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PRODUCTIVITY OF HUSK TOMATO PLANT (*Physalis longifolia* L.) AS AFFECTED BY INTRA-ROW SPACING AND NITROGEN FERTILIZATION UNDER THE CONDITION OF UPPER EGYPT.

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ABSTRACT

Tow field experiments were carried out at Upper Egypt region during the two successive seasons of 2001/2002 and 2002/2003 on the *Pysalis longfolia* L. (Harunkush) as a new vegetable crop in this regeon to determine the optimum plant population density and to study the effect of nitrogen levels on quantity and quality of fruits and seeds yield.

Results showed that maximum values of plant height, number of branches/plant, number of fruits/ plant, seed index, both total and netting fruit yield/ fed. as well as seed yield/ fed. were found with 75 cm.spacing between hills. On the other hand, plants sown on the same previously hill spacing (thin stands) were significantly more susceptible to delay in maturation and decreased T.S.S. percentage.

Application of nitrogen fertilizer to harunkush plants up to 150 Kg N/fed. increased significantly plant height, number of branches/ plantand all the studied fruit and seed characteristics except T.S.S.percentage which was not significantly affected. Moreover, the two high levels of nitrogen,i.e.100 and 150 Kg N/ fed. produced significantly early flowers and fruit setting than the low level (50 Kg N/ fed.) with no significant differences were observed between both high levels.

The highest values of the most studied traits were obtained from the combination of widest spacing (75 cm.) with the highest nitrogen application (150 Kg N/ fed.).

INTRODUCTION

Probably 100 species belonging to the genus *Physalis*, of them 3 common species are grown for their edible fruits; *Peruviana*, *Ixocarpa* and *Longfolia* which was previously known under the name of pubescens *(Zayed et al, 2003)*. They belong to the*Solanaceae* family and are called ground cherry, tomatillo or husk tomato N. F. S. D. (1999).

In Egypt, *Physalis Longfolia* is grown like tomatoes and populary known as"Harunkush". It has mall, sticky, tomato-like fruits and can be prepared like vegetables or eaten as a fruit. Generally, it is considerably used for preserves and sometimes for sauce *S. F. C.(1998)*. This crop is grown in very limited scattered places near the large cities. Information about the suitable agricultural practices for the production of this crop, especially, under Upper Egypt conditions is limited. Harunkush could be considered as a potential alternative crop for exportation in Egypt. On the other hand, there has been an increasing demand observed on the harunkush by the consumer and tourist marketing in UpperEgypt. Therefore, it is natural for the growers in this area to be mindful of the factors which may influence the productivity of this crop.It is well known that plant spacing and/or nitrogen application are one of the most important factors which play an important role in improving the quantity and quality of fruits and in the life cycle of the plants . However, although the literature on harunkush is scanty it is a matter of interest to follow the effect of both important factors on tomato. Ferri and Janick (1970) reported that low population density in tomato fell that number of fruit plant.

However, Mohamed; (1989) found that widening the distances between husktomato plants from 40 to 80 cm.resulted in increasing the number of fruits per plant, total yield per both plant and plot and fruit weight, whereas, no response was noticed in T.S.S. percentage. Moreover, much croweded plants might adversly reflect on yield or at least attenuate plant growth and fruit size (Metwally *et al,*1985).

The relationship between plant density and nitrogen application, and their effect on yield and quality of harunkush and/or tomato grown in Upper Egypt have not yet been fully investigated. N-fertilizer at a rate of 120 Kg/fed. significantly increased the yield and was continuously superior in all investigated topics (Metwally *et al,*1985). Considerable data have been collected on the effects of the N-fertilization on growth and yield of tomato and, consequently on husk-tomato (harunkush) performance. Yield parameters, including number of fruits per plant was highest at 150 Kg N/fed., while average fruit weight slightly increased with increasing of nitrogen levels (Hewedy *et al.*,1994).

Therefore, this study herein was an attempt to determine the optimum plant spacing and nitrogen level for maximum yield and good fruit and seed qualities of *Physalis longfolia* L., local cv. (Harunkush) grown in Upper Egypt.

MATERIALS AND METHODS

This study comprises a field experiment that was conducted in a private farm, Quift, Kenna Governorate, Upper Egypt region (25 Km south of Kenna city) during the growing seasons of 2001/2002 and 2002/2003.Seeds of Physalis longfolia L. local cv. (Harunkush) were sown on 18th and 11th of September and transplanting took place on 5th and 1st of December in both years of 2001 and 2002, respectively. Two intra-row planting spaces,i.e.50 and 75 cm. in combination with four nitrogen levels being 0,50,100 and 150 Kg N/fed..in the different forms of were used in a clay loam soil. The experimental design was a split plot with 6 replications. Row-spacing treatments occupied the main plots and those of nitrogen levels were distributed randomly in the sub-plots.

Each sub-plot ($20m^2$) consisted of five ridges each of 4 meters length and one meter width. Nitrogen fertilizers was applied in four portions, both the first and second applications (20 and 50 days from the transplanting) were in the form of ammonium sulphate (20.5% N), while the two rest doses(about 75 and 90 days from the transplanting) were supplied in the two forms of the ammonium nitrate (33.5% N) and calcium nitrate(15% N),respectively to meet the plant requirements during the last stages of fruits development.

Each treatments received P fertilizer in the form of calcium super-phosphate (15.5% P_2O_5) at the rate of 300 Kg/ fed..as well as 200 Kg/ fed. Potassium sulphate(48% K_2O), half of phosphatic fertilizer was added at soil preparation.The rest of phosphatic and half of potassic fertilizers were applied at the first irrigation (21days from transplanting), whereas, the rest of potassic fertilizer was applied at flowering and beginning of fruiting stage. Rate, amount, time and source of fertilizers applied in this experements are shown in Table1.

Table (1): Rate, amount, source and time of fertilizers applied in the study.

Treatments	Rat of fertilizers (Kg/fed.)			Amount of fertilizers (Kg/fed.)					Portions of nitrogen amount after transplanting with			
	N	P	K	N AS	N AN	N CaN	P	K	20 days	50 days	75 days	90 days
N_1 + PK	0	46.5	96	-	-	-	300	200	-	-	-	-
N_2 + PK	50	46.5	96	116.7	47.4	67.9	300	200	50 AS	66.7 AS	47.7 AN	67.9 CaN
N_3 + PK	100	46.5	96	233.3	94.8	136.1	300	200	100 AS	133.3 AS	94.8 AN	136.1 CaN
N_4 + PK	150	46.5	96	350.0	142.2	200.4	300	200	150 AS	200 AS	142.2 AN	204 CaN
During soils preparation							150 S. Ph.	-				
At 20 days after transpl.							150 S. Ph.	100 K.Sulph.				
At flower. & fruit . stages							-	100 K.Sulph.				

AS: N-fertilizers in the form of Ammonium sulphate(20.5%).
AN: N-fertilizers in the form of Ammonium nitrate(33.5%).
CaN:N-fertilizers in the form of Calcium nitrate(15%).
S.Ph: P-fertilizers in the form of Calcium supper phosphate(15.5%).
K- Sulphate: K-fertilizers in the form of Potassium sulphate(48%).

Recorded data:

1- Growth traits, i.e. plant hight and number of branches/plant .
2- Flowring traits, i.e.earlines in days from transplantins till both flowring and fruit setting times of 25% plants.
3- Fruit yield and its components, i.e.number of fruits/plant, total fruit yield/ fed. and total netting fruit yield/fed. (without husks) .
4- Seed traits, i.e. total seed yield/fed. and seed index as 100-seed weight.
5- Total soluble solids percentage (T.S.S).

Obtained data were statistically analysed according to Snedecor and Cochran,1980.

The physical and chemical properties of the soil at the depth of 0-30 cm. are shown in Table 2.

Table (2): The physical and chemical properties for the soil till 30cm depth.

Physical analysis	Chemical analysis
Sand 15.36	Organic matter 1.5%
Silt 38.98	Total soluble salts 0.14%
Clay 45.66	Total nitrogen 2 p.p.m
	Available phosphorus 5 p.p.m
	Available potassium 200 p.p.m
	pH 7.8

RESULTS AND DISCUSSION

Growth traits:

Data presented in Table 2 , clearly showed that the growth traits of harunkush plants, i.e.plant height and number of branches/plant were influenced significantly by treatments of plant density. However, plant height significantly increased and the highest values 96.1 and 106.7 cm.were obtaind from the wide planting (75 cm.) compared with the lowest value resulted from the other treatment, these results held good in the two experimental seasons. On the other hand, number of branches/plant gradually increased with increasing plant spacing up to the widest plant spacing (75cm.) in both seasons. It could be concluded that the plants in dense plant spacing (50cm.) caused a depresion in plant growth traits.This might be attributed to the above and below competition between harunkush plants for light, minerals and water. Many other investigators had similar conclusions such as *Kalyal (1977); Metwally et al (1985) and Mohamed (1989).*

Nitrogen fertilization rates (Table2) gradually increased plant height in both seasons but the differences failed to show any significant effect in the second season. Whereas, the highest values (99.8 and108.9cm.) were resulted from the highest nitrogen rate (150 Kg N/ fed.) compared with the lowest values resulted from the control. The favourable effect of nitrogen fertilization on plant height might be attributed to the stimulating effect of nitrogen on meristematic activity of the plant. Also, number of branches significantly increased with increasing nitrogen fertilization rates compared

with the control. These results are true in both experimental seasons. These findings are in harmony with those found by Pandita and Bhatnagar (1981)

Insignificant effects were detected owing to the studied combination between the two studied factors on growth traits in the two experimental seasons except plant height in the second year which was significant.The highest values for both plant height and number of branches per plant were produced from the widest plant spacing (75 cm.) combined with the highest nitrogen level (150 Kg N/fed..). These results held true in both seasons.

Flowering traits:

Data presented in Table2, illustrated the effect of plant densities on earliness and fruit setting. The obtained results obviously revealed that the plant density significantly influenced the abovementioned traits in the two studied seasons. The general trend of results reveals that harunkush plants sown on 75cm.hill spacing (thin stands) were significantly more susceptible to delay in maturation based on lower earliness and much days to fruit setting comparing with 50cm.hill spacing (dense stands). These results are in agreement with those obtained by Hewedy *et al*, (1994).

Data in the same previous mentioned Table indicated that the nitrogen fertilization rates failed to give any significant effect on earliness in the first season. However, the differences were more pronounced and statistically appeared in the second season. The lowest number of days from transplanting to 25% opening flowers achieved with unfertilized treatment followed by the level of 100 Kg N/ fed. application in the second season. On the other hand, nitrogen fertilization significantly influenced fruit setting in both seasons, whereas the lowest number of days from transplanting to the 25% fruit setting plants achieved by 100 Kg N/ fed. in both seasons. Generally, the two high levels of nitrogen, i.e.100 and 150 Kg/ fed. produced significantly early flowers and fruit setting than the low level (50 Kg N/ fed.), while there were no significant differences between 100 and 150 Kg N/fed..on both traits. Results are confirmed with those reported by *Hewedy et al, (1994) and Abdel-Naem et al (2000).*

Data dealing with the effect of the interaction between the two studied factors are presented in (Table3). It is clear from the obtaind data that the interaction did not show any significant effect on the earliness. The same general trend was detected with fruit setting but the differences were more pronounced and statistically approved in the second season

Fruit yield and its components:

Plant density significantly affected number of fruits per plant, total fruit yield (ton/ fed.) and total netting fruit yield(ton/ fed.) in both seasons as shown in (Table4). The heighest number of fruits per plant resulted from the widest distance (75cm.). Also, the heaviest fruit yield (ton/ fed.) and sequently the netting fruit yield, were obtained from the widest plant spacing. These results held good in both experimental seasons. The same conclusion on husk tomato were obtaind by Mohamed, (1989) who found that there were a continuous significant increases in yield with every increase in the distance between plants.

Table (3): Effect of transplanting spaces and N-level on some growth flowering and fruit setting traits of local harunkush cultivar, plants.

Character	Year	In-row spaces			Nitrogen level Kg. N/ fedd.				
		50 cm	75 cm	LSD.05%	Control	50	100	150	LSD.05%
Plant height (cm.)	2001/2002	81.7	96.1	8.7	82.2	88.3	90.5	99.8	9.11
	2002/2003	90	106.7	13.01	85.7	94.5	104.5	108.9	NS
Number of branches	2001/2002	13	13.7	1.11	12.2	12.7	13.3	15.3	1.5
	2002/2003	12.6	13.7	2.5	10.1	10.4	14.1	18.1	1.8
Flowering time	2001/2002	54.2	56.2	1.85	55.4	55.7	54.4	55.5	NS
	2002/2003	55.1	56.5	1.12	54.8	57.3	55.4	55.8	0.54
Fruit setting	2001/2002	62	65.1	2.4	65.1	64.4	62.3	62.5	1.7
	2002/2003	63.3	66.8	3.1	65.5	67.3	62.8	64.7	2.6

Table (4): Interaction effect between transplanting spaces and nitrogen levels on some growth flowering and fruit setting traits of harunkush, plants.

Character	Year	S_1				S_2				LSD at 5%
		N_0	N_1	N_2	N_3	N_0	N_1	N_2	N_3	
Plant Height	2001	76.6	82.7	84.9	92.6	87.7	93.8	96.0	106.9	NS
	2002	77.3	86.1	96.1	100.5	94.0	102.8	112.8	117.2	19.0
No. branches / Plant	2001	11.8	12.3	12.9	15.0	12.6	13.1	13.6	15.5	NS
	2002	9.2	9.1	13.6	17.5	11.0	11.6	14.6	17.6	NS
Flowering time	2001	54.2	54.7	53.8	54.2	56.6	56.6	55.0	56.7	NS
	2002	54.0	57.0	54.5	54.9	55.6	57.6	56.2	56.6	NS
Fruit setting	2001	62.7	62.0	61.0	62.3	67.4	66.9	63.5	62.6	NS
	2002	62.7	65.6	62.3	62.7	68.3	69.0	63.3	66.7	4.3

$S_{1,2}$: in-row spacing, i.e. 50 and 75cm, respectively.

$N_{0,1,2}$ and $_3$: nitrogen level, i.e.0,50,100 and 150 Kg. N/ fed., respectively.

Data presented in (Table 4) obviously clear that a progressive and significant increments were detected in fruit yield and all its components studied herein, due to highly nutritional status resulted from using different nitrogen rates compared with the control. In this connection, harunkush plants received the highest N rate (150 Kg/ fed.) produced higher fruit yield and its components followed by those fertilized with 100 Kg N/ fed. These results are true in the two experimental seasons. As a general trend, the positive and progressive increments induced in growth traits previously discussed due to nitrogen fertilization surly reflected on the fruits yield and its components.

These results are in harmony with those found by *Dimri and Lal, (1988)* and *Trpevski et al, (1993)*.The effect of interaction between the two studied factors on fruits yield and its components (Table 5) was significant on number of fruits per plant in both seasons and total fruit yield per feddan in the first season. Respecting the effect of interaction on netting fruits weight (ton/ fed.), it is obvious that no significant differences may be detected in this respect at both seasons of study. On the other hand, the numerous fruits/plant and heaviest both total and netting fruit yields per feddan were obtained from plants grown at 75cm.apart and fertilized with the highest nitrogen level (150 Kg N/ fed.) whereas, the lowest values for yield and its components were obtained from unfertilized plants grown at 50cm. apart.

Seed traits and T.S.S.%:

The obtained data in (Table 4), clearly showed the effect of plant density on total seed yield per feddan, seed index and T.S.S. It is obvious that the seed yield and seed index significantly increased as spacing between plants increased. Therefore, the maximum values for both traits were obtained when plants were grown at 75cm.apart. however, there is no significant differences between both dense (50cm.) and widest (75cm.) plant spacing for seed index in the second season. Cocerning to the effect of plant density on T.S.S., plant density gradually decreased this character from the dense (50cm.) to the widest plant spacing (75cm.). However, the differences were more pronounced and statistically approved in the studied season. These results are in line with those found by *Nassar (1986) and Dimri and Lal (1988).*

The results (Table 4) indicated that applying nitrogen fertilizer caused a significant increase in seed yield per feddan as well as seed index. The maximum values for both traits were obtained from the level of 150 Kg N/ fed. followed by the level of 100 Kg N/ fed. On the other hand, no significant differences were detected in T.S.S. percentage. These results held good in both seasons of study with respect to seed yield and seed index. *Hewedy et al,(1994)* reported that the effect of nitrogen fertilization on tomato fruit quality was not significant.

Data presented in (Table 5) showed that total seed yield (Kg/ fed.), seed index and T.S.S. percentage significantly affected by the interaction between the two studied factors in both experimental seasons, except seed index in the second season. The highest values of both seed yield and seed index as well as the lowest value of T.S.S. percentage were obtained from

Table (5): Effect of transplanting spaces and nitrogen levels on total fruit yeild and its components of harunkush

Character	Year	In-row spaces			Nitrogen level Kg. N/ fedd.				
		50 cm (S_1)	75 cm (S_2)	LSD. 5%	Control (N_2)	50 (N_3)	100 (N_0)	150 (N_1)	LSD. 5%
No. of Fruits/plant	2001	208.3	337.4	11.5	231.5	237.3	298.7	317.7	26.9
	2002	248.2	262.0	12.9	217.3	218.2	285.8	299.2	36.1
Total fruit (ton/ fed.)	2001	3.96	4.24	NS	2.68	3.48	4.97	5.29	0.92
	2002	4.68	5.13	0.42	3.69	3.89	5.08	6.98	1.4
Netting fruit (ton/ fed.)	2001	3.65	4.13	0.2	2.65	3.36	4.65	4.91	0.65
	2002	4.31	4.9	0.5	3.36	3.46	4.76	6.86	1.32
Seed yield (k.g/ fed.)	2001	51.5	64.8	12.8	44.0	45.0	59.6	84.1	7.5
	2002	80	88	7.4	64.6	76.0	87.4	108.0	11.2
Seed index	2001	0.87	1.0	0.07	0.85	0.90	0.95	1.06	0.05
	2002	0.87	0.97	NS	0.86	0.88	0.95	1.0	0.05
T. S. S	2002	13.3	12.4	0.6	12.7	13.1	13.3	12.5	NS

Table (6): Interaction effect between transplanting spaces and nitrogen levels on fruit and seed yield as well as their components, and T.SS.

Character	Year	S_1				S_2				LSD at 5%
		N_0	N_1	N_2	N_3	N_0	N_1	N_2	N_3	
Fruit number/ plant	2001	169.1	176.7	234.1	253.1	293.9	298.3	363.3	382.3	40.2
	2002	210.4	211.3	278.7	292.4	224.1	225.0	292.8	306.0	38.
Total fruit yield (ton/ fed.)	2001	2.53	3.33	4.82	5.16	3.00	3.71	5.11	5.41	2.42
	2002	3.46	3.66	4.85	6.75	3.91	4.11	5.30	7.20	NS
Netting fruit (ton/ fed)	2001	2.30	3.00	4.50	4.8	2.82	3.62	4.80	5.01	NS
	2002	3.00	3.21	4.41	6.61	3.70	3.70	5.10	7.10	NS
Seed yield (kg./ fed.)	2001	37.0	38.7	50.2	80.2	51.0	51.3	69.0	88.0	14.1
	2002	59.2	71.9	83.8	105.0	70.0	80.0	91.0	111.0	23.3
Seed index	2001	0.78	0.83	0.89	0.99	0.92	0.96	1.0	1.12	N.S.
	2002	0.81	0.82	0.90	0.95	0.90	0.94	1.0	1.05	N.S.
T. S. S.	2002	13.10	13.6	13.70	12.9	12.2	12.6	12.8	12.0	0.70

$S_{1,2}$: in-row spacing, i.e. 50 and 75 cm, respectively.
$N_{0,1,2}$ and $_3$: nitrogen levels, i.e. 0.50,100 and 150 Kg N/ fed., respectively.

the combination of widest spacing with the highest nitrogen application (150 Kg.N/ fed.).

REFERENCES

Abd el-Naem, G. F., E.M.M. Abd Allah and I.M.Darwish (2000). Growth, yield and chemical constituents of tomato as affected by some fertilizer treatments. In proceeding of 8th Conf. Agric. Dev. Res., Fac., Agric., Ain Shams Univ., Cairo, November 20-22,2000. Annals Agric. Sci., Sp Issue 3, 1087-1109.

Bailey, L.H.(1961). The standard cyclopedia of horticulture. The Macmillan company, New york V.III-P-Z:2423-3639.Dimri,

Dimiri,D.C. and G. Lal (1988). Effect of nitrogen fertilization, spacin and method of planting on yield parameters and quality of tomato cultivar Pant Bahar. Vegetable Sci. 15:105 – 112, India.

Ferry, R.D. and J. Janick (1970). Response of the tomato to population pressure. J. Amer. Soc. Hort. Sci., 95: 616 – 624.

Hewedy, A.R.M., A.El-Bagdady and M.A. Morsy (1994). Influence of nitrogene fertilization on yield and fruit constituents of some new tomato cultivars. Menofiya J. Agric. Res. 19 : 1552 – 1564.

Kalyal, S.L. (1977). Vegetable growing in India. Mohan Primlani, Oxford & IBHG (70 – 72).

Metwally, A.M., A.A.El-Mansi and Wedad, S.M. (1985). Interrelationship between the population density and nitrogen supply on the behaviour of tomato plant J. Agric. Sci. Mansoura Univ. 10 :987 – 993.

Mohamed, A.A. (1989). Studies on growth and yield of husk-tomato. Ph. D. Thesis,Fac. Agric., Al-Azhar Univ. Egypt.

Nassar, H. H. (1986). Effect of planting pattern, planting population and nitrogen level on yield and quality of tomato. Acta Hortic. 190: 435-442.

N.F.S.D. (1999): The national food safety database (Tomatillos). http://www.foodsafety.org/il/il017.htm.

Pandita, M.L. and D.K. Bhatnagar (1981). Effect of nitrogen, phosphorus and spacing on fruit quality of tomato cultivar HS – 102. Haryana Agric. Univ. J. Res., 11:8 – 11, India.

S.F.C. (1998). Small Farm Centre. Califor. Univ.

Snedecor, g. w. andw.g. Cochran, (1980).statistical methods. 7th ed. Iowa stat. Univ. press, AMES, Iowa, USA,P. 255 - 273

Trpevski, V., V. Demirovska, L. Stojcevska and V.Ognenovski (1993). The effect of different rates of nitrogen on the quality and yield of some tomato cultivars. Savzemena polyop. 40 :100 – 102, Macodonia.

Zayed G.A.,W.Y.Reyad and M.H.Aboul-Nasr (2003). Harunkush production in Egypt. Agric.Res. Centre (Under prep.).

١- تأثير بعض المعاملات الزراعية على إنتاجية الحرنكش بمصر العليا

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أجريت تجربتان حقليتان فى موسمى٢٠٠١/٢٠٠٢ & ٢٠٠٢/٢٠٠٣ بمحافظة قنا بهدف دراسة الكثافة النباتية ومعدل التسميد النيتروجينى المناسب والتفاعل بينهما للوصول إلى إنتاجية عالية من الثمار الصالحة للاستهلاك المحلى أو التسويق السياحى بالمناطق السياحية بجنوب مصر ..... أو التصدير. كما تهدف الدراسة أيضا إلى الوصول على محصول بذرى جيد تحت ظروف جنوب مصر.

وقد تضمنت الدراسة تقييم مسافات الزراعة المختلفة بين النباتات بالخط (٥٠سم ، ٧٥سم) وأربعة مستويات من النيتروجين (صفر ، ٥٠ ، ١٠٠ ، ١٥٠ كجم/فدان) وبذلك فقد كان هناك ثمان معاملات تمثل التوافيق المختلفة لهذين العاملين. زرعت الثمان معاملات فى ستة مكررات.....وقد تم تسجيل البيانات الخاصة بالتبكير وصفات النمو (ارتفاع النبات وعدد الفروع بالنبات) وصفات المحصول الثمرى (عدد الثمار/ نبات ، المحصول الكلى ، المحصول الصافى بعد نزع القشور المغطية للثمرة طن/ فدان) وكذلك صفات البذور (وزن ١٠٠ بذرة ، المحصول البذرى كجم/ فدان) وصفة المواد الصلبة الذائبة الكلية بالثمرة.

وقد أوضحت النتائج أن:

١) الزراعة على مسافة ٧٥سم بين النباتات أدت إلى زيادة صفات النمو وصفات المحصول الثمرى وكذلك صفات البذور.

٢) زيادة التسميد النيتروجينى حتى ١٥٠ كجم أزوت/ فدان أدت إلى زيادة جميع الصفات أعلاه الخاصة بالثمرة والبذور ماعدا صفة المواد الصلبة الذائبة الكلية بالثمرة ، والتى لم تتأثر معنويا بمستويات الإضافة إلا أنها زادت تدريجياً بزيادة التسميد النيتروجينى حتى مستوى ١٠٠ كجم/ فدان فقط.

٣) وكانت أفضل النتائج المتحصل عليها بالنسبة لصفات النمو أو المحصول الثمرى الكلى ومكوناتة وكذلك المحصول البذرى ووزن١٠٠ بذرة عند الشتل على مسافة ٧٥ سم بين النباتات والتسميد العالى بمعدل ١٥٠ كجم أزوت/فدان