contribute a nitrogen (N) to subsequent crops. Other cover crops, especially grasses and brassicas, are better at scavenging residual N. Kuepper *et al.* (2016) notes that beans and squash have aunique symbiotic relationship in a native. the beans in turn, help to replenish the soil with nutrients, and the large leaves of squash and pumpkin vines provde living mulch that concerves water and provides weed control.

Isha *et al.* (2017) said all intercropped peas and clover received cultural managements as seedless grapevines vines nutritional status, increased N and organic matter (O. M) in the soil, which enhanced increased total

microbial count. Intercropping with peas plants which increased, leaf area and N in the leaves.

Saeid *et al.* (2020) reported that using the trellis for shading to reduce the effect of heat stress on led to more efficient distributed yield on the trees. productivity also reduce production costs and increase farm income, and showed that legumes offer significant advantages in terms of weed control, soil moisture conservation, productivity, and grain quality, using promising legumes species combinations result in the improvement of N fertilizer land-use efficiency and hence help to reduce N-fertilization inputs.

Sharma *et al.* (2021) studied the weeds are among the major constraints to any crop production system, reducing productivity and profitability. over-reliance on herbicides leads to environmental-health issues and herbicide-resistant weeds, causing human health and ecological concerns.

Fang *et al.* (2022) studied the intercropping citrus trees by vegetable crops, legume crops and clover what of a positive effect of the solve the problem of weeds and chemical control using safer treatments for humans and the environment. Aurello Scavo *et al.* (2022) showed the cover crops are a promising and sustainable agronomic practice to ameliorate soil health and crop performances. Cover cropping is a helpful practice in improving the physical, chemical, and biological soil properties, optimizing nutrient use efficiency and reducing the dependency of crops on external supplies of nutrients. A positive effect of the solving the problem of weeds and chemical control using saver treatments for human and the environment. Its aims to improve soil properties and productivity also reduce production costs and increase farm income

5. Conclusion

Therefore, it can be said that silver nanoparticles has the potential to be thought about for early broiler feeding and for enhancing the health and productivity of chicken. In order to maximize growth performance, and bird health, additional research under climate changes conditions is still required to assess the precise mechanism of action and identify the ideal quantity of dietary inclusion.

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Data Availability Statement
Data presented in this study are available on fair request from the respective author.

Ethics Approval and Consent to Participate
Not applicable

Consent for Publication
Not applicable.

Conflicts of Interest
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6. References

A.O.A.C. (1984). *'Association of Analytical Chemists, Standard Official Methods of Analysis of the Association of Analytical Chemists',* 14th Edition, S.W Williams, Washington DC, 121 p.

A.O.A.C. (2000). *'Official Method 920',*163 Fats (Foreign) containing tristearin in lard/pearsons Composition and Analysis of Foods 17th edn., page 611.

Abdel-Aziz, R., Salam, S., Al-Bitar, L. (2008). 'Effect of intercropping cover crops on Citruus Orchards growth and fruiting under Toshka conditions', *Journal of Islamic Sciences.*

Aisha, S.A., Thoraua, G., Abo El-Wafa, S.A., El-Kenawy, M.A. (2017). 'Effect of Intercropping of Peas and Clover Corps on Growth, Productivity and Soil Characteristics of Flame Seedless and Thompson Seedless grapevine Cultivars', *Egypt. J. Hort.*, 44 (2), pp. 183-197.

Aurelio Scavo, Stefania Fontanazza, Alessia Restuccia, Gaetano Roberto Pesce, Cristina Abbate, Giovanni Mauromicale (2022). 'The role of cover crops in improving oil fertility and plant nutritional status in temperate

climates. A review', *Agronomy for Sustainable Development*, 42, 93.

Dabney, S.M., J.A. Delgado, and D.W. (2001). 'Using winter cover crops to improve soil and water quality. Commun', *Soil Sci. Plant Anal.*, 32 (7&8), pp. 1221–1250.

El-Mehy-Amira, A., El-Badawy, H.E.M. (2017). 'Evaluation of intercropping corn, soybean and cowpea with Washington navel orange orchard under different N fertilizer levels', *Middle East Journal of Agriculture Research*, 06 (02). ISSN 2077-4605

Fang, L., Zhang, Y., Yang, Y., Zhang, X. (2022). *'The effect of ground cover management on Fruit Yield and quality',* a meta-analysis Taylor &Francis-Archives of Agronomy.

Hesse, P.R. (1991). *'A text Book of soil chemical analysis',* Juan. Murry (Publisher) Lid, London.

Kuepper, G., Dodson, M., Duncan, J. (2016). *'Companion planting & Botanical Pesticides: Concepts& Resources',* ATTRA Sustainable Agriculture.

Kumar, D., Singh, S., Arora, I., Sharma, J.R., Pankaj (2022). 'Effect of mulched and without mulched intercrops on growth yield and fruit quality of Kinnow Mandarine plantion under semi-Arid irrigated conditions', *International Journal of Environment and Climate Change,* 12 (11), pp. 1394-1400.

Mulinge, J.M. (2018). *'Effects of legume cover crops on soil properties and productivity of grafted Oranges (Citrus sinensis) in the coastal',* Philosophy in Horticulture of Pwani University Lowlands of Kenya.

Rifat, B., Hussain, S., Wani, W.M., Banday, F.A., Sharma, M.K. (2015). 'Effect of intercrops on productivity, quality, leaf nutrient status and relative economic yield of apple cv. Red Delicious', *Journal of Applied Horticulture,* 17(3), pp. 213-216.

Saied, K.M. Abd El-Naby; Baiea, M.H.M., Abdelkhalek, A., Amin, O.A.E., Khalifa, R. Kh. M. (2020). 'Mitigation of heat stress effects using agricultural treatments on growth, yield and fruit quality of washington navel orange trees grown in Egypt', Plant Archives, 20(2), pp. 2128-2133.

Salama, A.R. Fekry, Wafaa, A., Wahdan, H.M. (2019). 'Influence of some squash cultivars and growth stimulants on flowering, yield and fruit quality at autumn – winter season under open field conditions', *J. Product. & Dev.*, 24(3), pp. 433 – 460.

Sharma, G., Shrestha, S., Kunwar S., Te-Ming Tseng (2021). 'Crop Diversification for Improved Weed Management: A Revie',.

Shoeib, M.M. (2012). 'Effect of intercropping on fruiting and growth of flame seedless Grapevine', *Plant Production, Mansoura Univ.*, 3 (1), pp. 33 – 50.

Snedecor, G.W., Cochran, W.G. (1980). *'Statistical Methods',* 7th Ed. Iowa State Univ. Press, Ames., Iowa U.S.A.

Soni, M.L., Birbal, Saxena, A., Nangia, V., Yadava, N.D. (2021). 'Intercropping with vegetables on productivity and economic returns of Kinnow in arid region', *Indian J. Hort.*, 78(2), pp. 211-215

Swain, S.C., Sahoo, S.C., Mishra, P.J. (2012). 'Effect of intercropping systems on growth, yield, fruit quality and leaf nutrient status of mango under rainfed situation', *International Journal of Agricultural Sciences*, 8(1), pp. 174-178.