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EFFECT OF DIFFERENT LEVELS OF NITROGN, PHOPHORUS AND POTASSIUM ON GROWTH , YIELD AND CHEMICAL COMPOSITION OF CUMIN (*Cuminum cyminum L.*) PLANT GROWN UNDER SINAI CONDITIONS.

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Abstract

Field experiments were carried out at El-Shiekh Zowayed of North Sinai Governorate. The study included the application of three different types of chemical fertilizers namely; ammonium sulphate, potassium sulphate and calcium super phosphate. The First and second fertilizers were applied at three different levels, whereas the third was applied at only one level. The study investigates the effect of interaction between the three fertilizers. Thus, a combination between the three fertilizers at the three applied levels was added to a reclaimed sandy soil. Cumin (*Cuminum cyminum L.*) fruits were cultivated in treated and untreated sandy soils at 15 November in the growth season 2002/2003 and at 30 November in the growth season 2003/2004. The result obtained indicated an obvious increase in different investigated growth parameters as shoot length, fresh and dry weight of shoot, number of branches, number of umbels and number of fruits per plant. Moreover a marked increase in cumin shoot system of nitrogen, phosphorus, potassium, total carbohydrates and total proteins was obtained in response to different treatments under investigation, if compared with the control group. There were no appreciable differences in the response of cumin plants to fertilization treatments at the two seasons of cultivation.

Introduction

Cumin (*Cuinum cuyminum L.*) is native to upper Egypt. It was also cultivated in Spain,France and India in the earlist times .

Cumin (*Cuminum cuyminumL.*) Fam. apiaceae (*umbelliferae*) is one of the important medicinal, aromatic and spices plants. It acts as a source of substances having antioxidant, antiseptic, antispasmdic, antitoxic, bactercidial, carminative, digestive, diuretic, larvicidal, nervine, stimulant and tonic effects (*Lawless1992*).

It is also used in veterinary medicine in digestive preparations, as a fragrance component in cosmetic and perfumes and a flavour ingredient in many foods and drinks, especially meat products. It's fruit oil, showed strong fungitoxicity against Aspergillus flavus and A.niger (*Singh1991*).

The culivation of medicinal and aromatic plants in Sinai is a traget, as the climatic conditions of this region are suitable for the growth of a wide variety of wild plants (*Table A*).

The extension in the cultivation of Sinai is promising as the problem of water shortage prevailing there could be minimized with the arrival of Nile water to Sinai.

Table (*A*): Climatic conditions during the two successive seasons in 2002/2003 and 2003/2004 in North Sinai:

Month	2003					2004				
	Avg temp °C	ET (mm)	Avg.WS (Km/h)	Total rainfall (mm)	RH (%)	Avg temp °C	ET (mm)	Avg.WS (Km/h)	Total rainfall (mm)	RH (%)
1	14.179	1.26	14.53	37.048	82.433	13.101	1.063	16.765	33.02	79.553
2	13.196	1.752	20.86	14.224	73.518	13.372	1.201	15.939	29.21	88.637
3	14.14	1.804	17.64	42.418	81.416	16.597	2.115	13.363	19.05	81.524
4	18.502	2.881	16.332	13.208	78.069	17.991	2.579	14.833	0.254	85.235
5	21.843	3.287	13.627		87.589	20.639	2.869	14.471	0.508	85.55
6	23.757	3.42	13.051		92.275	23.217	3.154	13.448		92.994
7	25.741	3.525	13.924		91.333	25.774	3.505	12.766		94.619
8	26.059	3.304	12.794		92.422	26.064	3.192	13.378		91.99
9	25.059	3.145	12.419	1.016	83.746	25.023	1.427	10.009		88.516
10	22.657	1.746	12.533	0.254	89.799	23.137	0.941	10.803	0.762	95.238
11	18.9	1.148	12.402	2.286	87.309	18.933	0.704	14.313	75.946	90.161
12	14.8	1.048	13.977	23.622	83.564	13.199	0.568	11.383	99.314	88.49

Where:

ET (mm) = Evapo tanspiration .
Avg. Ws (Km/h) = Wind spead.
RH (%) = Relative hymidily

Materials and Methods

Fruits of Cumin (*Cuminum cyminum L.*) were obtained from the experimental farm of Medicinal and Aromatic Plants Research Station.

On 15th November, Cumin fruits were sown directly in reclaimed sandy soil plains in the first season and on 30th November in the second season at the rate of 2kg / feddan. After germination the plants were thinned at two plants per hill (*24000 plants/ fed*.). Drip irrigation system was used in the experiment with droppers (*4.0 1/h*).

The fertilization treatments included the following:

1. Ammonium sulphate (*20%N*) was used as nitrogen source at the rate of 300,450 or 600 kg/ feddan.
2. Calcium supper phosphate (*16%*) was used as phosphorus source at the rate of 100 kg feddan^{-1}.

3. Potassium sulphate (*48%*) was used as potassium source at the rate of 50,100 or 150 kg feddan^{-1}.

The chemical fertilization treatments were used as follows

Fertilization Systems	**Treatments respectively (kg feddan^{-1})**
N_0 pk_0	Control
N_1 pk_1	300,100 and 50 kg / feddan respectively
N_1 pk_2	300,100 and 100 kg / feddan respectively
N_1 pk_3	300,100 and 150 kg / feddan respectively
N_2 pk_1	450,100 and 50 kg / feddan respectively
N_2 pk_2	450,100 and 100 kg / feddan respectively
N_2 pk_3	450,100 and 150 kg / feddan respectively
N_3 pk_1	600,100 and 50 kg / feddan respectively
N_3 pk_2	600,100 and 100 kg / feddan respectively
N_3 pk_3	600,100 and 150 kg / feddan respectively

Methods Of Analysis

On 15 November 2002/2003 and on 30 November 2003/2004 seeds of cumin fruits were sown directly in reclaimed sandy soil in the two seasons at the rate of 2 kg / feddan. Harvesting was carried out on 30th April and 31th May in the first and second seasons.

Samples of shoot system were dried at 70^{o}C till constant weight then ground to a fine powder and packed in paper bags for the determination of elements, carbohydrates and protein contents.

A*- *Extraction and Determination of Nitrogen (N), phosphorus (P) and potassium (K):

The N, P and K contents of the shoot system of cumin were determined in the acid digested solution, which was prepared according to Hach et al (*1985*) using a mixture of hydrogen peroxide and sulfuric acid (*4:1*).

1) Nitrogen:

Nitrogen percentage was determined by modified micro kjeldahl method as described by Peach and Tracey (*1956*). The values were expressed as gm / 100gm dry matter. The nitrogen content was multiplied by the factor 6.25 to obtain the protein content.

2) Phosphorus:

Phosphorus content was determined following the method of Briggs (*1924*), Snell & Snell (*1949*). The method is based on the determination of the blue color of molybdenum resulted from the addition of three reagents, i.e ammonium molybdate, hydroquinone and sodium sulfite. The absorbance was read at 660 nm using (*Jasco*) Spectrophotometer (*7800*).The content of phosphorus was calculated from standard curve of potassium di-hydrogen phosphate.

3) Potassium:

Potassium content was determined by using Atomic Absorption Spectrophotometer, following the method of phosphorus content?

B- *Extraction and Determination of total carbohydrates*:

Total carbohydrates was extracted following the method of described by Chaplin and Kennedy (*1994*). The absorbance was taken at 420 nm using (Jasco) Spectrophotometer (*7800*).

Results And Discussion

Effect of different levels of N, P and K and their interactions on vegetative growth parameters of Cuminum plants is illustrated in tables 1 and 2.

It is clearly evident from table (*1*) that there is an obvious difference among the averages of plant height, number of branches and umbels per plant, in response to the different treatments under investigation. Moreover, it was found that the interaction between N, P and K when applied at a relatively high level (N_3 PK_3) gave the highest increase in most investigated parameters, if compared with both the control and the other treatments. This trend was observed in both seasons.

Data illustrated in table (*2*) refer to the effect of different levels of N, P and K and their interaction on fresh and dry weights of the shoot system and the yield of Cuminum plants. The results indicate that all these parameters were increased gradually with each increase in N and K levels. Similar results were obtained by Bhati (*1990*); patel et al. (*1992*); Jangir & Rajender-Singh (*1996*); Amin et al. (*1998*) and Yadav et al. (*2005*).

Data in table (*3*) indicated that in response to the different treatments under investigation, there was appreciable increases in nitrogen, phosphorus, potassium, total carbohydrates and total proteins of the shoot system of Cuminum plants with a magnitude being obtained on the case of interaction between the relatively higher

levels of N, P and K elements (N_3 PK_3). These results could be obtained in both the two seasons of growth.

The marked increase encountered in different growth parameters, in the content of total carbohydrates and total proteins in response to different fertilization treatments could be attributed to the appreciable increase obtained in nitrogen, phosphorus and potassium. These elements are pre-requiset for normal growth and developmental processes. These elements satisfy specific metabolic requirement of plant growth and development. Most of the macroelements as N, P and K have a predominantly structural role, involved in regulatory roles as maintaining ion balance, activation of enzymes, and act as a second messenger in hormone and phytochrome response(*Orcutt& Nilsen, 2000*).

It is worthy to note that at the different levels of fertilization, the vegetative growth and chemical analysis of Cuminum plants was more vigorous in second season compared with first season. This might be attributed to more favorable environmental conditions (*Table 4*) prevailing in the second season.

Table (1): Effect of chemical fertilization on vegetative growth of Cumin (*Cuminum cyminum L.*) plants during the two successive seasons in 2002\2003 and 2003\2004 in North Sinai:

Growth Parameters / **Treatment (Kg feddan^{-1})**	**Plant height (cm)**		**Number of branches / plant**		**Number of umbels/ plant**	
	First season	Second season	First season	Second season	First season	Second season
Control	16.08	19.33	2.05	3.71	12.60	13.33
N_1PK_1	18.81	28.87	3.20	4.02	28.55	35.55
N_1PK_2	21.03	29.27	3.50	3.90	32.67	37.05
N_1PK_3	21.06	30.27	3.40	4.05	32.66	39.50
N_2PK_1	30.05	35.60	4.82	5.30	51.50	58.73
N_2PK_2	35.80	41.00	5.22	5.28	57.20	59.60
N_2PK_3	36.70	70.73	5.53	5.56	51.10	56.40
N_3PK_1	30.91	38.22	5.80	6.13	43.20	55.67
N_3PK_2	35.27	39.80	5.00	5.80	43.10	53.00
N_3PK_3	35.31	39.88	6.30	5.88	40.33	54.47

Table (*2*): Effect of chemical fertilization on fresh, dry weights of shoots and fruits yield/plant of Cumin(*Cuminum cyminum L.*) plants during the two successive seasons in 2002\2003 and 2003\2004 in North Sinai:

Growth Parameters / Treatment (Kg feddan^{-1})	Fresh wt / plant (gm)		Dry wt /plant (gm)		Fruits wt /plant (gm)	
	First season	Second season	First season	Second season	First season	Second season
Control	31.00	32.22	9.15	10.05	1.66	1.47
N_1PK_1	56.60	75.88	17.77	19.20	6.05	6.90
N_1PK_2	55.31	56.53	20.22	22.61	6.29	7.42
N_1PK_3	51.67	56.53	20.41	22.80	7.70	7.40
N_2PK_1	89.00	100.50	29.93	46.10	14.80	16.72
N_2PK_2	80.64	100.47	34.35	47.00	17.31	17.14
N_2PK_3	91.67	115.32	49.51	49.51	16.01	16.00
N_3PK_1	99.33	118.70	30.41	40.87	15.21	16.78
N_3PK_2	105.33	117.60	31.30	46.77	17.80	17.83
N_3PK_3	101.33	95.47	28.90	46.69	16.97	17.50

Table (*3*): Effect of chemical fertilization on Nitrogen, Phosphorus and Potassium percentages of Cumin (*Cuminum cyminum L.*) plant, during the two successive seasons in 2002/2003 and 2003/2004 in North Sinai:

Elements / Treatment (Kg feddan^{-1})	Nitrogen %		Phosphorus %		Potassium %	
	First season	Second season	First season	Second season	First season	Second season
Control	0.30	0.40	0.09	0.09	1.01	1.60
N_1PK_1	1.10	1.20	0.11	0.13	2.75	3.30
N_1PK_2	1.23	1.10	0.10	0.11	3.60	3.77
N_1PK_3	1.14	1.16	0.13	0.14	3.90	3.95
N_2PK_1	1.28	1.27	0.18	0.19	3.00	3.09
N_2PK_2	1.30	1.38	0.21	0.27	4.93	3.97
N_2PK_3	1.92	1.96	0.27	0.29	3.96	4.00
N_3PK_1	1.66	1.67	0.30	0.29	3.75	3.83
N_3PK_2	1.90	1.44	0.19	0.17	4.13	4.08
N_3PK_3	1.95	1.90	0.21	0.23	4.10	4.70

Table (*4*): Effect of chemical fertilization on total carbohydrates and total proteins of Cumin (*Cuminum cyminum L.*) plant, during the two successive seasons in 2002/2003 and 2003/2004 in North Sinai:

Chemical Analysis / Treatment (Kg feddan^{-1})	Total Carbohydrates (gm)/100 gm D.Wt		Total Proteins (gm)/100 gm D.Wt	
	First season	Second season	First season	Second season
Control	6.08	6.00	3.13	5.00
N_1PK_1	6.10	6.23	7.50	10.00
N_1PK_2	6.31	6.45	11.88	13.13
N_1PK_3	6.66	6.69	11.90	12.53
N_2PK_1	7.39	6.18	13.13	13.70
N_2PK_2	7.80	7.01	13.75	14.38
N_2PK_3	7.43	8.33	14.07	14.13
N_3PK_1	8.07	8.50	13.69	14.20
N_3PK_2	8.11	9.19	14.31	14.38
N_3PK_3	7.00	8.51	13.61	14.38

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الملخص العربي

تأثير التسميد الكيماوي علي نبات الكمون تحت ظروف شمال سيناء :

- تم إجراء تجربه في منطقه الشيخ زويد في مزارع محافظه شمال سيناء, تضمنت استخدام ثلاثة أنواع مختلفة من الأسمدة الكيماوية علي وجه التحديد كبريتات نشادر, كبريتات بوتاسيوم وسوبر فوسفات الكالسيوم وذلك عند ثلاث مستويات مختلفة من الأول والثاني وعند مستوي واحد من الثالث علي التوالي . تم اضافه الأسمدة الي تربه رمليه مستصلحه وذلك من خلال اضافتها معا عند المستويات المختلفة الخاضعة للدراسة . تم زراعه ثمار الكمون في التربة المعاملة وغير المعاملة في 15 نوفمبر في موسم النمو 2002 إلـ 2003 وفي 30 نوفمبر في الموسم 2003 إلـ 2004 . من النتائج المتحصل عليها اتضح وجود زيادة ملحوظة في معايير النمو المختلفة ممثله في طول النبات , عدد الأفرع , الوزن الغض والجاف للنبات , عدد النورات وعدد الثمار لكل نبات وذلك استجابة المعاملات المختلفة تحت الدراسة وتم الحصول علي أعلي استجابة عند الجمع بين أعلي مستويات الأسمدة المختلفة. كانت هناك زيادة ملحوظة في محتوي المجموع الخضري للنباتات النامية في التربة المسمدة وذلك من عناصر نتروجين , فسفور , بوتاسيوم , من المحتوي الكلي كربوهيدرات وبروتينات مقارنه بالمجموعة الضابطة. لم يكن هناك فرق ملحوظ بين أستجابه نبات الكمون للمعاملات المختلفة نتيجة للزراعة في موسمي نمو مختلفين .