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EFFECT OF INTERCROPPING SUPERIOR GRAPEVINES WITH SOME LEGUMES ON NUTRITIONAL STATUS, YIELD AND BUNCH CHARACTERISTICS

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ABSTRACT

The effect of intercropping Superior grapevines with three intercrops namely, clover, fenugreek and bean under different levels of N (40 , 60, 80 and 100 g/ vine) on leaf area, N, P, and K content, yield as well as physical and chemical characters of the berries was investigated during three seasons (2005, 2006 and 2007) in Assiut governorate.

Results showed that intercropping the vines with clover, fenugreek and bean, was favorable in a descending order and enhancing leaf area, percentages of N, P and K, berry set, yield as well as physical and chemical characters of the berries. Intercropping governed effectively the optimum level of N required for obtaining an economical yield.

The best results with regard to yield and quality of Superior grapes were obtained when the vines were intercropped with clover and fertilized annually with N at 60 g/vine

INTRODUCTION

It is well-known that intercropping some field crops with vine trees as a general practice gives additional income, improves soil fertility, reduces soil erosion and is also effective in checking menace of weed infestation. Intercropping or growing two or more crops simultaneously in the same field is a farming practice, which received much attention from agronomists as a means for increasing yield per unit land area. Monoculture of fruit crops is very common.

Research work has also been carried out on intercropping fruit crops with respect to the effect of intercropping on yield and fruit quality. Superior grape cv. is a prime and popular grape successfully grown under Egyptian conditions. It ripens early in the first, week of June and has a great potentiality for export due to its early ripening character

The Egyptian clover, (*Trifolium alexandrinum* L.) is considered the most important green legume forage for animal feeding in Egypt during the winter season, and as a hay during summer season. It is of the most important leguminous crops in N fixation, and plays an important role in improving soil properties and consequently, increases soil fertility. Recently, the government of Egypt is pushing efforts to increase the cultivated area of forage crops especially in the new reclaimed lands to provide forage product for animal feeding. Therefore, the inclusion of Egyptian clover in the crop rotation as a winter crop preceding the summer crops is necessary.

Fenugreek (*Trigonella foenum graecum* L) is an ancient crop and is considered as a source of protein and has some medical uses in eastern countries. It has never been grown on a large scale in Egypt and is always

considered as a secondary crop. The plant is grown mainly for many purposes, the young green leaves are widely used for human consumption. It is processed into hay and silage for animal feeding. It is also used as a green manure and cover crop. It is grown mainly for medicinal purposes and to some extent for the flour mixing with maize and the sorghum flour as a protein extender. It is also used as a hot beverage, while germinated seeds are used as a good source of arginines.

Field bean (*Vicia faba* L.) is one of the most important legumimous crops all over the word. In Egypt, its seed not only provides a cheap source of protein, but also a food of high calorific and nutritive value especially in the diet of low income people.

The application of N as well as the role of legumes as cover crops in fruit orchards was previously mentioned and their profits on fruiting of fruit crops were also emphasized (Shukla *et al* 1976; Nijjar, 1985; Pool, 1990; Gao, 1991; Ashour *et al.*, 1992; El-Hebshi, 1993; Kanwar *et al.*, 1993: Darwish *et al.*,1996; Mohamed, 1996; Singh, 1996, Pinamont, 1998; Abou-El Lail, 2001; El-Sayed, 2001 and Frisullo *et al*, 2003).

Recently, Superior grape cv. was introduced to Minia Governorate and still needs additional studies for the optimum program of N and pattern of intercropping.

The aim of the present study was to throw some light on the effects of intercropping Superior grapevines with some legumes under different N fertilization levels on fruiting of the main crop.

MATERIALS AND METHODS

This study was conducted during 2005, 2006 and 2007 seasons on 108 uniform in vigour 12-year-old Superior grapevines grown in a private vineyard located at Mallawi district, Minia Governorate, where the soil texture is silty clay. Soil analysis was made according to Piper (1950) and the results are summarized in Table 1.

Table 1: Mechanical, physical and chemical analyses of the soil.

particle size distribution , Sand %	14.5
Silt %	42.2
Clay %	43.3
Texture	Silty clay
pH (1:2.5 extract)	7.81
E.C (1: 2.5 extract) (mmhos / cm / 25°C)	0.96
O.M. %	1.02
Total CaCO3 %	1.50
Total N%	0.05
Available P (ppm, Olsen)	12.0
Exch. K(mg/100 g soil)	1.10
Exch. Ca (mg/ l00g soil)	0.66
Exch. Mg (mg/ l00g soil)	0.18

The selected vines were planted at 2x 3 meters apart. Cane pruning under telephone supporting system was followed by leaving six fruiting canes x 10 eyes plus six renewal spurs x two eyes with 72 eyes vine bud load for all the selected vines (108 vines). Superior seedless grapevines as the overstory crop and the three legumes namely El- Khomassy clover, Balady Fenugreek and Giza 452 field bean as the understory crops were included.

The experiment consisted of two factors; the first factor (A) was the three intercrops (clover, Fenugreek and bean), while the second factor (B) was the four levels of N (40, 60, 80 or 100 g/vine). Therefore, the experiment involved twelve treatments; each treatment was replicated three times, three vines per each. The three intercrop seeds were sown at the last week of October in the three seasons of the study

Nitrogen was added in the form of ammonium sulphate (20.6% N). It was spitted into three batches added as 50% in the first week of Feb., 25% just after berry set (last week of Mar.) and 25% at one month later (last week of Apr.). The selected vines (108 vines) received all horticultural practices already given to the vineyard.

The following parameters were determined during the three seasons.

1. Leaf area (cm^2) according to Ahmed and Morsy (1999).
2. Percentages of N, P and K in the same leaves taken for measuring leaf area according to the procedures outlined by Piper (1950).
3. Berry set % by dividing the number of fruitletes by total number of flowers per cluster and multiplying the product by 100.
4. Yield per vine was expressed in weight (kg) and the number of cluster per vine was recorded at harvesting date (first week of July).
5. Average cluster weight (g).
6. Five clusters were taken at random from the yield of each vine for the determination of berry weight (g), percentages of total soluble solids and total sugars (AOAC, 1985). Total acidity (as g tartaric acid/100 ml juice) was determined according to AOAC. (1985).

Statistical Analysis :

The obtained results of every growin season wer statistical analyzed by the analysis of vartang using a completely randomized block desing in split-plot arrangement was followed . the three intercrops and the four levels of N ranked the main and subplots , respectively .

The least significant difference test (New L.s.d) at 5% level) of probability was calculated according to the procedure described by snedecor and Cochran (1967)

RESULTS AND DISCUSSION

Leaf area and N, P and K content of leaves:

Data in Tables 2 and 3 clearly show that intercropping Superior grapevines with the three intercrops, (clover, fenugreek and bean) was significantly accompanied with increase in the leaf area and N, P and K content of leaves. The maximum values were recorded on vines with clover intercrop.

Table 2: Effect of intercropping some legumes with vines under different levels of N on the leaf area and percentages of N and P in the leaves of Superior grapevines during 2005, 2006 and 2007 seasons.

Intercrops (A)	Leaf area (cm^2)														
	2005					2006					2007				
	N/levels (g/vine) (B)														
	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)
a_1 Clover	136.0	140.0	141.0	141.9	139.7	141.0	146.1	147.0	147.1	145.3	150.1	155.1	156.1	156.7	154.5
a_2 Fenugreek	119.0	122.1	123.2	124.2	123.1	119.2	124.2	125.0	125.5	123.5	127.1	132.0	133.1	134.1	131.6
a_3 Bean	111.1	115.0	116.0	117.1	114.8	114.0	121.0	122.1	123.0	120.0	121.1	126.0	127.0	127.2	125.3
Mean (B)	122.0	125.7	126.7	127.7		124.7	130.4	131.4	131.9		132.8	137.7	138.7	139.3	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	2.9		3.1		5.4	3.1		3.2		5.5	2.6		3.0		5.3
	Leaf N %														
a_1 Clover	2.32	2.52	2.63	2.65	2.53	2.40	2.61	2.82	2.88	2.68	2.55	2.80	2.91	2.94	2.80
a_2 Fenugreek	2.05	2.22	2.33	2.34	2.24	2.20	2.31	2.41	2.44	2.27	2.25	2.41	2.52	2.55	2.43
a_3 Bean	1.92	2.02	2.13	2.14	2.05	2.01	2.11	2.25	2.25	2.11	2.09	2.51	2.41	2.43	2.34
Mean (B)	2.10	2.25	2.36	2.38		2.20	2.34	2.48	2.52		2.30	2.30	2.61	2.64	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.07		0.10		0.17	0.06		0.09		0.16	0.07		0.10		0.17
	Leaf P %														
a_1 Clover	0.37	0.32	0.27	0.26	0.31	0.41	0.36	0.30	0.28	0.34	0.43	0.39	0.34	0.32	0.37
a_2 Fenugreek	0.25	0.21	0.17	0.15	0.20	0.28	0.24	0.20	0.18	0.23	0.30	0.26	0.22	0.21	0.25
a_3 Bean	0.18	0.11	0.07	0.06	0.11	0.19	0.14	0.10	0.09	0.13	0.20	0.16	0.12	0.11	0.15
Mean (B)	0.27	0.21	0.17	0.16		0.29	0.25	0.20	0.18		0.31	0.30	0.21		
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.03		0.04		0.07	0.02		0.03		0.05	0.03		0.04		0.07

Table 3: Effect of intercropping some legumes with vines under different levels of N on the percentage of K in the leaves, berry set % and yield per vine (kg.) of Superior grapevines during 2005, 2006 and 2007 seasons.

Intercrops (A)	Leaf K %														
	2005					2006					2007				
	N/levels (g/vine) (B)														
	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)
a_1 Clover	1.34	1.27	1.02	1.19	1.25	1.42	1.35	1.28	1.27	1.33	1.45	1.37	1.30	1.29	1.35
a_2 Fenugreek	1.15	1.07	1.00	1.00	1.06	1.24	1.27	1.10	1.09	1.15	1.31	1.24	1.16	1.15	1.22
a_3 Bean	1.05	0.97	0.90	0.89	0.95	1.14	1.07	1.00	0.99	1.05	1.15	1.06	0.98	0.97	1.04
Mean (B)	1.20	1.10	1.03	1.03		1.27	1.20	1.13	1.12		1.30	1.22	1.15	1.19	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.06		0.07		0.12	0.06		0.06		0.10	0.06		0.06		0.10
	Berry set %														
a_1 Clover	15.9	19.5	19.6	19.7	18.7	17.0	22.0	22.5	23.0	21.1	18.2	25.0	25.2	25.5	23.5
a_2 Fenugreek	13.4	16.0	16.1	16.2	15.4	14.5	16.5	16.9	17.0	16.2	16.0	18.0	18.5	19.0	17.9
a_3 Bean	11.5	13.3	13.5	13.6	13.0	12.0	14.0	14.7	15.0	13.9	13.1	15.0	15.5	16.0	14.9
Mean (B)	13.6	16.3	16.4	16.5		14.5	17.5	17.8	18.3		15.8	19.3	19.7	20.2	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	1.0		1.4		2.4	1.4		1.5		2.6	1.4		1.5		2.6
	Yield/vine (kg)														
a_1 Clover	8.6	9.0	8.9	8.9	8.9	10.7	12.2	11.8	11.8	11.6	10.6	12.5	12.2	12.2	11.9
a_2 Fenugreek	8.1	8.5	8.3	8.3	8.3	9.0	10.5	10.2	10.2	10.0	9.5	10.7	10.6	10.3	10.3
a_3 Bean	7.5	7.8	7.8	7.8	7.7	7.6	8.9	8.7	8.5	8.4	8.2	9.3	9.0	8.9	8.9
Mean (B)	8.1	8.4	8.3	8.3		9.1	10.5	10.2	10.2		9.4	10.8	10.6	10.5	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.5		0.3		0.5	0.4		0.4		0.7	0.6		0.5		0.9

A gradual promotion in leaf area and N content was observed with increasing N levels. Increasing N levels from 40 to 60 g/vine had significant promotion on leaf area and N content. However, increasing N levels from 60 to 100 g/vine had meaningless increase. The vice versa was recorded with regard to the effect of N levels on the percentages of P and K in the leaves.

The best level of N under intercropping system responsible for enhancing the leaf area and its content of N was 60 g/vine. According to the obtained statistical analysis, fertilizing Superior grapevines grown under clover intercrop with N at 60 g/vine was enough for enhancing growth and improving nutritional status of the vines.

The positive effects of the three legumes on fixation of N and enhancing soil fertility could explain the present results.

These results are in agreement with those obtained by Pinamonti (1998) and Abou- El- Lail (2001), who worked on different grapevine cvs.

Percentage of berry set, yield and cluster weight:

It is clear from the obtained data that varying intercrops planted with the main crop (Superior grapevines) significantly varied berry set, yield expressed in weight and number of clusters per vine and cluster weight. Intercropping Superior grapevines with bean gave the minimum values, while the maximum values were recorded on vines planted with clover.

Application of N at 60 to 80 g / vine significantly increased berry set, yield and cluster weight compared to 40 g / vine N. A slight and insignificant promotion of these parameters was observed by using N at levels higher than 60 g / vine/. The best level from the economical point of view was 60 g/ vines.

Intercropping the vines with clover and fertilizing with 60 g N/vine was suggested to obtain an economical yield. Under such promising treatment, yield per vine reached 9.0, 12.2, 12.5 kg in the three seasons, respectively. Number of clusters per vine in the first season did not alter with the present treatments. These results were true in the three seasons (except for number of clusters/ vine). The results are in line with those of Abou El-Lail (2001).

Physical and chemical characters of the berries:

It is evident from the data in Tables 4 and 5 that berry quality of Superior grapevines was improved significantly i.e increasing of berry weight, total soluble solids and total sugars and reducing total acidity of berry juice with intercropping the vines with bean, Fenugreek and clover in an ascending order in the three seasons. Also, a significant promotion on quality of the berries was observed with increasing N levels from 40 to 60 g/vine under the intercropping system. Negligable effect was detected on berry quality by using N levels above 60 g/vine.

Intercropping significantly governed the optimum level of N required for enhancing physical and chemical characteristics of the berries. Fertilizing the vines with N at 60 g/vine under intercropping with clover gave the best results with regard to fruit quality in the three seasons of the study

The effect of legumes on enhancing soil fertility and the uptake of N and Mg may result in stimulating the biosynthesis of plant pigments and advancing the biosynthesis of carbohydrates as well as maturity .

Table 4: Effect of intercropping some legumes with vines under different levels of N on the number of clusters per vine as well as weight of cluster (g) and berry (g) of Superior grapevines during 2005, 2006 and 2007 seasons.

Intercrops (A)	No. of clusters/vine														
	2005					2006					2007				
	N/levels (g/vine) (B)														
	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)
a_1 Clover	27.0	27.0	27.0	27.0	27.0	33.0	36.0	35.0	35.0	34.8	32.0	36.5	36.0	36.0	35.1
a_2 Fenugreek	27.0	27.0	27.0	27.0	27.0	29.0	31.5	31.0	31.0	30.6	30.0	32.0	31.5	31.0	31.1
a_3 Bean	26.0	26.0	26.0	26.0	26.0	26.0	29.0	28.5	28.0	27.9	28.0	30.0	29.0	29.0	29.0
Mean (B)	26.7	26.7	26.7	26.7		29.3	32.2	31.5	31.3		30.0	32.8	32.2	32.0	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	NS		NS		NS	2.0		2.0		3.5	1.0		2.0		3.5
	Cluster weight (g)														
a_1 Clover	320.2	335.0	330.0	328.0	328.3	334.8	325.0	340.0	338.0	336.0	330.0	342.0	340.0	340.0	338.0
a_2 Fenugreek	301.0	315.0	308.0	306.0	307.5	325.8	310.0	333.0	330.0	330.0	315.0	335.0	335.0	333.0	329.5
a_3 Bean	288.1	301.0	299.0	296.0	296.0	302.5	292.0	307.0	306.0	305.0	292.0	310.0	309.0	308.0	304.8
Mean (B)	303.1	317.0	312.3	310.0							312.3	329.0	328.1	327.0	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	11.0		12.2		21.1	11.9		12.2		21.1	10.9		11.2		19.4
	Berry weight (g)														
a_1 Clover	3.41	3.62	3.60	3.60	3.56	3.46	3.70	3.68	3.67	3.63	3.55	3.82	3.80	3.79	3.74
a_2 Fenugreek	3.25	3.36	3.33	3.30	3.31	3.30	3.41	3.40	3.38	3.37	3.33	3.50	3.47	3.46	3.44
a_3 Bean	3.11	3.25	3.22	3.20	3.20	3.16	3.30	3.27	3.26	3.25	3.20	3.33	3.31	3.30	3.29
Mean (B)	3.26	3.41	3.38	33.7		3.31	3.47	3.45	3.44		3.36	3.55	3.33	3.52	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.10		0.12		0.21	0.11		0.11		0.19	0.09		0.11		0.19

Table 5: Effect of intercropping some legumes with vines under different levels of N on some chemical quality parameters of Superior grapes during 2005, 2006 and 2007 seasons.

Intercrops (A)	T.S.S. %														
	2005					2006					2007				
	N/levels (g/vine) (B)														
	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)	b_1 40	b_2 60	b_3 80	b_4 100	Mean (A)
a_1 Clover	18.4	18.9	18.8	18.6	18.7	18.5	19.1	19.0	19.0	18.9	18.6	19.2	19.1	19.1	19.0
a_2 Fenugreek	18.0	18.4	18.3	18.3	18.3	18.1	18.5	18.4	18.3	18.3	18.1	18.6	18.5	18.4	18.4
a_3 Bean	17.5	17.8	17.6	17.5	17.6	17.6	18.0	17.9	17.8	17.8	17.7	18.1	18.0	18.0	17.9
Mean (B)	18.0	18.4	18.2	18.1		18.1	18.5	18.4	18.4		18.1	18.6	18.5	18.5	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.2		0.3		0.5	0.3		0.3			0.2		0.3		0.5
	Total sugars %														
a_1 Clover	16.4	16.9	16.8	16.7	16.7	16.8	17.5	17.4	17.3	17.3	17.1	17.8	17.7	17.6	17.6
a_2 Fenugreek	15.7	16.2	16.1	16.0	16.0	16.0	16.4	16.3	16.2	16.2	16.5	17.0	16.9	16.6	16.8
a_3 Bean	15.3	15.7	15.6	15.6	15.6	15.5	15.9	15.8	15.7	15.7	16.0	16.5	16.4	16.3	16.3
Mean (B)	15.8	16.3	16.2	16.1		16.1	16.6	16.5	16.4		16.5	17.1	17.0	16.8	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.3		0.3		0.5	0.2		0.3		0.5	0.2		0.3		0.5
	Total acidity %														
a_1 Clover	0.640	0.600	0.600	0.600	0.610	0.627	0.595	0.596	0.597	0.604	0.621	0.580	0.581	0.582	0.591
a_2 Fenugreek	0.671	0.630	0.631	0.631	0.644	0.666	0.621	0.622	0.623	0.633	0.663	0.618	0.620	0.621	0.631
a_3 Bean	0.720	0.691	0.692	0.692	0.699	0.710	0.690	0.691	0.691	0.696	0.707	0.682	0.684	0.685	0.690
Mean (B)	0.677	0.640	0.641	0.621		0.668	0.636	0.636	0.637		0.664	0.627	0.627	0.629	
New L.S.D. at 5%	A		B		AB	A		B		AB	A		B		AB
	0.022		0.025		0.043	0.020		0.025		0.043	0.019		0.027		0.047

These results are in agreement with those obtained by Abou-El-Lail (2001) on Flame seedless grapevines interplanted with legumes.

As a conclusion, intercropping Superior grapevines with clover or fenugreek and fertilizing with N at 60 g/ vine is beneficial for obtaining an economical yield and improving quality of the berries.

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دراسات فسيولوجية على تحميل كرمات العنب السوبيريور ببعض البقوليات

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تم دراسة تأثير تحميل كرمات العنب السوبيريور بثلاثة محاصيل بقولية هي البرسيم والحلبة والفول تحت جرعات مختلفة من النيتروجين هي ٤٠ ، ٦٠ ، ٨٠ ، ١٠٠ جرام نيتروجين لكل كرمة على مساحة الورقة ومحتواها من النيتروجين والفوسفور والبوتاسيوم ، كمية المحصول وكذلك الخصائص الطبيعية والكيميائية للحبات للمحصول الرئيسي وذلك خلال ثلاثة مواسم هي ٢٠٠٥ ، ٢٠٠٦ ، ٢٠٠٧ .

أشارت نتائج الدراسة إلى أن تحميل الكرمات بالبرسيم والحلبة والفول مرتبة ترتيبا تنازليا كان فعالا في زيادة مساحة الورقة ومحتواها من النيتروجين والفوسفور والبوتاسيوم وزيادة نسبة عقد الحبات وكمية المحصول وخصائص الجودة للحبات وكان التحميل عاملاً محدداً هاماً لكمية النيتروجين التى تحتاجها الكرمة للحصول على محصول اقتصادي.

أمكن تحقيق أفضل النتائج بخصوص كمية المحصول وجودة الحبات في العنب السوبيريور عند تحميل الكرمات بالبرسيم وتسميدها بالنيتروجين بمعدل ٦٠ جرام للكرمة سنويا.