

## EFFECT OF PERMANENT FERTILIZATION AND AGRICULTURAL ROTATION ON COTTON PLANTS.

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### Abstract

The permanent Experiment at Bahtim has been established in 1912 with three rotation systems of the main crops; cotton, wheat, and corn to study the effect of continuous application of mineral fertilizers and farmyard manure on crop yield. The yield results of cotton plant during 1979 to 1989 was studied and results showed:

- 1 . Mineral fertilization treatments gave highly significant increases in yield of cotton when compared with unfertilized plots. The mineral fertilizer treatments could be arranged as follows: NPK> N> O.
- 2 . The farmyard manure plots gave higher yields of cotton than unmanured plots and were comparable to that obtained by NPK treatment.
- 3 . The cotton yields of the three-year rotation were higher than those of any other rotation.

### INTRODUCTION

Cotton is considered one of the major crops which plays an important role in the Egyptian economy. It is of great interest to investigate the effect of fertilization and agricultural rotations on its yield. El-Damaty and Baradi (1956) analyzed the results of the permanent manuring experiment at Bahtim on crop yields from 1950 to 1955. They found that either mineral or organic fertilization showed a positive responses of cotton yield. Also, they noted that the application of nitrogen and

phosphorus fertilizers showed obvious increases in cotton yield than did nitrogen fertilization alone. Eid (1959) found that the application of calcium superphosphate in combination with nitrogen resulted in a higher cotton yield than did nitrogen fertilization alone. El-Sweedy *et al* (1985) and El-Shafie (1989) showed that the highest yields of cotton were obtained in plots receiving NPK fertilizer under three-year rotation while the least were found in the unfertilized plots under one-year rotation. Also, farmyard manure resulted in higher cotton yields than did the control and N-treatments.

The current work was carried out to study how manuring, fertilizing and rotation affect cotton yield in a long-term experiment.

## MATERIALS AND METHODS

The Permanent Experiment plots at Bahtim were chosen for this work. Some plots of this experiment received mineral fertilizers since 1912, while other received annually 15m<sup>3</sup>/fed. farmyard manure since 1919. The layout of experiment is illustrated in Fig.1. The rotations followed are one-two- and three-year rotations. Fertilization treatments of the three rotations are; unfertilized, N, NP, NPK and farmyard manure "FYM". The rotations (crop system) followed in the experiment from 1979 to 1989 are shown in Table 1. In 1978, the whole area of experiment was infested by herbs and treated with herbicides and left fallow for a complete

Table 1. Rotation followed in the Bahtim permanent experiment from 1979 to 1989

Years	1-year rotation	2-year rotation	3-year rotation
1970	Cotton	Cotton	Cotton
1980	Cotton	Wheat/Corn	Wheat/Corn
1981	Cotton	Cotton	Wheat/Corn
1982	Cotton	Wheat/Corn	Cotton
1983	Cotton	Cotton	Wheat/Corn
1984	Cotton	Wheat/Corn	Wheat/Corn
1985	Cotton	Cotton	Cotton
1986	Cotton	Wheat/Corn	Wheat/Corn
1987	Cotton	Cotton	Wheat/Corn
1988	Cotton	Wheat/Corn	Cotton
1989	Cotton	Cotton	Wheat/Corn

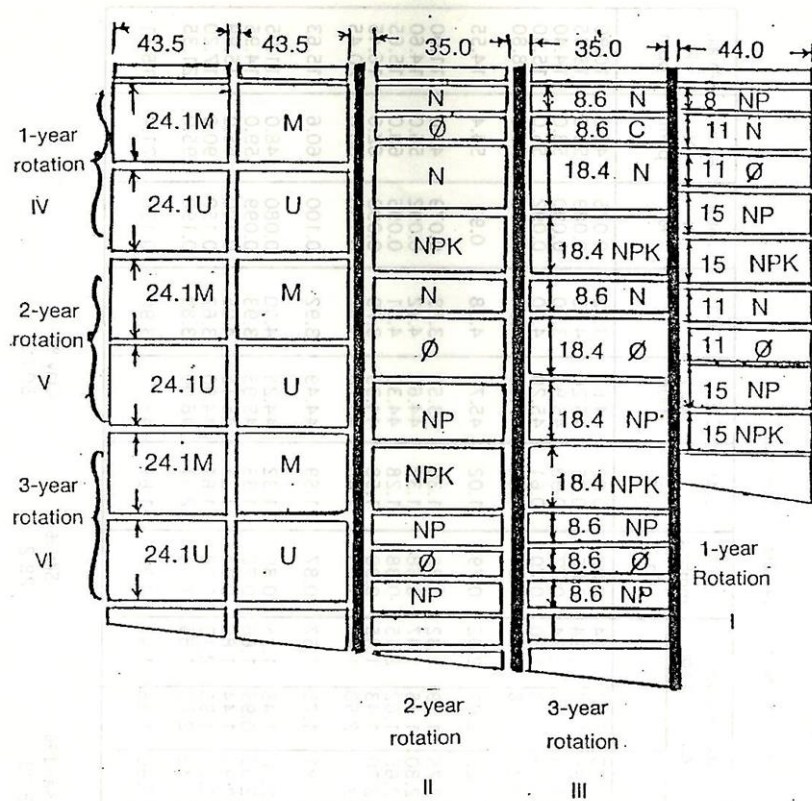


Fig. 1. Plan of the permanent manuring experiment plots at Bahtim 1912-1989 (All dimensions in meters)

Table 2. Physical and chemical properties of the studied soil samples (Surface samples 0-30cm)

Rotation	Treatments	PH	Soluble cations meq/100g soil				Soluble anions meq/100g soil			E.C. mmhos / Cm <sup>2</sup>	O.M %	C.E.C. meq / 100g	CaCO <sub>3</sub> %	Total N %	Avail. N ppm	Avail. P ppm
			Na <sup>+</sup>	Na <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sup>-</sup>							
1-Year	O	7.95	2.17	0.32	2.63	1.37	2.75	2.60	1.14	0.83	0.82	44.65	3.82	0.075	40.0	10.90
	N	8.25	1.56	0.30	2.35	1.75	1.95	1.77	2.24	0.66	0.85	45.20	4.35	0.089	50.0	13.95
	NP	8.20	2.15	0.32	2.30	1.72	1.85	1.90	2.74	0.77	0.99	45.95	3.90	0.090	58.0	14.40
	NPK	8.15	2.22	0.41	2.15	0.85	2.25	1.78	1.60	0.70	0.61	45.20	4.40	0.092	55.0	15.30
	FYM	8.10	1.45	0.69	3.02	1.51	2.30	1.98	2.39	1.01	1.84	47.50	3.91	0.110	70.0	18.80
2-Year	Mean	8.13	1.91	0.41	2.49	1.44	2.22	2.01	2.02	0.79	1.02	45.70	4.08	0.91	54.4	14.55
	O	8.10	1.75	0.28	2.49	1.52	2.75	1.79	1.32	0.85	1.30	43.50	3.93	0.079	45.0	11.00
	N	8.10	1.35	0.29	2.18	1.40	2.80	1.15	1.47	0.68	1.33	44.60	4.12	0.092	56.0	14.60
	NP	8.10	1.92	0.27	2.18	2.05	2.65	1.62	2.15	0.88	1.28	44.30	4.01	0.095	60.0	15.65
	NPK	8.10	1.93	0.35	2.00	1.30	2.70	1.43	1.45	0.90	1.58	44.35	3.79	0.099	62.0	16.45
3-Year	FYM	8.10	1.62	0.58	3.02	1.87	3.15	2.50	1.44	1.05	2.48	45.70	3.92	0.150	80.0	20.45
	Mean	8.10	1.71	0.35	2.37	1.63	2.81	1.75	1.57	0.87	1.59	44.49	3.92	0.100	60.6	15.63
	O	8.00	1.68	0.33	2.45	1.71	2.70	1.45	1.25	0.89	1.32	44.25	4.00	0.080	48.0	11.05
	N	8.10	1.17	0.20	2.06	1.15	2.95	0.95	1.68	0.72	1.35	45.95	3.93	0.099	59.0	14.95
	NP	8.10	1.75	0.35	2.00	2.04	2.90	1.44	1.80	0.94	1.26	45.15	4.05	0.100	65.0	15.99
	NPK	8.10	1.78	0.44	2.63	1.53	2.90	1.35	2.13	1.06	1.61	44.50	3.62	0.150	90.0	17.20
	FYM	8.10	1.95	0.61	3.32	2.04	3.35	2.72	1.85	1.34	2.51	48.00	3.89	0.190	95.0	21.35
	Mean	8.06	1.67	0.39	2.49	1.69	2.96	1.58	1.47	0.98	1.61	45.57	3.90	0.120	71.4	16.11

Mechanical analysis :

Coarse sand %	3.55
Fine sand %	18.20
Silt %	28.25
Clay %	50.00

year period.

Soil analyses were done according to the standard methods. Some physical and chemical properties are shown in Table 2.

The obtained results were statistically analyzed according to Ceapiou (1868).

## RESULTS AND DISCUSSION

The average yield values of cotton obtained under manuring and fertilizer treatments throughout the three rotations over the period 1979 to 1989 are shown in Table 3. Results can be discussed under the following subheadings:

### Effect of manuring and fertilization

For the 1979 season, which followed no cultivation for one year, yields of cotton plants were enhanced for all treatments under study compared with those produced in the following seasons under investigation.

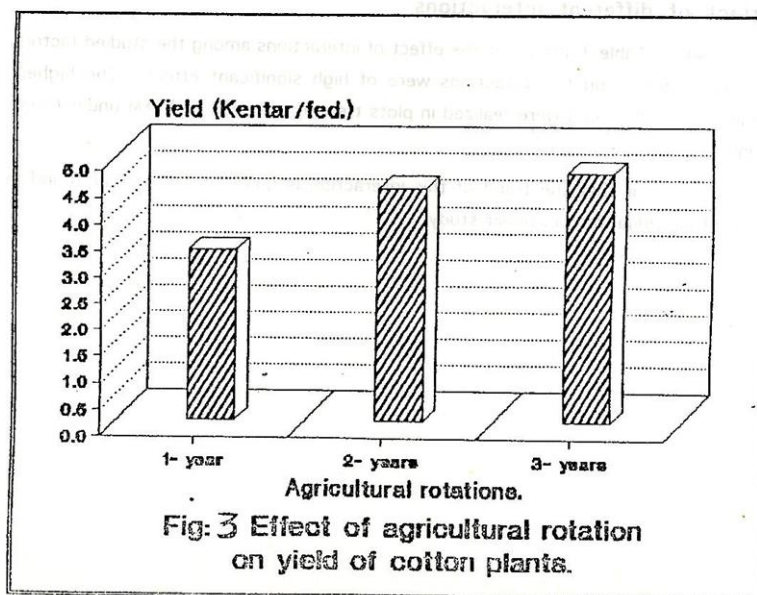
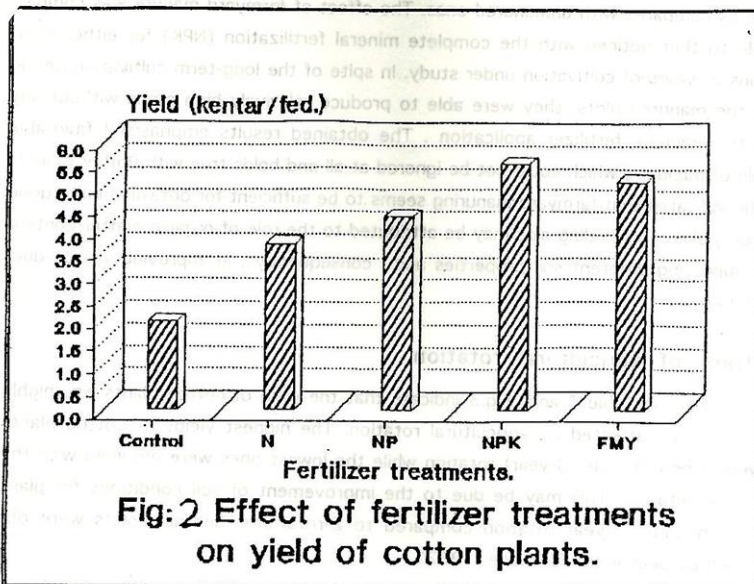
Regarding the effect of mineral fertilizer treatments on cotton yield, data showed highly significant differences between different fertilizer treatments. The highest yields of cotton were found with complete fertilization (NPK), while the lowest ones were found with unfertilized plots for any or both rotations and years of cultivation under study. Generally, the application of superphosphate combined with nitrogen (NP) caused more increase in yields of cotton than did nitrogen alone. Also, application of potassium with superphosphate and nitrogen, (NPK) led to an increment in yield of cotton plants than that of NP fertilization alone, (Fig. 2). This may hold true with findings by El-Sweedy *et al* (1985) and El-Shafie (1989) as they reported that significant increases of cotton yields were realized due to potassium fertilization during the long history of the permanent experiment.

Many investigators handled the effect of potassium fertilization on cotton yield and stated that no significant differences were realized between the NP and NPK fertilization treatments.

The effect of farmyard manure on yield of cotton plants, indicated that the

Table 3. Effect of permanent fertilization and agricultural rotation on cotton yield from 1979 to 1989

Rotations Treatment		Years											Mean
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
1-year rotation	O	1.49	1.51	1.07	0.53	0.12	0.20	0.96	0.78	0.27	0.02	0.17	0.64
	N	3.67	3.46	2.78	0.83	0.25	0.36	2.14	1.67	0.58	0.03	0.35	1.47
	NP	4.47	4.39	2.97	1.17	0.34	0.44	2.61	1.73	0.68	0.06	0.38	1.75
	NPK	5.72	5.64	3.65	1.35	0.35	0.49	3.33	2.28	0.75	0.12	0.42	2.19
	FYM	6.49	4.49	3.50	1.25	0.35	0.43	3.30	2.27	0.73	0.16	0.44	1.96
	Mean	4.01	3.90	2.80	1.03	0.28	0.38	0.38	1.75	0.60	0.08	0.35	1.60
2-year rotation	L.S.D at 5%	Years (Y)				Treatments (T)				YxT			
	at 1%	0.16				0.11				0.36			
		0.21				0.14				0.48			
	O	2.86	1.40		1.23		1.67		0.36		0.28		1.30
	N	5.13	2.90		7.71		2.99		0.92		0.38		2.34
	NP	5.70	4.14		2.16		3.32		1.04		0.72		2.85
3-year rotation	NPK	7.32	4.73		2.55		4.27		1.21		0.80		3.48
	FYM	6.40	4.70		2.47		4.30		1.41		0.81		3.30
	Mean	5.48	3.57		2.02		3.31		0.93		0.60		2.65
	L.S.D at 5%	Years (Y)				Treatments (T)				YxT			
	at 1%	0.18				0.16				0.40			
		0.24				0.22				0.53			
Common years	O	3.03	0.68		1.83		0.22		1.44				
	N	5.12	1.41		3.03		0.32		2.41				
	NP	6.05	1.31		3.52		0.89		2.94				
	NPK	7.78	1.42		4.53		1.39		3.78				
	FYM	7.67	1.30		4.30		1.63		3.73				
	Mean	5.63	1.17		3.44		0.90		2.86				
Common years	L.S.D at 5%	Years (Y)				Treatments (T)				YxT			
	at 1%	0.10				0.12				0.23			
		0.14				0.16				0.31			
	Mean	5.14	3.07										
L.S.D at 5%		Rotations (R)	Years (Y)		Treatments (Y)		(T)ExY		RxT	YxT	RxyxT		
at 1%		0.13	0.10		0.16		0.18		0.28	0.23	0.40		
		0.17	0.14		0.22		0.24		0.38	0.31	0.53		



yields of cotton plants were greatly increased in the plots receiving farmyard manure as compared with unmanured ones. The effect of farmyard manure was comparable to that noticed with the complete mineral fertilization (NPK) for either rotations or years of cultivation under study. In spite of the long-term cultivation period of the manured plots, they were able to produce relatively high crops without any further mineral fertilizer application. The obtained results emphasised favorable role of manuring which could not be ignored at all and holds true with Pother (1981) who indicated that farmyard manuring seems to be sufficient for obtaining quite good crop yields. This finding also may be attributed to the role of organic matter content in improving different soil properties and, consequently, in improving soil productivity.

#### Effect of agricultural rotation

Data in Table 3 and Fig.3 indicate that the yield of cotton plants was highly significantly affected by agricultural rotation. The highest yields of cotton plants were achieved under 3-year rotation while the lowest ones were obtained with the 1-year rotation. This may be due to the improvement of soil conditions for plant growth under 3-year rotation compared to 2-rotations. Similar results were obtained by Beatty and El-Dridge (1982)

#### Effect of different interactions

Data in Table 3 show that the effect of interactions among the studied factors, all expected di- and tri-interactions were of high significant effect. The highest yields of cotton plants were realized in plots treated with NPK and FYM under three-year rotation.

It is clear that the trend of this interaction is quite similar to that found in case of individual factors under study.

## REFERENCES

- 1 . Beatty, K.D. and I.L. El-Drdige. 1982. Crop sequencing effect on soil organic matter, pH, EC, plant nutrient levels and crop yields, Conservation implications. Agron. Abs., Annual meetings : 161.
- 2 . Ceapoiu, N. 1968. The theoretical bases of statistical analysis. Editura Agro-Silvica, Bucuresti, pp 351-371.
- 3 . Eid, M.T. 1959. Role of phosphate in Egyptain Agriculture, Ministry of Agric. Egypt, Bull. 297.
- 4 . El-Damaty, A.H. and T.A. El-Baradi. 1956. Results of the permanent manuring experiment at Bahtim of crop yields form 1950-1955. Ann. Agric. Sci. Cario , 1:143-153.
- 5 . El-Sweedy, A.M., N. Abou El-Ezz and A. Shoukry. 1985. Results of permanent manuring experiment at Bahtim of crop yields from 1970-1981. 1-Cotton. Agric. Res. Rev., 63 : 197-209.
- 6 . El-Shafie, A.I.E. 1989. Interaction effect between rotations and fertilization on some chemical and hysical properties of soil and crop yield. M. Sc. Thesis , FAc. Agric. Ain Shams Univ., Egypt.

## تأثير التسميد والدورة الزراعية علي محصول القطن بقطع التجربة المستديمة ببهتيم في الفترة من ١٩٧٩ الي ١٩٨٩

سمير صديق مجلع  
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معهد بحوث الاراضى والمياه - مركز البحوث الزراعية - الجيزة

أختبرت التجربة المستديمة ببهتيم والتي أنشئت عام ١٩١٢ بنظام الثلاث دورات زراعية للمحاصيل الرئيسية وهي القطن والقمح والذرة لدارسة تأثير التسميد المعدني والعضوي المستديم علي غلة المحاصيل.

وتم دراسة محصول القطن خلال المدة من ١٩٧٩ الي ١٩٨٩ تحت تأثير هذه التجربة للمناقشة

ولقد أوضحت النتائج المتحصل عليها الاتي :-

- ١- معاملات التسميد المعدني المستديم كانت ذات تأثير عالي المعنوية علي غلة محصول القطن اذا ما قورنت بالقطع الغير مسمدة.
- ويمكن توضيح تأثير هذه المعاملات كالآتي: معاملة التسميد الكامل (ن فوبو) > سوبر فوسفات + نتروجين (ن فو) > التسميد النتروجيني (ن) > الغير مسمدة
- ٢- الاضافة المستمرة للسماد البلدي أدت الي زيادة واضحة في غلة محصول القطن عن القطع الغير مسمدة وكان التأثير موازياً لتأثير معاملة التسميد المعدني الكامل (ن فوبو)
- ٣- حققت الدورة الزراعية الثلاثية أكبر غلة لمحصول القطن عن باقي الدورات الاخرى الاحادية والثنائية.