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Effect of Intercropping of Peas and Clover Corps on Growth, Productivity and Soil Characteristics of Flame Seedless and Thompson Seedless grapevine Cultivars

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THIS INVESTIGATION was conducted during the successive seasons (2014& 2015) in a private vineyard located at Menshiat Abdel Nabi village, Aga, Dakahlia Governorate, Egypt. The chosen vines were seven years old, planted in a clay soil, spaced at2×2.5 meters apart and irrigated by flood system. Flame seedless was spur pruned by leaving 7 spurs with two eyes on each cardon, the total load was 56 buds under pergolla trellis system, while Thompson seedless was cane pruned by leaving 6 cans with 12 buds/cane with 6 renewal spurs with two buds for each, the total bud load was 84 buds under double T trellis system. All intercropped peas and clover received cultural managements as recommended by the Egyptian Ministry of Agriculture. The obtained results reveal that intercropping of Thompson seedless and Flame seedless grapevines the used intercropped crops increased N, K and organic matter (O. M) in the soil, which enhanced vines nutritional status, increased total microbial count, vegetative growth, yield and berry quality. Intercropping with peas plants which increased shoot length, leaf area and N and K in the leaves as well as yield per vine, TSS content and total sugars, while reduced the total acidity in berries and increased total microbial count, dehydrogenase and phosphatase enzymes activity in the rhizosphere. In addition, the economic study indicated that intercropping Thompson seedless and Flame with peas gave higher net profit/ Fadden followed by intercropping Thompson seedless and flame seedless with clover crop.

Keywords: Grape, Thompson seedless, Flame seedless, Intercropping, Peas, Clover, Microclimatic

Introduction

Grape (*Vitis vinifera* L.) is considered one of the most important fruit crops in the world. In Egypt, it is the second important fruit crops after citrus. Thompson and Flame seedless grapes are the most important table grape cultivars grown in Egypt. Intercropping is the growing of two or more crops simultaneously on the same field (Sangakkara et al., 2003 and Belal et al., 2014). Intercropping can be used by smallholder farmers to increase the diversity of their product and the stability of their annual output through effective use of land and other resources (Okonji et al., 2012).

Egyptian clover (*Trifolium alexandrinum* L.) is considered the main winter forage legume in old and new lands of Egypt. This is due to its high yield and quality especially crude protein content. Pea (*Pisum sativum* L.) is one of the most important leguminous vegetable crops grown during winter season in Egypt for local consumption and exportation. The pods of pea contain a great amount of protein and carbohydrates since pea is considered as one of the most important sources in human nutrition (Bhat et al., 2013). Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus plays a vital role in fostering sustainable agriculture (Negi et al., 2006). Therefore, apart from meeting its own requirement of nitrogen, peas are known to leave behind residual nitrogen in soil 50-60 kg/ha (Kanwar, 1990)

Maximum fixation amounts occur when seasonal soil available nitrogen is less than 150 lbs. per acre. Differences exist among Egyptian clover varieties in the amounts of nitrogen fixation per acre (Williams et al., 1990).Legumes

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which have become a popular combination among farmers were probably due to legumes ability to combat erosion and raise soil fertility levels (Matusso et al., 2012).

For solving the problems of lack in fodder imported from abroad, high price and reduce fodder importation in Egypt, more attention should be given to expansion the cultivation of Pea and clover through intercropping with fruit crops, especially grapes.

Benefits of intercropping include providing multiple benefits in vineyard management such as reduce soil erosion, improve soil structure, suppression of weed growth, increase water infiltration, reduce ground water pollution, reduce sunburn of fruit, reduce input costs and increase farm profitability (Miller et al., 1989, Smith, 1993 and Amjad et al., 2015). Also, when the prices of the grapes are down in the outbreak of a disease or when the vines are still not producing a companion crop can provide another source of income (Seleem, 2009 and Belal et al., 2017). Cover crops improve soil fertility and physical properties (Hubbard et al., 2013), (Sainju and Singh, 1997), and reduce erosion (Baets et al., 2011). In addition, the negative effects of intercropping winter season were not found during dormant period. On the other hand by giving irrigation water to these crops during winter, the vines would continue to put some growth, which affects very badly in the next cropping. (Shoeib, 2012).

Maximum fruitfulness in Thompson seedless and Flame seedless under controlled conditions occurred at 25°C but was drastically reduced at 32°C in Thompson seedless and at 18°C in Flame seedless. The low input and high environment risk of the smallholder farmer benefits enormously from intercropping (Rana and Pal, 1999).

The aim of this study was determine the impact of intercropping of peas and clover corps on growth, productivity, microclimatic and soil characteristics of Flame Seedless and Thompson Seedless cultivars.

Materials and Methods

This investigation was conducted during two successive seasons (2014& 2015) in a private vineyard located at Menashe Abdel Nabi village, Aga, Dakahlia Governorate, Egypt. The chosen vines were seven years old, planted in a clay soil spaced at 2.5×2 meters apart and irrigated by flood system. The vines were pruned during the second week of January during the two seasons of the study. Flame seedless was trained according to quadrilateral cordon using pergolla trellis system and spur pruned by leaving 7 spurs with two eyes on each cardon, the total load was 56 buds. While, Thompson seedless was cane pruned by leaving 6 cans with12 bud/cane with 6 renewal spurs with two buds each, the total bud load was 84 buds under double T trellis system. The summer pruning for grape vine was done before intercropping directly by removing 50% of the immature secondary branches to increase lighting for intercropping clover and peas. The experiment consisted of six treatments arranged in a randomized complete block design, One hundred and eight uniform vines were chosen. Each six vines acted as a replicate and each three replicates acted as a treatment.

Treatments were conducted as follows:

- Thompson seedless alone
- Thompson seedless + Clover
- Thompson seedless + Peas
- Flame seedless alone
- Flame seedless + Clover
- Flame seedless + Peas

At primary of the experiment, physical properties of the soil at 0.0 – 90.0 cm soil depth were determined as shown in (Table 1) also chemical properties of the soil at 0.0 – 90.0 cm soil depth at the end of the experiment were determined according to Wilde et al., (1985) to give information about the effect of intercropping crops on soil nutritional element status after crop harvesting, and the obtained results are shown in (Table 1)

Intercropping materials

Clover (*Trefoilium Alexandrinum*) was planted in rows between the vines rows in the fourth week of September in the two seasons of the study and harvested at the end of February and plowings then the orchard was prepared for the new season.

Peas (*Pisum sativum L.*) (Master B) was cultivated in rows during the first week of October in both seasons of the study and harvested at the end of January and plowings then the orchard was prepared for the new season.

TABLE 1. Physical and chemical properties analysis of vineyard soil at depth 0.0-90.0 cm.

Characteristics	Thompson seedless	Flame seedless
Fine Sand %	9.13	9.13
Silt %	26.50	26.54
Clay %	70.64	70.65
Texture	Clay	Clay
PH	8.37	8.4
E.C	0.876	0.88
O.M %	1.37	1.39
Total N(ppm)	11.26	11.3
Available P (ppm)	12.8	12.9
Available K (ppm)	181	185

All vines received the cultural managements such as fertilization, irrigation, disease and pest control as recommended by the Egyptian Ministry of Agriculture

All intercropped clover and peas received cultural managements as recommended by the Egyptian Ministry of Agriculture such as fertilization, irrigation, disease and pest control.

The following characteristics were determined
Microbiological studies

Samples of the soil were taken after harvesting each intercropping plant to determine:

- Total microbial count (-x10^6 colony forming unit (cfu)/g soil) as the method described by Esher and Jensen (1972).
- Dehydrogenase enzyme activity (µgTPF/g/D.W.soil/day) due to Ping Dong (1997).
- Phosphatase enzyme activity (IP/g/D.W.soil/day) due to Drobnikova (1961).

Bud behavior

Bud burst date

The date of burst was recorded and compared with the control.

Percentage of bud burst

Number of burst bud was counted one month after bud burst and the percentage of bud burst were calculated as follows according to Bessis (1960).

Bud burst% = Number of bursted bud / Total Number of buds × 100

Bud fertility

Number of clusters per vine was counted and divided by the total number of buds and the fertility was calculated as follows according to Bessis (1960).

Bud fertility% = Number of clusters / Total Number of buds × 100

Morphological and vegetative growth

At full bloom, vegetative growth parameters were taken from non-bearing shoots

- Average shoots length (cm).
- Average number of leaves/shoot
- Average leaf area (cm2)

Twenty leaves / vine were picked at Veraison of the apical 6^{th} and 7^{th} leaves to determine average leaf area using a CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA.

N, P and K content in the leaves:

At full bloom, samples of 20 leaf petioles per each replicate were taken from the leaves opposite to cluster to determine of N, P and K according to the method of (Cottenie et al., 1982).

Wood ripening

Wood ripening was determined at the end of growing season as a parameter of canes ripening (Smith, 1993) by dividing the brownish cane length by the total shoot length X 100.

Yield and physical characteristics of cluster

Harvesting indices (TSS% and acidity %) were weekly monitored from veraison till maturity when TSS reached about 16-17% according to Tourky et al. (1995).

Yield/vine was determined by multiplying number of clusters/vine by average cluster weight.

The grape was brought to the laboratory for the following determinations.

- One-hundred berry weight (g).
- Cluster weight (g).
- Cluster length (cm).
- Cluster width (cm)

Chemical characteristics of berries

Total soluble solids (TSS %) in berry juice using a hand refractometer.

Total titratable acidity (as tartaric acid %) according to the Official Analysis Methods (A.O.A.C., 1980).

TSS/acid ratio.

Microclimatic data

Data of microclimate was taken during the growing season on three layers of the vine canopy for each treatment also at the lower parts above Thompson seedless on clover cover crop, peas cover crop and Flame seedless on clover cover crop, peas cover crop treatments.

The following microclimatic data were recorded weekly during the growing period as follow:

- Air temperature up of cover crops.
- Air temperature inside Vine .
- Relative humidity (RH%)
- Light intensity.

They were measured on three levels lower, middle and upper branches using "scheduler plant stress Monitor" standard oil Engineered Materials Co., Ohio,USD.AII the above-mentioned measurements were used by the microprocessor of the apparatus to calculate the average of canopy microclimate in order to find the relationship between the microclimate and the type of cover crop.

The air temperature was recorded at these levels using Celsius thermometer to calculate the effect of soil covers on changing the temperature around the vine roots.

The soil temperature

It was taken at three levels:

- At the soil surface in the cover crop.
- At 5 cm depth.
- At 20 cm depth

The soil temperature was revealed at these levels using Celsius thermometer to calculate the effect of soil intercropping on the change in the temperature around the vine roots.

Statistical analysis

The complete randomized block design was adopted for the experiment. The statistical analysis of the present data was carried out according to Snedecor and Cochran (1980). Average was compared using the L.S.D. values at 5% level.

Results and Discussion

Soil nutritional status in the second season after harvesting intercropping crops

Data results in Table 2 reveal soil nutritional status in the second season after harvesting intercropping crops, which showed that intercropping Thompson seedless and Flame seedless grapevines with clover and peas increased nutrient elements such as N, P, K and O.M, while decreased pH in the soil than control but gave insignificant P levels among treatments. Soil E.C was higher significant with cover crops than control. Clover and peas cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus play a vital role in fostering sustainable agriculture (Negi et al., 2006).

The obtained results are in harmony with those reported by Rizk (2012) on Thompson seedless grapevines and Shoeib (2012) on Flame seedless grapevines and Belal et al (2017) on Thompson seedless grapevines showed that intercropping vines with legume increased nutrient elements i.e. N, P, K and O.M, while decreased pH in the soil than control which improved soil fertility properties.

Microbiological studies.

It is evident from the obtained results in Table 3 that intercropping Thompson seedless and Flame seedless grapevines with clover and peas plants significantly increased total microbial count such as, dehydrogenase and phosphatase enzymes activity. Maximum values of total microbial count (291.3and 295.66) & (289.3 and 297.6(-x10^6 cfu) /g soi), dehydrogenase (78.7 and 80.2) & (79.33 and 80.66 μgTPF/g/DWsoil/da) and phosphatase enzymes (26.7 and 27.8) & (29.44 and 29.9 IP/g/ DWsoil/day) were obtained when Thompson seedless and Flame seedless grapevines were intercropped with clover in both seasons of the study respectively, while the control treatment gave the lowest values of total microbial count (136.33 and 139.6) & (141and 144.3(-x10^6 cfu) /g soil), dehydrogenase (62.4 and 62.96) & (61.9 and 62.9 μgTPF/g/DWsoil/day) and phosphatase enzymes (12.46 and 13.0) & (12.3 and 13.16 IP/g/DWsoil/day) in both seasons of the study, respectively.

TABLE 2. Effect of intercropping with clover and peas on chemical characteristics in the roots rhizosphere of Thompson seedless and Flame seedless grapevine cultivars in the second season after harvesting intercropping crops.

Treatments	pH(1: 2.5)	E.C dS/m^{-1}	O.M %	Total N%	Available P (ppm)	Available K (ppm)
Thompson seedless						
Control	8.1	0.25	2.9	12.4	7.9	202
Clover	7.8	0.26	3.5	13.1	7.9	255
Peas	7.8	0.28	2.9	13.5	7.9	250
LSD at 5%	0.26	0.02	0.34	0.39	N.S	10.83
Flame seedless						
Control	8.1	0.25	2.9	12.4	7.9	200
Clover	7.9	0.27	3.4	13.2	7.9	252
Peas	7.9	0.28	3.3	13.1	7.9	284
LSD at 5%	0.18	0.01	0.26	0.22	N.S	6.04

TABLE 3. Effect of intercropping with clover, and peas intercropping crops on total microbial count, dehydrogenase enzyme activity and phosphatase enzyme activity in the roots rhizosphere of Thompson seedless and Flame seedless grapevine cultivars after harvesting during 2014 and 2015 seasons.

Treatments	Total microbial count (-x10^{6} cfu) /g soil)		Dehydrogenase enzyme activity (µgTPF/g/DWsoil/day)		Phosphatase enzyme activity (IP/g/DWsoil/day)	
	2014	2015	2014	2015	2014	2015
Thompson seedless						
Control	136.33	139.6	62.4	62.96	12.46	13.0
Clover	291.3	295.66	78.7	80.2	26.7	27.8
Peas	242.6	245	74.3	75.9	17.8	19.1
New L.S.D at 5%	34.7	22.3	4.21	3.77	4.4	3.7
Flame seedless						
Control	141	144.3	61.9	62.9	12.3	13.16
Clover	289.3	297.6	79.33	80.66	29.44	29.9
Peas	237.66	247.6	73.56	75.2	19.9	20.2
New L.S.D at 5%	22.19	20.6	4.07	5.5	3.5	3.8

These previous results are in agreement with those obtained by Abd El-Samad (2006) who intercropped peach trees with wheat and clover; Rizk (2012) intercropped Thompson seedless with peas and clover; Shoeib (2012) intercropped Flame seedless with peas, clover,onion and Japanese turnip; Sawsan Bondok (2013) intercropped Flame seedless with peas and clover; Nagwa et al. (2014) intercropped Sewy date palms with Egyptian clover, fenugreek and field bean, Belal et al (2017) intercropped Thompson seedless with fenugreek, anise, black cumin and parsley crops and reported that an increase was observed total microbial count as well as dehydrogenase and phosphatase enzymes activity in all treatments especially with fenugreek as an indication of increasing microbial activity in the soil. Also, Mohamed (2013) reported that intercropping of pea with some medicinal plants could regulate soil microbial community such as actinomyces, bacteria and fungi effectively consequently soil rizosphere was improved.

Bud burst date

Results presented in Table 4 show that the control vines with Flame seedless or Thompson seedless advanced the beginning of bud burst date compared with with other treatments followed by the vines intercropped with peas then the vines intercropped with clover which delayed bud burst date by about 16 – 11 days than the control with Flame seedless and delayed bud burst date by about 13 – 8 days than the control with Thompson seedless respectively, in both seasons of the study.

These findings were agreement with those obtained by Ndung et al. (1997) and Shoeib (2012).

Percentage of bud burst

Results presented in Table 4 reveal that control vines significantly increased the percentage of bud burst as compared with intercropping with peas or clover crops of Thompson seedless and Flame seedless respectively, in both seasons of the study.

Bud fertility

From Table 4 results showed that insignificant differences among all treatments in the first season of Thompson seedless cultivar bud fertility. On the other hand, intercropped with peas gave the higher significant bud fertility percentage than clover in the second season. In addition, control vines gave higher significant bud fertility percentage than peas in both season of Flame seedless cultivar.

The obtained results are in harmony with those reported by Rizk (2012) and Shoeib (2012).

TABLE 4. Effect of intercropping with clover, and peas on bud behaviour of Thompson seedless and Flame seedless grapevines cultivar during 2014 and 2015 seasons

Thompson seedless						
Treatments	**Bud burst date**		**Bud burst%**		**Bud fertility%**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**
Control	Mars 10	Mars12	91.53	92.93	29.87	29.20
Clover	Mars 23	Mars20	83.77	88.87	29.57	28.80
Peas	Mars20	Mars18	89.60	91.03	29.63	30.27
New L.S.D at 5%			0.66	0.51	N.S	1.36
Flame seedless						
Treatments	**Bud burst date**		**Bud burst%**		**Bud fertility%**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**
Control	Mars 4	Mars6	93.87	89.27	49.90	49.43
Clover	Mars20	Mars23	84.77	83.87	46.63	48.07
Peas	Mars16	Mars20	91.10	87.43	49.67	48.60
New L.S.D at 5%			1.27	0.63	1.46	0.81

Vegetative growth parameters

Results in the Table 5 clearly show that all treatments used significantly increased shoot length, number of leaves/shoot and leaf area (cm^2) as compared with the control except intercropping Thompson seedless with clover treatment which gave insignificant differences in shoot length as compared with the control in the first season of the study. Maximum values in shoot length (226.30 and 226.83 cm) & (234.80 and 235.27cm), number of leaves/shoot (46.00 and 49.00) & (50.00 and 52.00) and leaf area (159.37 and 161.53 cm^2) (158.97 and 169.30cm^2) were obtained when Thompson seedless and Flame seedless vines were intercropped with peas in both seasons respectively, while control treatment gave the lowest values in this respect in both seasons.

Regarding wood ripening, results in the same table reveal that the control vines significantly increased wood ripening as compared with intercropping with peas and clover of Thompson seedless grapevines cultivar in the first season, while in the second season, results showed that intercropping Thompson seedless cultivar with peas and clover significantly increased wood ripening as compared with the control. Intercropping Flame seedless grapevines with peas plants significantly increased in wood ripening in 2014 and 2015 seasons, respectively, compared with the control. No significant deference was between intercropping Flame seedless with peas or clover on wood ripening%, in both seasons.

TABLE 5. Effect of intercropping with clover, and peas on shoot length (cm), number of leaves/shoot , leaf area (cm)2 and wood ripening (%) of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

Thompson seedless								
Treatments	**Shoot length (cm).**		**Number of leaves/shoot**		**Leaf area (cm^2)**		**Wood ripening%**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
Control	220.0	221.9	42.33	43.33	148.4	152.5	73.03	68.00
Clover	221.4	225.6	43.00	44.67	156.4	157.6	68.00	79.00
Peas	226.3	226.8	46.00	49.00	159.3	161.5	69.00	80.33
New L.S.D at 5%	1.50	0.66	1.09	0.79	1.21	2.62	0.03	0.32

Flame seedless								
Treatments	**Shoot length (cm).**		**Number of leaves/shoot**		**Leaf area (cm^2)**		**Wood ripening%**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
Control	219.1	221.6	43.67	45.00	154.1	150.2	70.00	68.00
Clover	223.6	224.5	46.33	48.67	165.2	160.1	74.00	79.00
Peas	234.8	235.2	50.00	52.00	169.3	158.9	78.00	82.00
New L.S.D at 5%	0.75	1.35	1.12	1.56	1.97	1.02	8.00	13.00

Shoeib (2012) reported that wood ripening % was positively affected by the kind of intercropping crop and the maximum wood ripening % was resulted from the vines were interloped with peas and clover.

N, P and K content in the leaves

The results presented in Table 5 revealed that there was a significantly increased onion N, P and K percentage with all intercropping treatments used with Thompson seedless and Flame seedless cultivars compared with the control in both seasons. The highest percentage of nitrogen, phosphorous and potassium were obtained when Thompson seedless and Flame seedless cultivars were intercropped with peas followed by the vines intercropped with clover, while control treatment gave the lowest values of N, P and K percentage in 2014 and 2015seasons, respectively.

The enhancement effect of intercropping Thompson seedless and Flame seedless grapevine cultivars with peas and clover on nutritional status of the vine may be due to the legume crops has the ability to fix nitrogen from the atmosphere consequently increased N in the soil and help to bring the other nutrients back into the upper soil profile from deeper soil layers Miller et al. (1989). Also, the residual of organic parts improved physical and chemical properties of the soil. Potassium is a macronutrient, which can be brought up from deeper soil layers by intercropping crop roots, then the nutrients are released back into the active organic matter when the intercropping crop dies and decomposes. The roots of legume cover crops are house of beneficial fungi known as mycorrhizae. The mycorrhizae fungi have efficient effect to release P from the soil, which pass into their plant host keeping phosphorus in an organic form. This is the most efficient way to keep its cycling in the soil (Rizk 2012, Shoeib, 2012, Belal et al., 2017). Also, intercropping crops help retain P in the fields by reducing erosion (Sarrantonio, 1989).

Yield, cluster weight, 100 berry weight, Cluster length and width.

The concerned results in Table 6 show that Thompson seedless grapevines cultivar intercropped with peas crop recorded pronounced significant values of yield, cluster weight and 100 berry weight, cluster length and width as compared with the control, while Thompson seedless intercropped with clover show insignificantly differences in 100 berries weight as compared with the control in the first season only. Also, It is clear that the yield/vine, cluster weight were more pronounced significant values when Flame seedless grapevine cultivar intercropped with the peas followed by control then clover crop which gave the lowest values.

Results also showed that no significant difference among all treatments was observed on 100 berries weight of Flame seedless in the first season only and insignificant difference was detected between the vines intercropped with peas and clover in the second season. As for cluster length and width, the maximum values were resulted from the vines intercropped with peas and clover cover followed by control which gave the lowest values comparing Thompson seedless and Flame seedless cultivars.

The beneficial effects of intercropping Thompson seedless with peas and clover on increasing grapevine yield, cluster weight and 100 berry weights maybe due to legume crops fix atmospheric nitrogen in the soil Chambliss et al. (2003) and consequently increased N in the soil. Also residual organic parts improved physical and chemical properties of the soil Nijjar (1985) as shown in Table 2 and increased microbial activity (dehydrogenase and phosphatase enzymes) of the soil as shown in Table 3 which consequently improved roots growth and nutritional status of the vine and that increased shoot length and leaf area and enhanced berry weight and cluster weight finally increased yield.

Shoeib (2012) revealed that the vines intercropped with peas showed in a positive effect on yield / vine compared to free vines or intercropping vines with Clover and the best results were obtained with vines intercropped with Onion.

TABLE 6. Effect of intercropping with clover and peas on N, P and K content in the leaves of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

Thompson seedless						
Treatments	N%		P%		K %	
	2014	2015	2014	2015	2014	2015
Control	2.25	2.27	0.35	0.37	1.51	1.51
Clover	2.48	2.51	0.44	0.46	1.69	1.71
Peas	2.79	2.64	0.57	0.58	1.81	1.82
New L.S.D at 5%	0.25	0.11	0.02	0.01	0.02	0.01
Flame seedless						
Treatments	N%		P%		K %	
	2014	2015	2014	2015	2014	2015
Control	2.26	2.26	0.36	0.37	1.55	1.57
Clover	2.50	2.48	0.46	0.48	1.74	1.77
Peas	3.03	3.02	0.57	0.58	1.83	1.88
New L.S.D at 5%	0.04	0.04	0.01	0.01	0.02	0.01

TABLE 7. Effect of intercropping with clover and peas on yield /vine (kg), cluster weight (g), 100 berries weight (g), cluster length (cm) and width (cm) of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

Thompson seedless										
Treatments	Yield /vine(kg)		Cluster weight (g)		100 berries weight (g)		Cluster length (cm)		Cluster width (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	10.90	10.97	455.07	464.67	155.00	158.33	20.00	20.07	17.10	16.83
Clover	10.87	10.67	461.00	494.33	150.00	150.67	19.53	20.27	16.53	17.17
Peas	11.33	11.97	470.33	496.67	155.00	153.33	20.47	21.20	18.80	18.27
New L.S.D at 5%	0.20	0.25	7.40	5.24	3.27	0.16	0.28	0.13	0.75	0.59
Flame seedless										
Treatments	Yield /vine(kg)		Cluster weight (g)		100 berries weight (g)		Cluster length (cm)		Cluster width (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	17.80	18.00	486.67	503.33	235.00	249.17	21.90	21.80	18.73	18.67
Clover	16.30	17.87	506.67	496.67	220.00	231.67	19.67	21.93	18.37	17.97
Peas	18.57	18.40	518.00	531.67	235.00	225.00	23.43	22.73	18.90	19.83
New L.S.D at 5%	0.81	0.57	14.04	7.90	23.81	8.29	0.50	0.71	1.11	0.86

TSS %, acidity and TSS / acid ratio

Results in Table 8 show the effect of intercropping on TSS%, acidity and TSS/acid ratio of Thompson seedless grape vine cultivar, which showed significant differences among all treatments in 2014 and 2015seasons except acidity in the first season gave no significant differences among all treatments. It is clear that TSS % and TSS/Acid ratio recorded pronounced significant values when the vines intercropped with peas followed by clover cover crops then control which gave the lowest values with Flame seedless cultivar.

As for total acidity it was decreased by intercropping Flame seedless cultivars with peas and clover cover crops which gave lower values compared with the control. This might be attributed to their effect on leaf and nutritional status of vines (Tables 5 and Table 6) especially N that subsequently increased photosynthesis activity and hence increased T.S.S % and decreased total acidity in berries juice. These results are in agreement with Killer et al. (1998) who found that photosynthesis is the process for producing sugar (glucose), which means that more sugars are available for growth and fruit ripening

TABLE 8. Effect of intercropping with clover, and peas on TSS%, acidity and TSS/Acid ratio of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons

	Thompson seedless					
Treatments	**TSS %**		**Acidity%**		**TSS/Acid ratio**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**
Control	17.13	17.37	0.73	0.73	23.40	23.79
Clover	17.77	17.77	0.73	0.72	24.09	24.68
Peas	18.07	18.07	0.73	0.72	24.80	25.68
New L.S.D at 5%	0.24	0.15	N.S	0.01	0.19	0.19
	Flame seedless					
Treatments	**TSS %**		**Acidity %**		**TSS/Acid ratio**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**
Control	15.73	15.87	0.73	0.57	21.5	27.8
Clover	16.40	16.27	0.67	0.73	24.4	22.2
Peas	16.07	16.27	0.67	0.60	23.9	27.1
New L.S.D at 5%	0.34	0.26	0.10	0.04	0.59	0.30

These results were true during two the studies seasons and agreement with Abd El-Samad (2006) on peach trees, Killer et al. (1998), Rizk (2012) and Shoeib (2012) on Thompson seedless and Flame seedless grapevines.

Microclimatic results

Air temperature up of cover crops

Results in Table 9 indicate the effect of intercropping peas cover crop and clover cover crop treatments on air temperature (upper, middle and lower) of Thompson seedless and Flame seedless grape vine cultivars, which showed significant decreased value for air temperature (upper, middle and lower) as compared with the control in two the seasons.

Our results are in agreement with Sanchez and Dokoozlian (2005) who that the use of specific cover crops in vineyards under Mediterranean climates helps to reduce vegetative vigor. Nevertheless, yield reduction and slight quality improvement suggest that cover crops should be adjusted in order to reduce competition for water and thus prevent these negative effects of water scarcity.

Air temperature up of vine

It is evident from the obtained results in Table 9 that control vine significantly increased crop temperature (upper, middle and lower) compared with intercropping Thompson seedless and Flame seedless grapevine with peas cover crop or clover cover crop in 2014 and 2015 seasons. Results also showed that no significant difference between the vines intercropped with peas and clover crop on crop temperature in both seasons.

These results confirmed the finding of Bedrech (2005) and Igoune et al. (1995) that crop temperatures (upper, middle and lower) are higher in mulched treatments than the control and the chemical weed control in the two cultivars. Photosynthetic activity is optimal at 24°C for cool climates (explained more in depth in the next chapter) grapes and 28°C for the warm climate grapes Lombard and Richardson (1979).

Relative humidity (RH%)

Results in Table 10 show that intercropping Thompson seedless and Flame grapevines with peas and clover cover crops gave the higher significant values of relative humidity (upper, middle and lower) compared with the control in both seasons of this study, while control gave the lowest significant value of relative humidity compared with intercropped with peas and clover in Thompson seedless and Flame grapevines in both seasons of the study. Bedrech (2005) and Reuther and Metzener (1983) noticed that RH% (upper, middle and lower) is higher in the mulched treatments than the un-mulched ones, so that the transpiration rate is higher at lower humidity levels.

Light intensity

It is evident from the obtained results in Table 10 that control vines significantly increased relative light intensity (upper, middle and lower) compared with intercropping Thompson seedless and Flame grapevines with peas cover crop and clover cover crop in 2014 and 2015 seasons, while vines intercropped with clover gave the lowest values of light intensity (upper, middle and lower) compared with the other treatments in both seasons.

Sanchez and Dokoozlian (2005) found that Maximum fruitfulness in Thompson seedless and Flame Seedless under controlled conditions occurred at 25°C but was drastically reduced at 32°C in TS and at 18°C in FS. Again, there was no relation between individual bud light exposure and fruitfulness. In addition, the grapevine needs a lot of light, and the intensity and the duration of the incoming light has effects on the phenology of the grapevine (Galet, 2000).

The soil temperature

Results in Table 11 show the differences of soil temperature at three levels: at the soil surface in the cover crop, at 5 cm depth and at 20 cm depth.

It is noticed that the control treatment gave the highest value of soil temperature at the three depths compared with intercropping vines and the other treatments were arranged descending as follow peas cover crop and clover cover crop two cultivars in both seasons.

The practice of the invention is of particular value in the production of cash crops, particularly strawberries or tomatoes through weed control, under a hot, cloudy environment. Peng et al. (2006) found that the effectiveness was in the order of white clover intercropping > straw mulching > control, 13:00 > 19:00 >7:00 and lowering temperature > increasing and keeping temperature, and decreased

TABLE 9. Effect of intercropping with clover and peas on air and crop temperature of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

Air temperature up of cover crops (ºC)												
	Thompson seedless						Flame seedless					
Treatments	Upper (ºC)		Middle (ºC)		Lower (ºC)		Upper (ºC)		Middle (ºC)		Lower (ºC)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	25.03	25.57	27.07	27.00	26.60	26.73	25.77	26.13	27.22	27.12	29.37	29.42
Clover	23.93	24.07	26.03	26.20	21.50	21.47	24.87	25.07	23.49	26.50	23.41	23.46
Peas	24.10	24.10	26.07	25.90	21.47	21.55	24.90	24.93	23.52	23.54	23.39	23.46
New L.S.D at 5%	0.18	0.20	0.26	0.35	0.08	0.09	0.36	0.26	0.05	2.99	0.09	0.04

Air temperature inside Vine (ºC)												
	Thompson seedless						Flame seedless					
Treatments	Upper (ºC)		Middle (ºC)		Lower (ºC)		Upper (ºC)		Middle (ºC)		Lower (ºC)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	26.56	26.56	27.25	27.26	28.35	28.36	27.33	27.34	28.42	28.17	29.62	29.67
Clover	25.22	25.23	22.43	22.33	21.38	21.38	25.25	25.27	27.28	27.29	27.57	27.58
Peas	25.23	25.24	22.67	22.35	21.40	19.41	25.26	25.27	27.30	27.30	27.57	27.58
New L.S.D at 5%	0.02	0.02	0.31	0.02	0.03	2.90	0.02	0.01	0.13	0.02	0.01	0.01

with soil depth. Straw mulching and white clover intercropping adjusted the switching point of the temporal-spatial variation of soil temperature, and evidently decreased the emergence of harmful high temperature. During the period of continual high temperature, these measures markedly lowered soil temperature, and effectively shortened the duration of this period .Woodham and Alexander (1966) observed a direct relationship between root growth and the rise in soil temperature from 15 to 30 °C, and established that the optimal soil temperature for grapevines is close to 30 °C which was corroborated subsequently by Kliewer (1975).

Costs and net profi /feddan

It is clear from the obtained results in Table 12 that intercropping Thompson seedless and Flame seedless grape vines with peas or clover crops increased net profit /feddan as compared with control (Thompson seedless and Flame seedless grapevines alone). Intercropping Thompson seedless and Flame Seedless with peas cover crop gave the highest values of net profit / feddan which recorded 7700 L E and 6000 L E over control as average of two seasons followed by intercropping Thompson seedless and Flame seedless with clover cover crop, respectively.

TABLE 10. Effect of intercropping with clover and peas on relative humidity and light intensity (watt/m²) microclimatic results of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

Relative humidity (%)												
	Thompson seedless						Flame seedless					
Treatments	Upper		Middle		Lower		Upper		Middle		Lower	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	34.18	34.07	35.58	35.60	35.19	35.21	35.26	35.33	35.67	35.71	34.33	34.35
Clover	34.55	34.56	36.12	36.15	36.39	36.42	36.46	36.47	36.13	36.17	36.15	36.16
Peas	34.56	34.57	36.17	36.26	36.45	36.47	36.50	36.51	36.16	36.21	36.17	36.21
New L.S.D at 5%	0.03	0.03	0.01	0.03	0.05	0.04	0.02	0.01	0.02	0.02	0.01	0.01
Light intensity (watt/m²)												
	Thompson seedless						Flame seedless					
Treatments	Upper (watt/m²)		Middle (watt/ m²)		Lower (watt/ m²)		Upper (watt/m²)		Middle (watt/m²)		Lower (watt/ m²)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	73.32	73.33	59.36	59.46	65.36	65.63	61.68	61.77	42.37	42.44	48.27	48.36
Clover	64.82	64.84	51.74	51.76	54.14	54.18	59.37	59.96	41.03	41.10	41.49	41.51
Peas	66.17	64.86	51.76	51.77	54.18	54.23	59.74	60.09	41.08	41.17	41.54	41.58

TABLE 11. Effect of intercropping with clover and peas on soil temperature (soil surface, 5 cm and 20 cm of Thompson seedless and Flame seedless grapevine cultivars during 2014 and 2015 seasons.

	Thompson seedless					
Treatments	soil surface (ºC)		5 cm depth (ºC)		20 cm depth (ºC)	
	2014	2015	2014	2015	2014	2015
Control	28.15	28.18	27.39	27.42	26.14	26.15
Clover	27.53	27.54	25.81	25.82	25.11	25.12
Peas	27.56	27.59	25.83	25.84	25.13	25.15
New L.S.D at 5%	0.05	0.07	0.02	0.03	0.04	0.05
	Flame seedless					
Treatments	soil surface (ºC)		5 cm depth (ºC)		20 cm depth (ºC)	
	2014	2015	2014	2015	2014	2015
Control	30.06	30.11	30.39	30.45	26.75	26.76
Clover	29.31	29.34	28.69	28.71	25.38	25.38
Peas	29.34	29.36	28.70	28.81	25.38	25.40
New L.S.D at 5%	0.04	0.02	0.04	0.02	0.03	0.04

TABLE 12. Costs and net profit /feddan of intercropping of clover and peas cover crop of Thompson seedless and Flame seedless grapevine cultivars as average of 2014 and 2015 seasons.

Treatments	Costs of cultural Practices / fed. (L E)		Total costs / fed. (L E)	Yield/ fed. (Kg) of grape	Total income / fed. (L E) of grape	Seed yield/ fed. (Kg) of intercropping crops	Total income / fed. (L E) intercropping crops	Total income / fed.(L E) grape + intercropping crops	Net profit / fed. (L E)	Net profit /fed. over control (L E)
	grape	Intercropping crops								
Thompson seedless	8000	-------	8000	9700	38800	-------	--------	38800	30800	0
Thompson seedless +clover crop	8000	2000	10000	9650	38600	3 cutting	6000	44600	34600	3800
Thompson seedless +peas crop	8000	4500	12500	10500	42000	3000	9000	51000	38500	7700
Flame seedless	8000	--------	8000	16100	48300	-------	-------	48300	40300	0
Flame seedless +clover crop	8000	2000	10000	15330	45990	3 cutting	6000	51990	41990	1690
Flame seedless +peas crop	8000	4500	12500	16600	49800	3000	9000	58800	46300	6000

Price/1 kgfrom Thompson seedles grapevine fruit (L E) = 4 Price/1 kg from Flame seedless seedless grapevine fruit (L E) = 3
Price/1 kg from peas (L E) = 3 * clover plants were harvested 3 cutting times as leaf yield) (L E) = 6000

Conclusion

From the previous results, it can be recommended that intercropping Thompson seedless and Flame seedless with peas and clover crop gave a number of environmental benefits such as enhancing microbiological activity of the soil, promoting yield and increasing farmer income. Intercropping Thompson seedless and Flame seedless with peas gave the highest yield and net profit /Fadden as compared with other treatments.

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تأثير التحميل بالبسله والبرسيم على النمو والانتاجيه وخصائص التربه للعنب الفليم سيدلس والطومسون سيدلس

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أجريت هذه الدراسة خلال موسمى ٢٠١٤-٢٠١٥ فى مزرعه خاصه فى قريه منشيه عبد النبى- مركز أجا - محافظه الدقهليه على كرمات عنب الفليم سيدلس والطومسون سيدلس منزرعتين فى تربه طينيه وعمرها سبع سنوات وتروى بالغمر وعلى مسافة الزراعه ٢×٢,٥ م .

صنف عنب الفليم سيدلس قلم دابرى بترك ٧ دوابر على كل كردون تحت نظام T المزدوجه بمجموع ٥٦ عين للكرمة بينما صنف الطومسون سيدلس تم تقليمة قصبيا بترك ٦ قصبات كل قصبة تحمل ١٢عين مع ترك ٦ دوابر تجديدية بمجموع ٨٤ عين للكرمة تحت نظام التكاعيب مع اجراء كل العمليات حسب توصيات وزارة الزراعة المصرية.

وقد أظهرت النتائج ان تحميل العنب باالمحاصيل البقوليه (البرسيم والبسله) كان له تأثير فى تحسين النتروجين والفوسفور والبوتاسيوم والمادة العضوية فى التربه وزيادة العدد الكلى للميكروبات الكليه والمحصول وصفات النمو الخضرى وكذا جودة الحبات .

وكانت الكرمات المحملة بمحصول البسلة الافضل لانها زودت طول الفرع والمساحة الورقية ومحتوى النتروجين والبوتاسيوم فى الاوراق ونسبة السكريات الذائبة والمحصول ونشاط الميكروبات فى التربة وانزيمات الدهيدروجينز والفوسفاتيز كما انها قللت الحموضة الكلية .

بالاضافة ان تحميل العنب الفليم والطومسون بالبسلة كان الافضل فى العائد الاقتصادى يلية البرسيم.