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IMPACT OF MINERAL AND BIO-NITROGEN FERTILIZATION ON B: FLOWERING, EARLY YILD AND FRUIT QUALITY OF CUCUMBER PLANTS.

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ABSTRACT: *Two field experiments were carried out at Sakha Agricultural Research Station Farm, Kafr El Shiekh Governorate, Egypt during the two successive summer seasons of 2004 and 2005 using Prince hybrid cucumber seeds. To asses the effect of mineral and bio-nitrogen fertilizers on vegetative growth, flowering, early yield and fruit quality of cucumber plants. The most important results can be summarized as follows:*

- *Biofertilization produced higher vegetative growth parameters (leaf area, leaf dry matter %, and chlorophyll content), number of female flowers/plant, early yield as (weight and number) and total soluble solids%.*
- *Increasing of mineral nitrogen levels led to an increase in vegetative growth parameters. Also, caused promoting of number of female flowers/plant and early yield (weight and number), so fruit quality parameters (T.S.S, fruit length and fruit diameter).*
- *Liquid inoculation methods increased vegetative growth parameters, female flowers/plant and early fruit yield (weight and number).*
- *The interaction between inoculation methods, nitrogen levels and inoculation treatment exerted significant effects for most of vegetative growth, female flowers/plant and fruit yield. The best results were obtained from liquid inoculation method with 60 kg N/fed. followed by tablets inoculation method with 60 kg N/fed., while the liquid inoculation method with 30 kg N/fed had higher results than that, of 60 kg N/fed. without biofertilizer inoculation.*

Key words: *cucumber; N fertilizer levels; biofertilizer; flowering; early yield.*

INTORDUCTION

Cucumber, *Cucumis sativus* L, is the fourth most important vegetable crop after tomato, cabbage and onion and a favorite vegetable crop in Egypt. Although its calorie and nutritional value is very low, it is a primary source of vitamins and minerals in a human diet. It is a popular in developed countries where there is an excessive calorie intake. The cucumber fruit products are used not only for fresh eating and culinary cooking but also for salad and pickling (Mangbao, 1991).

Plant growth rate and yield are often dependent on N supply, although excess N often results in poor fruit quality and depresses commercial yield (Davenport, 1996). In general, at monoecious cucurbits, high levels of nitrogen appear to promote female sex expression. Whereas low levels promote male expression. (Swiader *et al.*, 1994 and Harrison, 2008), modification of sex expression in monoecious plants, especially in favour of female flowers, can lead to increased number of fruits per plant hence higher yield(Omini and Hossain, 1987).

Nitrogen fertilizer applications are expected to be double or even triple within the next 30 years, making the problem of nitrogen fertilizer related to the pollution even more serious (Zhang *et al.*, 1996). Recent attention has been given to less pollution practices in modern agriculture. One of the ways to reduce soil pollution is the use of biofertilizer (Saber, 1993). Beside the farmers can not afford the cost of these chemical N fertilizers, application of biofertilizer is important economically to reduce the cost of fertilizers and ecologically to reduce pollution of the environment (Saber, 1993 and Hassan *et al.*, 2000).

Hence, the purpose of this study was the possibility of using bio-fertilizer replace or reduce the application of mineral N fertilizer of cucumber plants, also the best of bacteria inoculation methods and the interaction effects of study factors on vegetative growth, number of female flowers /plant, early fruit yield and fruit quality.

MATERIALS AND METHODS

A field experiment was carried out at Sakha Agricultural Research Station Farm during the successive summer seasons of 2004 and 2005 using Prince cucumber hybrid to asses the effects of nitrogen fertilizer levels, inoculating the soil by effective strains of non symbiotic N_2-fixing bacteria and two different inoculation methods on vegetative growth, number of female flowers /plant, early fruit yield and fruit quality . The properties of soil are shown in Table (1).

Split split plot design with four replicates was used. The main plots were assigned to two inoculation methods 1): Inoculums was added to the soil as a liquid, 2): The inoculum was dressing to the soil as tablets beside the plants roots. The sub plots were assigned to three nitrogen levels of 0, 30, 60 kg. N/ fed^{-1}. The sub sub plots were assigned to two inoculation treatments of 1): with inoculation and 2): without inoculation. The plot area was 20 square meter, the spacing between plants was 40 cm. ($1m^2$ included 2.5 plant).

Nitrogen fertilizer was applied as ammonium nitrate 33% N and splited into two equal doses with the first and the third irrigation. The inoculums of effective strains of non symbiotic N_2-fixing bacteria prepared by Department of Soil Microbiology-Soil, Water and Environment Research Institute, Agric. Res. Center. The recommended dose of phosphorus and potassium fertilizers was added before transplanting.

Data recording:-

Vegetative growth parameters:

Vegetative growth parameters in this study included

1-leaf area (cm^2), which determined using the leaf area meter (model li-3100). 2- leaf dry matter %, recorded after drying the leaf at 70 ^{0}C till a constant weight 3-chlorophyll content SPAD unit, was estimated in the fifth leaf from the growing tip using SPAD meter (Minolta Corp, Ramsey, N.J.) Samples of 5 plants were randomly chosen from each experimental unit to determine.

Flowering:

Data on flowering were recorded on five plants randomly chosen from each experimental plot, where accumulative number of female flowers per plant was recorded daily.

Early fruit yield:

Early fruit yield was determined as weight (Kg) and number of fruits per plot (20 m^2). It was determined on base of yield of the first 4 pickings.

Table (1): Mechanical and chemical analysis of soil before conducting the experiments in 2004 and 2005 seasons.

Soil analyses	2004 season	2005 season
Mechanical analysis:		
Clay%	53.21	49.17
Silt%	25.14	26.11
Sand%	21.65	24.72
Chemical analyses:		
pH(1:2.5 soil: water suspension)	8.05	8.2
EC dSm^{-1} (soil paste extract)	2.1	2.4
Organic matter	1.7	1.6
Available-N mg^{-1} (1 M KCl extracts)	36	28
Available-P mg^{-1} (0.5 N $NaHCO_3$ extracts)	6.1	5.8
Available-K mg^{-1}(ammonium acetate extracts)	280	214

Mechanical and chemical analysis of soil before conducting the experiments were determined by Department of Soil Microbiology-Soil, Water and Environment Institute Agric. Res. Center

Fruit quality:

Included, average fruit length (cm), and fruit diameter (cm). Total soluble solids (TSS %) was determined in fruit juice by a hand refractometer according to A.O.A.C. (1965). Fruit characteristics were determined in fruits picked in the same day (which its flowers were previously labeled at the same opening day).

Data were tested by analysis of variance (Little and Hills, 1972) and treatment means were compared by using revised L.S.D test according to the procedure outlined by Snedecor and Cochran (1972).

RESULTS AND DISCUSSION

1:- Vegetative growth parameters:

Vegetative growth parameters in this study included leaf area, leaf dry matter % and chlorophyll content.

Data presented in Table (2) show that, application of biofertilizer had significantly increase leaf area, leaf dry matter and chlorophyll contents. These results were in agreement with those obtained by Abd El-Fattah and Sorial , 1998 on lettuce and Abd El-Fattah and Sorial, 2000 on squash .

Concerning the effect of nitrogen levels, the results in Table (2) demonstrate that, increasing mineral nitrogen levels significantly increase all studied vegetative growth characters in both seasons. The highest values were obtained from application of N at 60 kg/fed compared with the other N levels.

The promote effect of increasing nitrogen levels might be due to its positive effect on amount of chlorophylls (Aroiee and Omidbaigi, 2004) and N content of the leaves (Knany and Abd Alla, 2006)

Concerning inoculation methods, the results in Table (2) show that, liquid inoculation had the highest values of leaf area and leaf dry matter % compared with tables' incoulation method, while no significant differences were detected between these treatments on chlorophyll content. These results may be result of increasing the available nitrogen in the soil from liquid inoculation method at the most of growth season of cucumber plants (knany and Abd Alla, 2006).

Concerning the interaction effect between biofertilizer inoculation, nitrogen levels and inoculation methods, Data presented in Table (2) reveal that, leaf area and leaf dry matter% were significantly affected by the interaction in both seasons. The highest values of the previous characters were obtained from plants treated with biofertilization as liquid inoculation methods and fertilized with 60 kg N/fed, followed by similar treatment with tablets inoculation methods. Liquid inoculation with 30 kg N/fed. was superior than the control treatment (60Kg N/fed without biofertilization).

With respect to chlorophyll, no significant differences were obtained from all treatments at both seasons. This results were agreement with Abd El-Fattah and Sorial (1998) on lettuce and Barakat and Gabr(1998) on tomato.

Table (2): Effect of biofertilization, inoculation methods, nitrogen levels and their interactions on vegetative growth characters of cucumber plants in 2004and 2005 seasons.

[Treatments			Leaf area (cm^2)		Leaf dry matter%		Chlorophyll content (SPAD unit)	
Inoculation methods	Nitrogen levels	Inoculation	2004	2005	2004	2005	2004	2005
Liquid	N0	Without	59.33	64.67	14.17	14.77	31.93	32.89
		With	75.97	78.00	17.43	17.83	33.33	37.07
	N30	Without	71.57	73.33	16.35	16.5	34.5	36.6
		With	89.87	93.17	19.41	19.6	36.40	39.50
	N60	Without	84.67	89.33	19.01	19.10	36.91	40.00
		With	106.24	108.50	23.72	24.23	38.30	40.57
Tablets	N0	Without	59.33	64.67	14.17	14.77	31.93	32.89
		With	74.51	77.17	16.36	16.93	34.57	36.3
	N30	Without	71.57	73.33	16.35	16.50	34.50	36.60
		With	83.51	86.77	19.00	19.37	35.73	36.9
	N60	Without	84.67	89.33	19.01	19.1	36.91	40.00
		With	93.54	96.9	21.33	21.83	40.47	43.37
LSD			1.400	2.083	1.080	0.788	1.237	1.787
Inoculation	Without		71.86	75.78	16.51	16.79	34.45	36.49
	With		87.27	90.08	19.54	19.97	36.47	39.28
F.test			**	**	**	**	**	**
Nitrogen levels	N0		67.29	71.13	15.53	16.08	32.94	34.79
	N30		79.13	81.65	17.78	17.99	35.28	37.90
	N60		92.28	96.02	20.77	21.77	38.15	40.98
LSD			0.5634	1.929	0.960	1.106	0.8363	2.306
Inoculation methods	Liquid		81.27	84.50	18.35	18.67	35.23	37.77
	Tablets		77.85	81.36	17.70	18.08	35.68	38.01
F.test			**	**	*	*	Ns	Ns

2- Female flower and Early fruit yield:

Data presented in Table (3) show that, biofertilization had significant increase number of female flowers / plant compared with chemical fertilizer. The superiority of female flower / plant may be due to the increases in vegetative growth parameters. Data in Table (3) indicate also that, the same trend was observed for early yield as wt. and number as the results of using biofertilizer compared with mineral fertilizer, the differences were significant at both seasons.

Table (3): Effect of biofertilization, inoculation methods, nitrogen levels and Their interactions on number of female flower early yield as (weight and number of fruits) and in 2004and 2005 seasons.

Treatments			Number of female flowers/plant		Early yield wt. kg/plot		Early yield no. of fruits/plot	
Inoculation methods	Nitrogen levels	Inoculation	2004	2005	2004	2005	2004	2005
Liquid	N0	Without	8.00	10.00	2.20	2.44	34.68	38.40
		With	19.25	21.08	6.00	6.72	84.00	100.68
	N30	Without	13.17	14.67	5.24	6.04	72.68	79.60
		With	26.17	27.00	9.88	10.40	138.40	158.52
	N60	Without	21.33	22.67	8.56	10.04	110.68	127.20
		With	35.33	37.00	15.88	17.44	214.68	243.60
Tablets	N0	Without	8.00	10.00	2.20	2.44	34.68	38.40
		With	19.00	21.67	6.36	6.52	76.00	86.52
	N30	Without	13.17	14.67	5.24	6.04	72.68	79.60
		With	23.67	25.00	7.60	8.04	99.20	105.20
	N60	Without	21.33	22.67	8.56	10.04	110.68	127.20
		With	32.67	35.00	12.20	12.96	134.68	150.92
LSD			0.874	0.880	1.604	0.756	11.316	10.048
Inoculation	Without		14.17	15.78	5.32	6.16	72.68	81.72
	With		26.01	27.79	9.64	10.36	124.08	140.92
F. test			**	**	**	*	**	**
Nitrogen levels	N0		13.56	15.69	4.20	4.52	57.32	66.00
	N30		19.04	20.33	7.00	7.64	95.12	105.72
	N60		27.67	29.33	11.32	12.64	142.68	162.24
LSD			1.804	0.470	4.356	0.856	22.244	24.856
Inoculation methods	Liquid		20.54	22.07	7.96	8.84	108.76	124.68
	Tablets		19.64	21.50	7.04	7.68	87.96	97.96
F. test			*	*	*	**	**	*

Cucumber early yield increases could be due to the enhancing in vegetative growth (Table 2) and the increasing of female flowers / plant (Table 3) by biofertilizer treatments and enhance uptake of minerals (Kanny and Abd Alla, 2006).

Concerning nitrogen levels, data in Table (3) indicate that, increasing mineral nitrogen levels significantly increase female flowers / plant in both seasons. These results may be due to the possible role of mineral nutrients in hormonal balance and thereby in sex flower ratio (Omini and Hossain 1987).

Concerning the effect of nitrogen levels on early fruit yield, data present at Table (3) show that, N application levels had a significant increase at both seasons, early fruit yield as weight and number remained the same trend of female flower at both seasons.

The increase in early fruit yield with increasing N levels may be due to importance of N of plant growth which presented in Table (2), and reported also by Davenport (1996).

Concerning the effect of inoculation methods. data in Table (3) show that, liquid method significantly increase female flowers / plant. The improvement in number of female flowers may be due to the increase in vegetative growth parameters (Table, 2).

With respect to early fruit yield, data in Table (3) show that, liquid inoculation method significantly increase early fruit yield as weight and number compared with tablets inoculation method. These results may be due to increase number of female flowers, hence increase early fruit yield.

Concerning the interaction effect between biofertilizer, nitrogen levels and inoculation methods, data presented in Table (3) manifest that, cucumber plants which received 60 kg N / fed. and were inoculated with biofertilizer as liquid method had the highest number of female flowers/ plant. Early yield had the same trend with the above mentioned treatment, followed by similar treatment with tablets inoculation method.

On the other hand, data in the same Table show that, cucumber plants which received 30 kg N/fed and inoculated with biofertilizer as liquid inoculation method had the highest number of female flowers/ plant and early fruit yield than the control treatment (60 kg N without biofertilization). While the lowest values of both female flower number and early fruit yield were obtained from cucumber plants with no nitrogen application and without biofertilizer inoculation.

3- Fruit quality:

Fruit quality in this study included total soluble solids in fruits % (TSS %), average fruit length (cm) and average fruit diameter (cm).

Data presented in Table (4) show that, biofertilizer had significant increase in TSS % and average of fruit length in both seasons. However, there were no significant differences between inoculation and uninoculation plants, similar results were obtained by Barakat and Gabr (1998).

Concerning nitrogen levels, data in Table (4) show that, N at 60 kg/fed. significantly improved TSS %, fruit length and fruit diameter, similar results were reported by many investigators, Raese and Drake (1997) and Abd El-Fattah and sorial (2000).

Table (4): Effect of biofertilization, inoculation methods, nitrogen levels and their interactions on cucumber fruit quality in 2004and 2005 seasons.

Treatments			Total soluble solids in fruits (%)		Average fruit length (cm)		Average fruit diameter (cm)	
Inoculation methods	Nitrogen levels	Inoculation	2004	2005	2004	2005	2004	2005
Liquid	N0	Without	4.60	4.53	10.60	10.77	2.37	2.23
		With	4.87	4.80	11.67	11.93	2.73	2.57
	N30	Without	4.70	4.87	12.50	12.07	2.70	2.60
		With	4.80	4.87	13.27	13.43	2.67	2.63
	N60	Without	4.60	4.70	13.90	13.77	3.17	2.90
		With	5.03	5.17	14.30	14.00	2.93	2.80
Tablets	N0	Without	4.60	4.53	10.60	10.77	2.37	2.23
		With	4.67	4.73	11.80	11.93	2.50	2.37
	N30	Without	4.70	4.87	12.53	12.07	2.70	2.60
		With	4.78	4.87	13.07	13.20	2.47	2.23
	N60	Without	4.60	4.70	13.90	13.77	3.17	2.90
		With	5.00	5.07	13.17	13.57	3.70	2.57
LSD			0.272	0.224	0.752	1.181	0.518	0.426
Inoculation	Without		4.64	4.70	12.34	12.20	2.74	2.58
	With		4.86	4.92	12.88	13.01	2.67	2.53
F. test			**	**	**	**	Ns	Ns
Nitrogen levels	N0		4.68	4.65	11.17	11.35	2.49	2.35
	N30		4.76	4.87	12.85	12.69	2.63	2.52
	N60		4.81	4.91	13.82	13.78	2.99	2.79
LSD			0.186	0.259	2.011	1.909	0.345	0.387
Inoculation methods	Liquid		4.77	4.82	12.71	12.66	2.76	2.62
	Tablets		4.73	4.79	12.51	12.55	2.65	2.48
F. test			Ns	Ns	Ns	Ns	Ns	Ns

Concerning the effect of inoculation methods, data in Table (4) show that, liquid inoculation method increased all fruit characters compared with tablets method, but the differences were not significant in both seasons.

Concerning the interactions between the previous treatments, data in the same Table show that, fruit of cucumber plants which received 60 kg N / fed. and inoculated with biofertilizer as liquid method had the highest values in the most fruit characteristics (total soluble solids in fruits % and average fruit length), but the difference were not significant in both seasons.

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تأثير التسميد النيتروجينى المعدنى والحيوى علي ب: التزهير والمحصول المبكر وجوده الثمار لمحصول الخيار.

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الملخص العربي

أجريت دراسة حقلية لمدة عامين علي نباتات الخيار-صنف هجين برنس خلال الموسم الصيفي لعامي ٢٠٠٤،٢٠٠٥م في المزرعة البحثية بمحطة البحوث الزراعية بسخا- محافظة كفر الشيخ.لدراسة تأثير التسميد النيتروجينى المعدنى والحيوى عل كل من النمو والتزهير والمحصول المبكر وكذلك جودة الثمار

صممت التجربة بنظام القطع المنشقة مرتين في أربعة مكررات وكانت مساحة القطعة التجريبية ٢٠متر مربع

وقد وزعت في القطع الرئيسية طرق التلقيح البكتيرى :-

١- وضع اللقاح في صورة سائلة بمنطقة البذور

٢- وضع اللقاح في صورة كبسولات بمنطقة البذور

أما القطع المنشقة فقد وزع بها ٣ مستويات من السماد النيتروجينى:-

١- صفر نيتروجين بدون اضافة

٢- ٣٠ وحدة نيتروجين للفدان

٣- ٦٠ وحدة نيتروجين للفدان

استخدم السماد المعدنى النيتروجينى علي صورة نترات الامونيوم ٣٣ % نيتروجين حيث اضيف علي دفعتين مع الرية الأولي والرية الثالثة.

بينما شغلت القطع المنشقه المنشقه بمعاملتين للتلقيح الحيوى :

١- بدون تلقيح

٢- التلقيح بمخلوط من سلالات نشطة من البكتريا المثبتة للازوت لا تكافليا.

وقد تضمنت الدراسة بيانات عن النمو الخضرى، والأزهار ، والمحصول المبكر. وصفات الثمار.

ويمكن تلخيص النتائج فيما يلي:

- أدي التسميد الحيوى الي: زيادة معنوية لصفات النمو الخضرى (المساحة الورقية – النسبة المئوية للمادة الجافة بالاوراق- محتوي الأوراق من الكلوروفيل), كذلك لزيادة عدد الأزهار المؤنثة للنبات الواحد وزيادة المحصول المبكر(وزنا وعددا) كما أدي لزيادة محتوي الثمار من المواد الصلبة الكلية .
- زيادة مستوي التسميد النيتروجينى المعدنى المضاف ادت الي زيادة معنوية لصفات النمو الخضرى كذلك أدت الي زيادة عدد الأزهار المؤنثة والمحصول المبكركما أدت لتحسين خواص الثمار المختلفة .
- أدي استخدام الطريقة السائله لاضافة التسميد الحيوى للزيادة المعنوية لصفات النمو الخضرى وعدد الأزهار المؤنثة وكذلك زيادة المحصول المبكر بينما لم تتأثر صفات الثمار باختلاف طريقة الاضافة للسماد الحيوى .
- أدى التفاعل بين معاملات كل من التسميد الحيوى ومستويات التسميد النيتروجينى المعدنى وطريقة اضافة التسميد الحيوى الي زيادة معنوية لأغلب صفات النمو الخضرى والأزهار والمحصول المبكر بينما لم يؤثر علي صفات الثمار وأفضل النتائج المتحصل عليها هى الناتجه من المعاملة المستخدم بها تسميد معدنى بمعدل ٦٠ كجم ن/ فدان مع التسميد الحيوى المضاف بالطريقة السائلة وتبعها المعاملة المستخدم بها نفس معدل التسميد مع التسميد الحيوى المضاف بطريقة الكبسولات. في حين أن المعاملة المستخدم فيها معدل تسميد ٣٠كجم ن/ فدان مع التسميد الحيوى المضاف بالطريقة السائلة قد تفوقت عن المعاملة المستخدم فيها السماد المعدنى ٦٠ كجم ن/ فدان بدون استخدام السماد الحيوى.
- يمكن التوصية باستخدام التسميد الحيوى بطريقتي الاضافة حيث يؤدي ذلك للتبكير فى الاثمار مما يؤدي بالمنتج للحصول علي عائد مادي مناسب كذلك باستخدام التسميد الحيوى بطريقة الاضافة السائلة لانتاج الخيار حيث أنها تؤدي لخفض معدل استخدام السماد الأزوتي المعدنى بنحو ٥٠% بدون نقص المحصول مما يؤدي لخفض نفقات التسميد.