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EFFECT OF WATER SUPPLY AND GROWTH REGULATORS ON NITROGEN METABOLISM OF *PISUM SATIVUM*

By

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ABSTRACT

The aim of the present investigation is to find out how far the application of growth regulators namely CCC and GA_3 affect the nitrogen metabolism in one of the most important vegetables (Pisum sativum) under shortage of irrigation water.

With decrease in water supply the content of total soluble nitrogen increased considerably. In treated plants with growth regulators,the increase was less pronounced than in the untreated ones.

The protein content showed a considerable reduction with age . In the early stage of development the protein content of the untreated plants was nearly double that of the mature stage. The protein content of plants in all the treatments exhibited remarkable reduction with decrease in water supply. Treatments with growth regulators resulted in slight rise in protein content at the mature stage.

There is appreciable increase in proline content with rise in moisture stress in treated and untreated plants. Treatment with growth regulators particularly CCC resulted in remarkable decrease in proline centent at the different levels of water supply.

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INTRODUCTION

The cultivated area in Egypt depending on Nile water does not exceed about 6% of the total area. Therefore it is of prime importance to study the water economy of cultivated plants. The present investigation deals with the water economy of one of the important leguminous vegetable namely *Pisum sativum* L. Variety Victory Feezer. Since *Pisum sativum* is a leguminous plant therefore it is of considerable importance to study the effect of water supply on nitrogenous compounds. The study also comprises the application of two growth regulators namely *Chlorocholine chloride* (CCC) and gibberellic acid (GA_3) to find out how far the application leads to increase the protein content and the other nitrogenous compounds.

MATERIAL AND METHODS

The soil was obtained from a newly reclaimed desert region in Quiesna, Menoufiya Governorate, Egypt. The pea seeds (*Pisum sativum* L. var Victory Freezer) were obtained form the Agriculture Research Center, Giza, Cairo.

Pea seeds were planted in plastic pots (25 cm diameter) each containing 20 kg soil. The pots were divided into three groups, each group consisted of three sets, and each set consisted of 10 pots. Each of the first three sets was subjected to water supply of 100, 150 and 200 mm rainfall. Each of the second three sets was subjected to the same water regime system and sprayed with 400 ppm cycocel (CCC), while each of the third three sets was subjected to the same water regime system and sprayed with 20 ppm gibberellic acid (GA_3).

The range of rainfall involved (200, 150 and 100 mm) was determined experimentally as the lowest level of rainfall which is efficient for growth of plants and production of seeds and also the highest level of rainfall affect the yield. Irrigation was applied one time each week at week intervals throught the whole life period.

The growth regulators were sprayed three times of 20 days intervals The first spraying was started on two weeks- old seedlings.

After full germination (two weeks after sowing), plants were thinned to three healthy seedlings per pot. The plant samples were collected at two stages of the plant growth, after 50 and 80 days form sowing and rapidly dried in an electric oven at 56 °C to constant weight and then ground to fine powder which was used for analysis of nitrogenous compounds.

Estimation of Nitrogenous Compounds

Total nitrogen contents and the total soluble nitrogen were determined as mentioned by Humphries (1956) and Pirie (1955). protein nitrogen contents were determined as described by Cantarow and Schepartz (1967).

The procedures mentioned by Fawcett and scott (1960) and Chaney & Marbach (1962) had been done for determination of free ammonia. Nitrate nitrogen was determined spectrophotometrically as described by Tracey (1956).

Amino acid nitrogen and peptide nitrogen were estimated according to Russel (1944) and Lowry et al. (1951) respectively.

Free Proline

For proline determination, the selected shoot parts were immediately weighed after harvesting and homogenized in 10 ml of 3% sulphosalicylic acid. The homogenate was filtered, kept in well stoppered, sample taken and transferred to the laboratory as soon as possible in an ice box.

A Known volume of the filtrate was used for the proline estimation following the procedure of Bates et al (1973). The values were expressed as μ mol /g fresh weight.

Nucleic acids

The extraction of nucleic acids was made by a method cited by Marmur (1961) and Mohamed & Capesius (1980). DNA and RNA were quantitatively determined using the method adopted by Dische & Schwartz (1937) and Schneider (1957).

RESULTS AND DISCUSSION

Nitrogenous Components.

a) Ammonia-Nitrogen.

The ammonia- N content showed slight increase with age. It is slightly higher in the late stage (80 dayse) than in the younger vegetative stage (50 days). It exhibited noticeable decrease with increase in moisture stress in the two stages of development. A noticeabl increase is detected on application of GA_3(Table 1 and Figs. 1&2).

b) Nitrate - Nitrogen.

The Nitrate-exhibited appreciable increase with deficiency in water supply in the two stsges of development and on application of growth regulators (Table 1 and Figs. 1&2). Treatment with growth regulators reulted in slight variations in nirate-N.

c) Amino Acids-Nitrogen.

The content of amion acids - N increased progressively with deficiency in water supply or increase in moisture stress in the two stages of developement. Tretment with growth regulators has no significant effect (Table 1 and Figs. 1&2).

d) Peptide-Nitrogen.

Examination of Table 5 and Figs. 1&2 demonstrate irregular and slight variations with deficiency in water supply and treatment with growth regulators.

e) Total soluble Nitrogen.

Detemination of total soluble nitrogen has an important value in osmotic adjustment when plants are subjected to high moisture stress resulting from deficiency in water supply. With decrease in water supply, the content of total soluble nitrogen increased considerably. In treated plants with growth regulators, the increase was less pronounced than in the untreated ones (Table 1 and Figs. 1&2).

f) Protein Content.

The protein content showed a considerable reduction with age. In the early stage of development (50days), the protein content of the untreated plants was nearly double that of the mature stage. The protein content of plants in all the treatments exhibited remarkable reduction with decrease in water supply. Treatment with growth regulatos resulted in slight increase in protein content at the mature stage (Table 1 and Figs. 1&2).

g) Total- Nitrogen content.

Unlike the protein content, the total nitragen content demonstrated remarkable increase with deficiency in water supply in the different stages of development as well as in the different treatments. Both the protein content and the total-N content decreased considerably with age.

It is obvious form the above discssion that the total soluble nitrogen compounds increased with decrease in water supply. This phenomenon is important in water economy since it has an important role in osmotic adjustment. On the contrary, the protein content exhibited a reverse trend.

The total-N represents the sum of all the nitrogenous compounds soluble and insoluble. Generally, there is tendency towards increase in total-N content with deficiency in water supply in the different treatments. It is much higher in the early stage of developent (50days) than in the late stage (80days). The effect of growth regulators on the total-N content is not regulare in the two stages of development (Table 1 and Figs. 1&2).

The obtained data are in agreement with that obtained by other investigators. Barnett and Naylor (1966) observed a high levels of free amino acids and amides have been associated with drought stress in plants. Slatyer(1969) and Maranville and Paulsen (1972) reported that interruption of protein synthesis and proteolysis generally occur in

8 bars. Furher decrease in leaf water potential did not reduce DNA appreciably more.

DNA content in pea cells of non growing internodes were not altered by GA_3 application, but in growing internodes an increase in DNA followed GA_3 treatment (Mohamed and Bopp, 1980).

Tomi et al. (1983) concluded that gibberellic acid enhances RNA synthesis by increasing RNA polymerase activity in pea seedlings.

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Table 1 : Effect of water supply and growth regulators on nitrogenous components of pea shoots (as mg. /g. D. Wt.).

Stage I. (50 days) :

Growth regulators	water supply (mm)	Ammonia-N	Nitrate-N	Amino acid-N	Peptide-N	Total soluble N	Protein-N	Total-N
o	200	0.14	1.93	2.47	11.40	17.36	40.27	57.63
	150	0.05	3.47	22.94	13.37	22.47	38.42	60.89
	100	0.03	3.56	3.76	12.90	26.86	35.08	61.94
CCC	200	0.11	1.90	2.55	13.46	19.43	41.53	60.96
	150	0.07	2.77	2.75	13.18	21.17	40.74	61.91
	100	0.05	3.40	3.32	12.96	25.07	37.12	62.19
GA_3	200	0.17	1.90	2.24	12.70	17.94	35.81	53.75
	150	0.10	2.31	2.41	12.42	18.43	35.17	53.60
	100	0.06	3.23	3.20	12.52	20.83	34.29	55.12

Stage II. (80 days) :

Growth regulators	water supply (mm)	Ammonia-N	Nitrate-N	Amino acid-N	Peptide-N	Total soluble N	Protein-N	Total-N
o	200	0.18	0.85	2.68	11.68	17.59	20.79	38.38
	150	0.11	1.73	3.01	10.73	20.27	20.78	41.05
	100	0.06	2.37	3.92	11.35	23.68	18.52	42.20
CCC	200	0.18	0.77	2.64	11.61	16.17	23.19	39.36
	150	0.14	1.41	2.75	10.57	17.51	23.21	40.72
	100	0.07	2.15	3.39	10.07	21.20	21.21	42.41
GA_3	200	0.21	0.65	2.48	10.85	14.43	23.87	38.30
	150	0.20	1.42	2.52	9.86	14.74	23.79	38.30
	100	0.12	2.03	3.27	10.36	17.26	22.68	39.94
L.S.D.	5% :	0.009	0.19	0.07	0.5	0.73	0.76	0.76
	1% :	0.01	0.25	0.09	0.66	0.98	1.01	1.01

Table 2 : Effect of water supply and growth regulators on proline content of pea leaves (as μ moles / g. F. Wt.)

Growth regulators	water supply (mm)	Stage I. (50 days)	Stage II. (80 days)
o	200	1.38	1.22
	150	14.37	1.42
	100	24.01	3.37
CCC	200	1.08	1.08
	150	2.25	1.10
	100	10.23	2.22
GA_3	200	1.25	1.12
	150	4.32	1.26
	100	18.19	2.97
L. S. D.	5 %	0.35	0.35
	1 %	0.47	0.47

Table 3 : Effect of water supply and growth regulators on nucleic acids content of pea leaves (as µg ./ g. F. Wt.)

Growth regulators	water supply (mm)	DNA	RNA
Stage I. (50 days) :			
o	200	55.2	127.1
	150	59.6	96.4
	100	56.8	92.0
CCC	200	63.3	153.9
	150	62.9	141.8
	100	61.6	115.6
GA_3	200	93.8	182.8
	150	92.4	161.6
	100	94.9	128.0
Stage II. (80 days) :			
o	200	72.3	135.3
	150	70.1	124.3
	100	69.5	117.0
CCC	200	81.0	156.5
	150	85.5	146.3
	100	82.6	126.5
GA_3	200	95.4	184.0
	150	93.5	162.1
	100	95.8	130.9
L. S. D.	5 %	3.16	9.0
	1 %	4.22	12.31

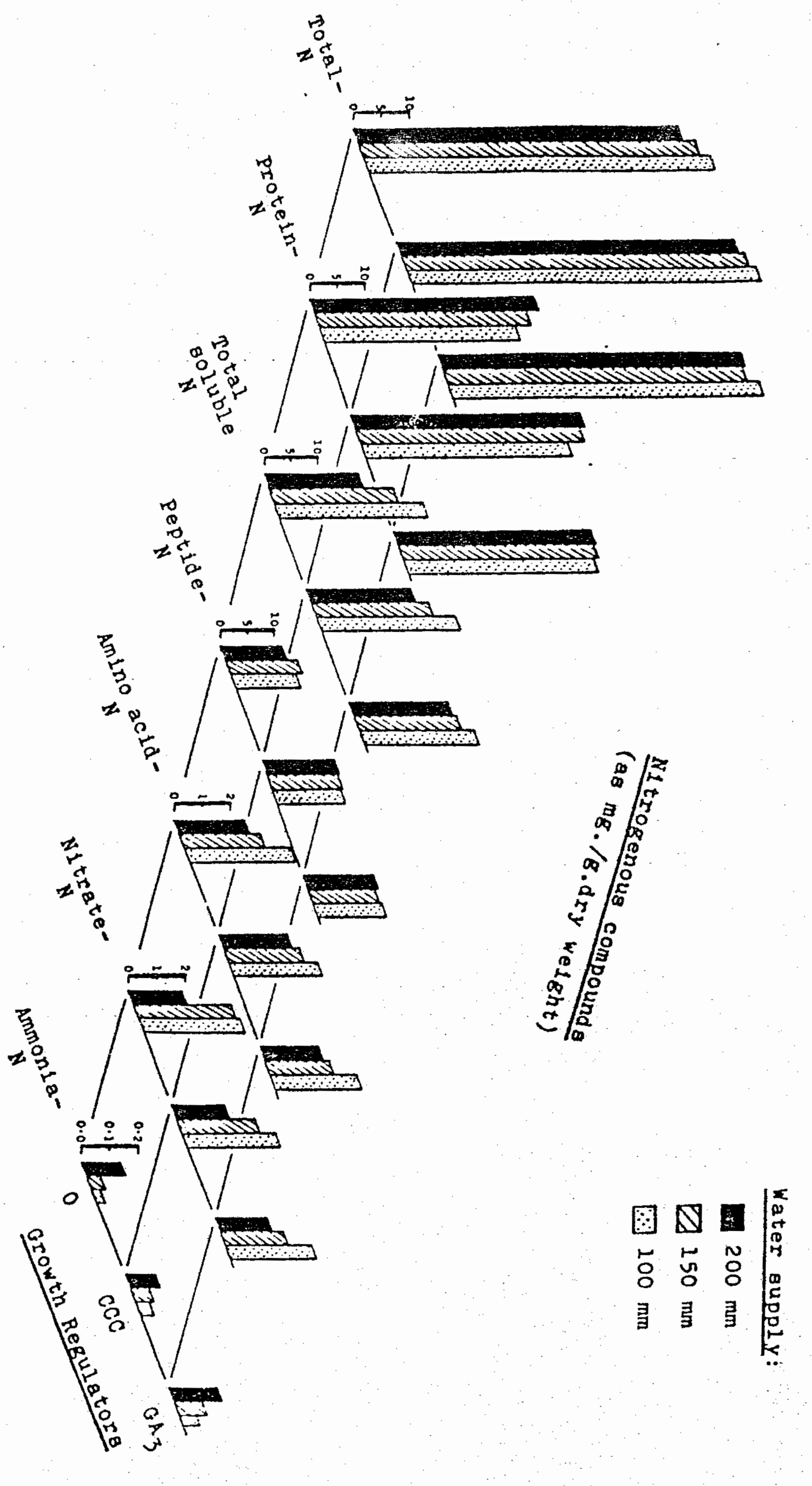

Fig. (1). Effect of water supply and growth regulators on nitrogenous compounds of pea shoots after 50 days of growth.

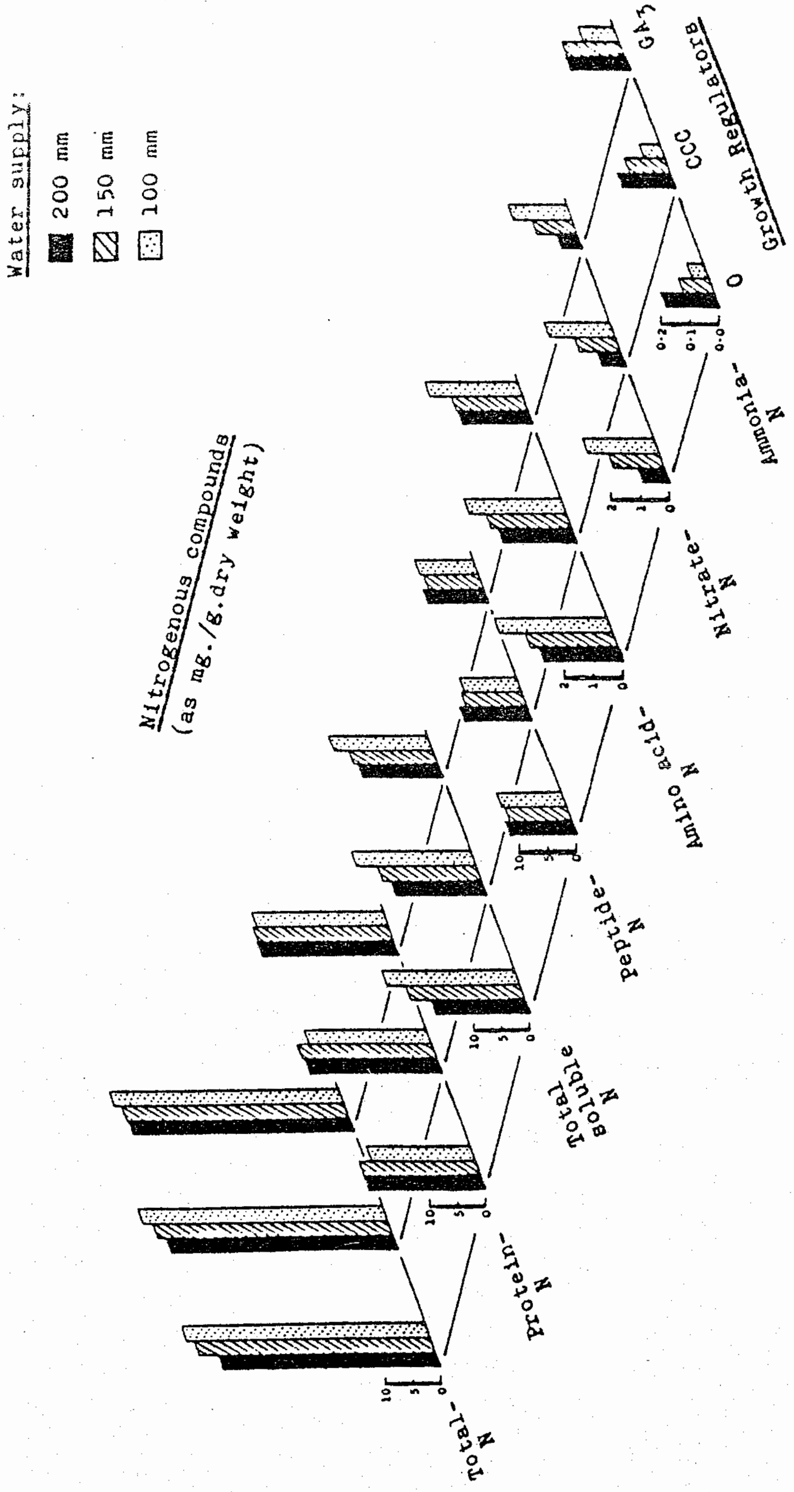

Fig. (2). Effect of water supply and growth regulators on nitrogenous compounds of pea shoots after 80 days of growth.

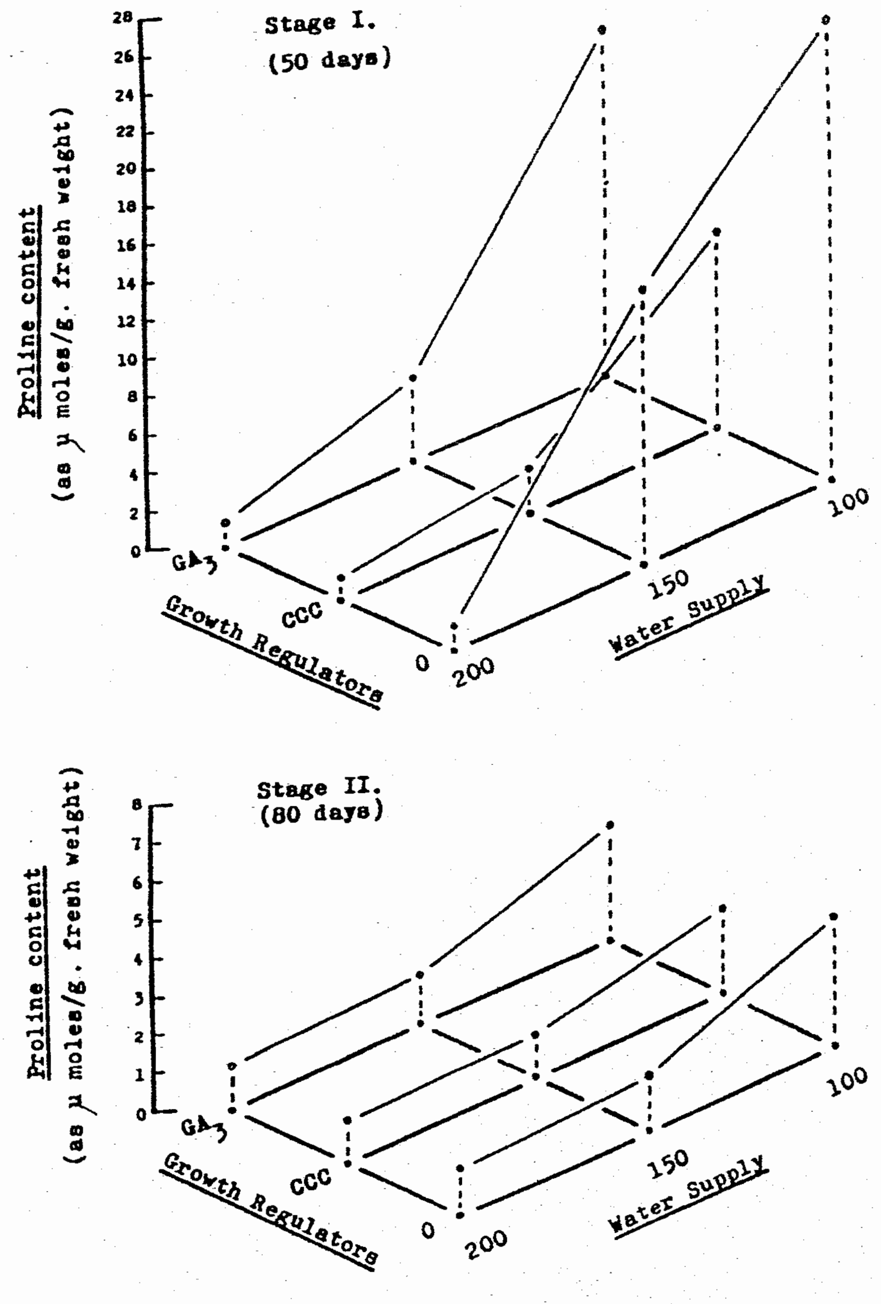

Fig. (3). Effect of water supply and growth regulators on proline content of pea leaves.

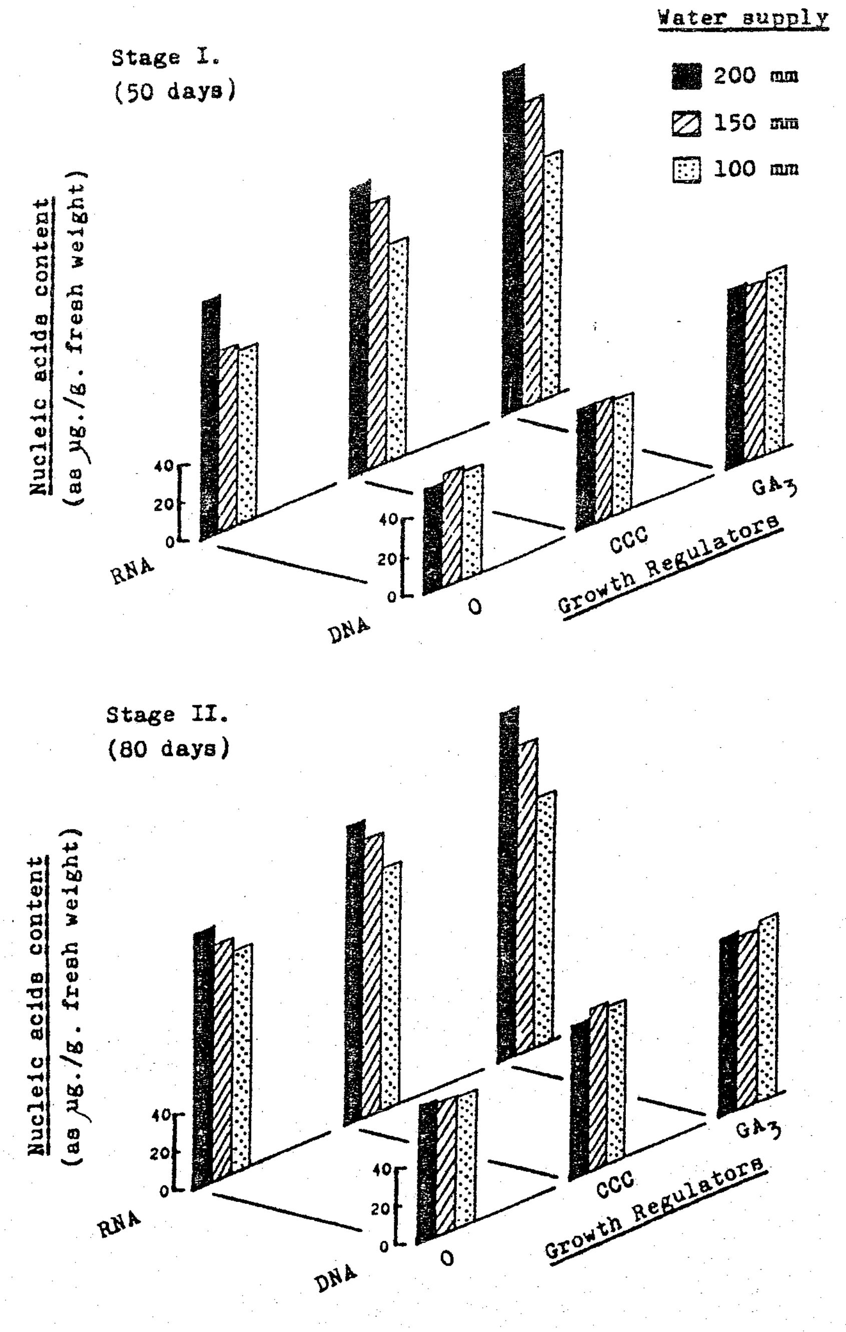

Fig. (4). Effect of water supply and growth regulators on nucleic acids content of pea leaves.

تأثير الإمداد المائى ومنظمات النمو على الأيض النيتروجينى فى نبات البسلة

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يهدف البحث دراسة تأثير الجبريللين والسيكوسيل على الأيض النيتروجينى فى أحد المحاصيل الهامة وهو نبات البسلة تحت ظروف النقص فى الامداد المائى.

فقد زاد المحتوى الكلى للنيتروجين الذائب مع النقص فى الامداد المائى. أما فى النباتات المعاملة بمنظمات النمو فقد كان معدل الزيادة أقل منه فى النباتات الغير معاملة.

أدى النقص فى الامداد المائى الى اختزال نسبة البروتين بدرجة كبيرة الا أن المعاملة بمنظمات النمو أدت الى زيادة المحتوى البروتينى فى مرحلة النضج.

مع النقص فى الامداد المائى زادت نسبة البرولين فى النباتات المعاملة والغير معاملة بمنظمات النمو. إلا إنه بإستعمال منظمات النمو وخاصه السيكوسيل فقد إنخفض المحتوى البرولينى عند مستويات المياه المختلفة .