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CROP MANAGEMENT STUDIES BY THE EGYPT WATER USE AND MANAGEMENT PROJECT

By:

Mohamed Abdel Naim

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ABSTRACT

A distributary canal and farm watercourse system serving 1200 feddans in Middle Egypt was renovated to provide controlled gravity flow for improved efficiency and equitable water distribution. Brief physical, social and farming system background on the irrigation practices, attitudes and behavior of the farmers and the results of an irrigation performance evaluation are given as related to the designed irrigation improvements that were implemented in the physical hardware of the system. This information was integrated into the irrigation system management needs for the distributary system as specifications and limitations of a management plan. An innovative process was introduced for the development and adoption of a joint management plan with shared responsibility and authority demarcated between the personnel of the irrigation department and the farmers' water users association. The introduction of a joint management plan and the consequent responsibilities required the introduction of a new irrigation foreman role in the heirarchy of the irrigation department as the critical interface between the department and the end users of water. The management plan was placed in a framework relative to levels of jurisdiction and the types of control exerted on the system. The system management plan that was evolved through consultation, dialogue, negotiation, interaction and agreement with the distributary canal committee consisted of five major sections: water requirements, weather delivery, maintenance, conflict management and duties and responsibilities of the persons involved. The requirements for working with farmers and managers of the irrigation administration and the critical constraints for successful implementation were discussed as they related to the institution of new personnel and new roles for the irrigation department and the continuing need for action research to glean the lessons from the trial effort.

بسم الله الرحمن الرحيم

مستخلص

يتضمن التقرير التالى تقييم مقومات الاساليب الحديثه فى محطه الابحاث التجريبيه تحت الظروف الطبيعيه لمستوى الاداره للفلاح ٠تمت هذه التجارب فى منطقه المنصوريه كفر الشيخ ،منطقه المنيا حيث تم تحليل ودراسه الوسائل التكنولوجيه المقترحه والتى يقبلها الفلاحون ٠ تم تجميع هذه البيانات بمعرفه فريق البحث فى مواقع العمل خلال الفتره من سنه ١٩٧٨ــ١٩٧٩، ١٩٧٩ــ ١٩٨٠، ١٩٨٠ــ ١٩٨١ وذلك خلال الاعوام الزراعيه فى مناطق معهد بحوث المياه الثلاثه وتضمنت موضوعات البحث الزراعيه الكثافه النباتيه ،معدلات التسميد وكذلك التحكم فى كميه المواد التى تستخدم فى مقاومه الحشرات وكذلك بتنويع المحاصيل وطرق الرى الحديثه ٠ وتم هذا على عده محاصيل مختلفه فى مناطق البحث الثلاثه ٠

اجريت تجارب بحوث المياة الحقلية في ٦ حقول بمنطقة ابوريا وذلك لدراسة الطرق التقليدية للفلاح مع ادخال بعض التحسينات باتباع الاساليب الاقتصاديه للزراعة الحديثة ٠

عموما قد سجلت زياده ملحوظة في انتاجية المحاصيل وذلك باتباع الاساليب الحديثة التى اوصت بها وزارة الزراعة ٠

ويمكن الوصول الى معدلات اعلى فى انتاجية المحاصيل اذا طبقت طرق الرى الحديثة عموما فان بحوثا اضافية مطلوبة لدراسة البدائل التى تناسب امكانيات الفلاحين المحدودة ٠

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INTRODUCTION

Crop Management deals with principles and practices of production and field management. Higher crop production will result from improving management practices such as water management, better machinery, the use of agricultural chemicals and the growing of superior cultivars. Farmers in developed communities generally are quick to adopt those improvements that fit into their system of management. This is evident from the acceptance of hybrid cultivars of corn, sorghum and sunflowers, farm mechanization, fertilizers and chemical pesticides. This results in a considerable increase in output per farm. Where the proposed component technology does not fit the farming system, on-farm research must be conducted to adjust the new technology to fit the farmers circumstances.

Component technology research conducted on an Experiment Station generally is conducted at an optimal (non-limiting) level of the non-experimental variables. Under farmers conditions the non-experimental variables are seldom at optimum levels, and a component technology which is highly effective on an experiment station may fail when introduced to a small farmer with limited resources. Thus, individual component technologies coming from Experiment Station research should be tested under farmers conditions where the level of other management practices are determined by the farmers environment. Farmers will be inclined to accept the technology that gives the most return with the least input and with minimal risk. Management practices, other than those proposed for introduction, probably will be continued at the traditional level. The purpose of the field trials reported here was to test under the farmers conditions the introduction of component technologies believed, as the result of the diagnostic analysis, to be limiting crop production in the Egypt Water Use and Management Project (EWUP) study areas. This report summarizes the results of these trials conducted in the three Project sites: Mansuriya, Kafr El-Sheikh and El-Minya and to analyze for possible acceptance of the proposed technologies.

MATERIALS AND METHODS

Analysis of the on-farm diagnostic surveys in each of the three Project sites identified symptoms of a number of crop production constraints. The teams then designed on-farm investigations to test the following hypotheses proposed to improving crop management practices.

1. Low plant densities limited the production potential of tomato, cabbage, corn and cotton.
2. Fertilizer supplies were not adequate to the the farmers' perceived requirements. Field team members also noted that, when fertilizer was available, it was often applied improperly, and in some areas farmers applied more fertilizer than was necessary.
3. Crop yields were reduced because farmers did not use insecticides to control aphids; high infestations of aphids were noted on most crops, but the cotton crop was an exception, and insect control on cotton was practiced regularly.
4. Crop yields can be increased by using improved crop varieties not yet available to the farmer.
5. On-farm water management practices can be improved by land leveling, the use of a long furrow irrigation, larger stream flows and gravity irrigation.

Two types of on-farm studies were conducted.

1. Field trials to study component technologies under farmers conditions.
2. On-farm trials to evaluate MOA recommended practices.

Field Trials To Test Component Technologies

The on-site teams conducted field trials in the three Project sites; Mansuriya, Kafr El-Sheikh, and El-Minya during the 1978/79, 1979/80 and 1980/81 agricultural years. The purpose of these trials was to test component technologies developed at the Research Institutes on farms under farmers management circumstances.

Field trials conducted to test component technologies included the following:

- Density of plantings (plant population)
- Rates and methods of fertilizer application
- Use of chemical pest control
- Use of new varieties
- Improved water management practices

On-Farm Trials To Evaluate Ministry Of Agriculture (MOA) Recommendations

Crop management practices were studied by the Project team during the 1981/82 agricultural year to compare the results of MOA recommendations with farmer practices. To do this, trials were conducted on both winter and summer crops.

RESULTS AND DISCUSSION

Field Trials To Test Component Technologies

Plant Density Studies

Field trials were conducted on farmers fields for both winter and summer crops of cabbage, cotton, broad beans and maize.

A survey of crop management practices in El-Hammami area had shown that low plant populations of cabbage and pest infestations of green worms and aphids were probable causes of poor yields.

These cabbage trials involved a reduction in the traditional row spacing from the traditional 88 to 55 cm and a triangular planting method. The tests were conducted on paired fields selected at random in El-Hammami. There were three treatments:

1. The control or traditional practice;
2. the Project's recommended practice; and
3. the farmers adjustment to the recommended practice.

Throughout the whole growing season, plants were sprayed by Project personnel for control of white fly and cabbage green worms. Although this test spraying proved to be very effective, this was not the usual farmer practice in El-Hammami.

The effect of the three management practices on yield of cabbage heads is shown in Table 1. The fertilizer application was similar for the three management practices. The primary difference among the three management

Table 1. Effect Of Three Management Practices On Yield Of Cabbage

Management Practice					
Fertilizer Application Rates Per Feddan					
Type of Management	Row Spacing (cm)	Kg N	Manure Donkey Loads	Phosphate	Yield - Heads per Feddan
Farmer's Traditional Practice	88	120	120	None	10,200
Farmer's Adaptation of Recommendation	74	158	150	None	15,400
EWUP Recommended Practice	55	158	100	None	19,200

practices is the row spacing. The EWUP recommended practice (55 cm inter-row spacing) produced about 90% more heads per feddan than the farmers traditional practice (88 cm inter-row spacing). The farmer changed the recommended row spacing from 55 to 74 cm. This increased the number of heads per feddan about 50%, but still 20% below the number of heads produced by the EWUP recommendation.

Cabbage yield was determined in head per feddan rather than tons per feddan because cabbage is sold on the local markets on a head basis rather than a weight basis. Head size was proportionally larger for cabbage produced on the wider rows and a measurement of weight yield would have shown smaller differences among the three row-spacings. Quality, as judged by firmness of the head, was greater, however, for the small heads. As with head size, quality often is not a factor in the selling price at the Egyptian market.

As previously noted surveys during problem identification had shown that plant densities of most crops were below those recommended by the MOA. In a preliminary investigation, the effect of plant stand on yields of maize, cotton and broadbeans grown in Abyuha area was determined by comparing crop yields on paired fields selected to represent different plant densities. The data in Table 2 shows that plant densities may be 50% or more below those recommended by MOA, and that low plant densities are associated with low crop yields.

Since the preliminary results indicated the need for a more extensive investigation of the effect of plant densities on crop yields, detailed field surveys were conducted with broadbeans and maize in Abyuha and with cotton in Kafr El-Sheikh.

Data for the broadbeans study were obtained from three fields selected at random in each of four areas in Abyuha. Plant populations and yields were determined for each field. The data summarized in Table 3 show that yields increased with an increase in plant population. A regression analysis of the data plotted in Figure 1 shows that the linear relationship is strong to about 140,000 plants per feddan, the maximum plant stand observed.

The regression equation is:

$$Y = 5.53 + 0.0014X,$$

where "Y" is yield in ardabs per feddan and "X" is the plant population per feddan. The correlation coefficient (f= 0.94) is highly significant. As noted in Table 2 plant stand had little effect on straw (forage) yield.

Table 2. Preliminary Survey Of The Effect Of Plant Density On The Yield Of Different Crops At Abyuha (El-Minya).

Farmer	Crop	Plants/Feddan*	Yield/Feddan
1	Maize	10,000	8.9 ardabs
2	Maize	16,000	12.5 ardabs
1	Cotton	38,000	2.9 qintars
2	Cotton	46,000	4.5 qintars
1	Broadbeans	52,000	5.9 ardabs
2	Broadbeans	140,000	13.2 ardabs

*MOA recommended plants/feddan: maize - 24,000
cotton - 70,000
broadbeans - 175,000

Table 3. The Effect Of Plant Population On Grain And Straw Yield Of Broadbeans During The 1979/80 Winter Season At Abyuha (El-Minya Area).

Abyuha Area	Field	Mean Plant Population Per Feddan (x 1000)	Grain Yield Ardab/Feddan	Straw Yield Ton/Feddan
1	1	86.4	6.37	3.16
	2	85.6	6.76	3.14
	3	140.0	13.17	3.18
2	1	87.3	5.12	1.32
	2	99.6	8.52	2.10
	3	104.0	10.51	2.55
3	1	94.0	7.66	3.00
	2	95.0	7.61	2.36
	3	121.0	11.83	3.67
4	1	96.8	8.12	2.77
	2	97.2	8.50	2.63
	3	109.0	10.80	2.34

MOA recommended plant population - 175,000 plants/feddan.

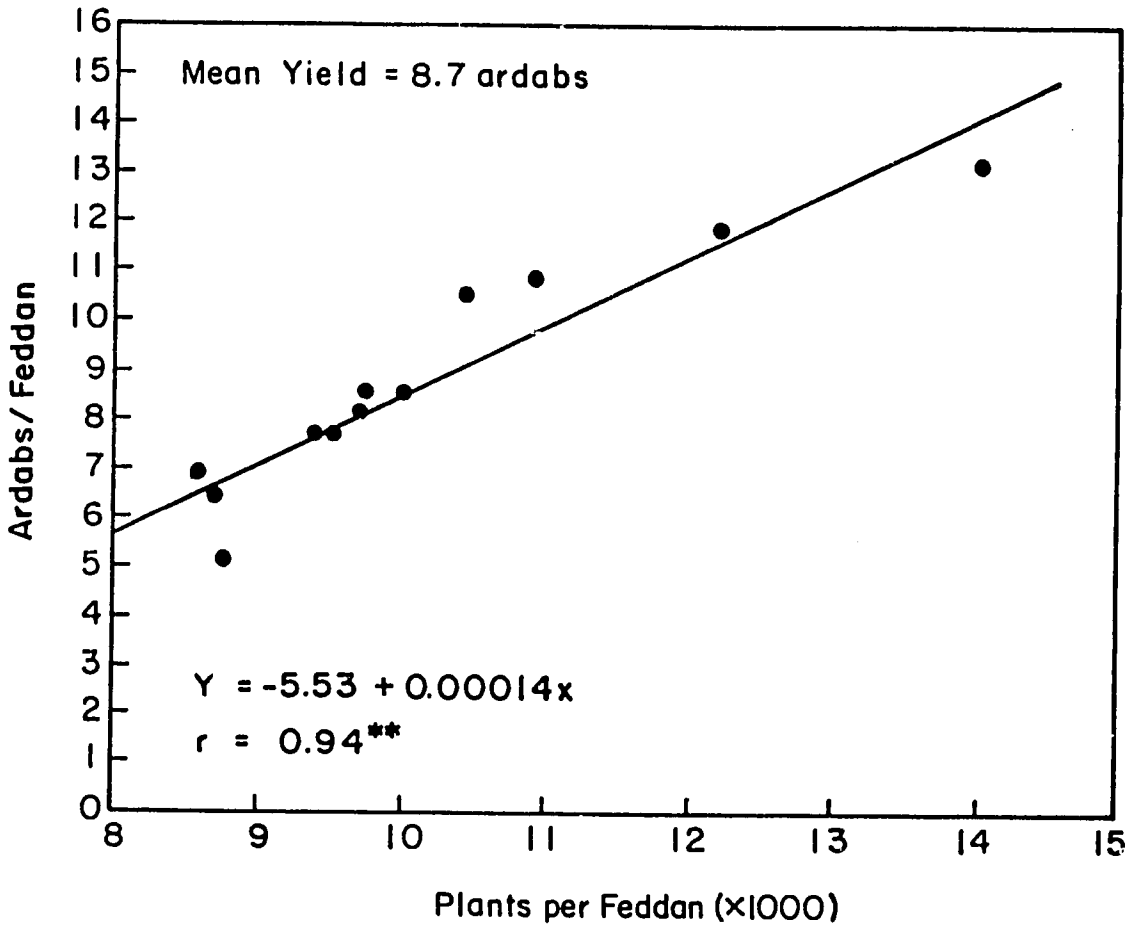

Figure 1. Simple Regression Between Plant Densities And Yield of Broadbeans in Abyuha, 1979-80.

Although the linear effect of plant stand on grain yield was observed to about 140,000 plants per feddan, yield increases probably will lose linearity beyond approximately 150,000, or 85% of the MOA recommended stands of 175,000. In the Abyuha farming system environment, 13 to 14 tons per feddan are probably the maximum yields that can be expected. In considering increasing plant stands as an improved technology, a survey should be conducted to determine the proportion of fields in Abyuha that have stands above or below about 12,500. If the population of broadbeans is below 12,500 plants per feddan in most fields, improving plant stands should receive major attention. If plant stands are greater than 12,500, few adjustments in plant stands can be made without considerable adjustment in the farmers' practice. This probably would limit the use of stand improvement as an appropriate technology for farmers with limited resources.

The study with maize was conducted in Abyuha. Nine fields planted to Balady maize were randomly selected, as with broadbeans, and plant populations and yields were determined for each field. The results of the study are plotted graphically (Figure 2) and a regression analysis gave the following equation:

$$Y = 7.3 + 0.003X,$$

where "Y" is the yield of maize in ardabs per feddan and "X" is the plant population per feddan. The correlation coefficient ($r = 0.69$) was significant at the 0.05 level. The maximum grain yield was 11.8 ardabs per feddan with a plant population of 13,000, about 55% of the MOA recommended population. The equation can be considered to continue linearly to about 18,000 plants per feddan.

The cotton plant population studies were conducted in Kafr El-Sheikh. The optimum cotton plant population recommended by MOA is 70,000 plants/feddan (35,000 hills/feddan). Plant population counts obtained in 1980 through the soil fertility survey (PTR #10) in Abu Raya revealed that the cotton plant density ranged from 18,750 to 49,500 plants/feddan.

The Kafr El-Sheikh team conducted trials in 1980 in Om-Sen to evaluate the EWUP irrigation improvement package on six farms in On-Sen. The improvement package included precision land leveling, deal level-long furrow irrigation, irrigation scheduling, recommended fertilizer and pesticides and improved stands.

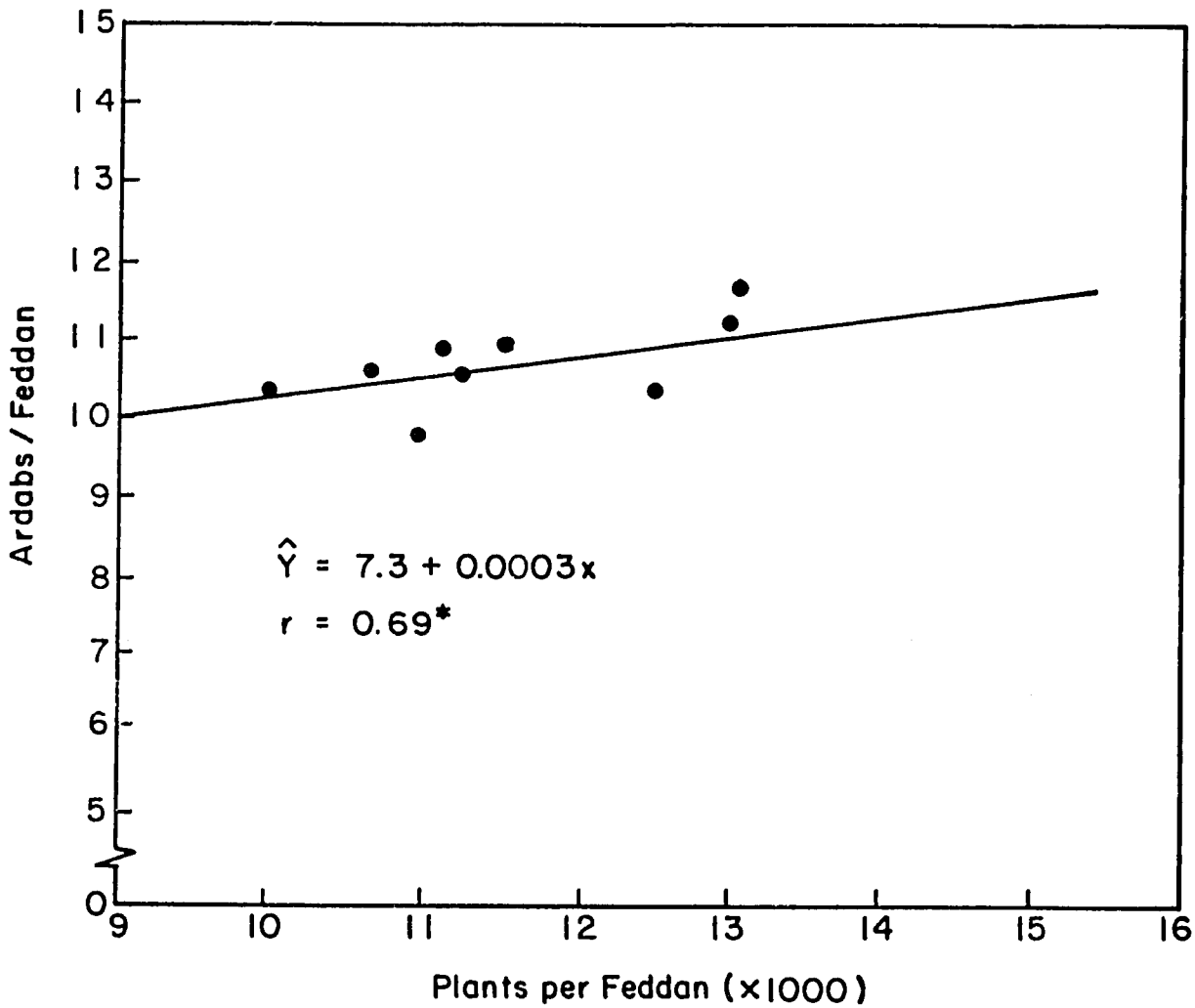

Figure 2. Regression Between Plant Density And Yield Of Maize In Abyuha, 1979.

Traditionally the farmer is ineffective in leveling his land, hence he uses small basins. Farmers usually follow MOA fertilizer and pest control recommendations, but do not attain the recommended plant stands.

The field trials were conducted as paired treatments on each field. Results of the trials on six farms are shown in Table 4. There was a 19% yield increase to EWUP's irrigation improvement package. Plant stands were approximately 60% of that recommended by MOA. The lack of difference between the two treatments probably reflects an influence of the EWUP treatment on the farmers management of the "traditional" practice. The 60% stand level for the EWUP treatment also indicates a basic difficulty that farmers have in attaining MOA plant density recommendations. A possible direction for future research may be to investigate the farmers problems associated with obtaining recommended plant stands.

Fertilizer Trials

The diagnostic analyses survey had indicated that farmers felt that fertilizer supplies were not adequate for their needs. The team also reported that fertilizers were not applied properly. Fertilizer trials were conducted to test the validity of these opinions.

In 1980 five fields were selected at various locations in the Mansuriya area to study the effect of nitrogen fertilizer on the yield of maize. Each field was planted with the Early American variety. Nitrogen was applied at the rate of 50, 60, 75 and 100 kg N/feddan. The traditional rate of fertilization was 50 kg nitrogen per feddan. Each field constituted one replication.

The results of this study, presented in Table 5, indicate that, except for the 100 kg N/feddan levels, there was little variation in the average grain yield among the four levels. The lower yield at the higher rates of nitrogen fertilizer may be due to imbalance between nitrogen and other macro/microelements in growth medium. Thus, based on this limited test, a nitrogen rate of 50 kg N/feddan was sufficient for maize in Mansuriya. Unfortunately, since there was no zero rate, it was not possible to evaluate production on the base nitrogen fertility level of the soil. Additional field studies are needed to evaluate the need for the initial 50 kg rate of nitrogen.

Table 4. The Effect of Plant Population On Yield Of Cotton In The Field Trials On Farms Served By On-Sen, 1980.

Farm Designation	Farmers' Practices (Traditional Methods)		EWUP's Irrigation Improvement Package	
	Number Of Plants/Feddan	Yield Qintar/Feddan	Number Of Plants/Feddan	Yield Qintar/Feddan
3-16	35100	8.9	40400	11.7
3-17	32100	7.7	27000	9.4
3-13	55700	6.7	58100	6.9
3-14	39300	4.0	22700	3.4
$3\text{-}15_a$	33300	7.7	57300	6.9
$3\text{-}15_t$	41200	6.5	52100	11.0
AVERAGE	41200	6.9	42900	8.2

L.S.D. YIELD (0.05) - 1.86
L.S.D. STAND (0.05) - NS

Table 5. Yield Of Maize Grain in Tons Per Feddan As Affected By Nitrogen Fertilization on Mesqa 6, Beni Magdul, 1980.

Nitrogen Level Kg N/fed	Field					Mean Yield	Relative Yield
	I	II	III	IV	V		
50	1.7	2.8	2.4	1.4	1.9	2.0	100
60	1.6	2.8	2.4	1.6	1.4	1.9	95
75	1.7	3.1	2.3	2.1	1.0	2.0	100
100	1.8	2.5	1.7	1.1	1.0	1.6	80

LSD 0.05 for mean yield - N. S.

The time of fertilizer application, relative to stage of plant growth, was tested for cotton on four farms in El-Manshiya. The two methods of application of the 60 kg N/feddan were 1) 30 kg after thinning and 30 kg before the third irrigation and 2) 30 kg applied before planting and 30 kg after thinning. The results from two farms indicated little difference between the two treatments. The first treatment was the MOA recommendation. Farmers, in general, follow the recommended method of fertilization for cotton, but generally apply 20 to 30 percent more nitrogen than recommended.

A rice test was conducted to determine the effect of applying urea by 1) two surface applications after transplanting (the traditional method) or 2) a single application at the time of puddling the soil. The fertilizer rate was 60 kg N per feddan with 1 kg $ZnSO_4$ per garat in the nursery. Application of urea before preplanting (treatment 2) increased the grain yield from 1.9 to 3.2 ton grain per feddan. When urea is incorporated during puddling, the resulting anaerobic conditions will reduce nitrification of the urea and the denitrification losses that occur when urea is surface applied. The yield response to the preplant application of urea is attributed to the more effective utilization of the fertilizer when placed in an anaerobic environment.

A complex liquid fertilizer mixture, "Bayfolan" is begin sold for foliar application on cotton. The composition of Bayfolan is given in Table 6. It is an 11-8-6 fertilizer with a few ppm of six micronutrients. A complex mixture, such as Bayfolan, is difficult to evaluate, but since it is sold commercially in Egypt, the team believed the material should be tested. The manufacturers recommend foliar application of their product.

To evaluate the effect of foliar applications of Bayfolan on cotton, field trials were designed with two treatments:

1. Check - The farmers traditional method of applying fertilizer.
2. Foliar fertilization - Two foliar application of Bayfolan.
3. Other - Management practices were those normally used by the farmers in the area.

The first foliar application of fertilizer was applied when the cotton plants were in flowering but had not yet started boll-formation. The second foliar application of Bayfolan was applied approximately 15 days later, or at the start of boll-formation. The rate used in application was 0.8 liters Bayfolan in 400 liters of water per feddan. Since this application rate would supply only minute quantities of nitrogen, phosphorus or potassium, it should be considered as a micronutrient fertilizer.

Table 6. Composition Of "Bayfolan", A Liquid, Foliar Applied Fertilizer Used For Cotton And Maize Studies, 1978-79.

Constituent	Composition %
Nitrogen, N	11
Phosphorus, P	8
Potassium, K	6
	-ppm-
Iron, Fe	.185
Cooper, Cu	.80
Cobalt, Co	.04
Manganese, Mn	.180
Zinc, Zn	.60
Molybdenum, Mo	.09
Boron, B	.113

The test was conducted using paried treatments on 25 fields. Four components of yield-plant height, bolls per plant, number of fruiting branches and seed yield-were used to evaluate treatment effects. Results of the study, are given in Table 7. The foliar application of Bayfolan increased the three components, plant height, number of bolls per plant and seed yield. The number of fruiting branches was not affected by foliar Bayfolan. The yield for lint was not determined, but it was assumed that the increase in bolls per plant and in seed yield would also result in an increase in yield of lint.

Similar results were obtained with maize grown on three farms in Abyuha. Bayfolan was sprayed one time on the plant at the ate of 0.8 liter Bayfolan per 200 liters water per feddan. The results, presented in Table 8, show that the foliar application of Bayfolan one time increased the yield of corn grain by 1.3 ardabs above the control.

Since Bayfolan contains ten minerals (Table 6), in variable amounts, it is difficult to state the primary factor involved. It is beyond the scope of this work to attempt to isolate this effect, but it is assumed that the response is to one of the micronutrients because the macrofertilizer rate is nearly negligible.

Variety Trials

On-farm trials are needed to determine if the benefit of the improved varieties observed in Research Station trials are effective in the farmers management system. Maize and wheat variety trials were conducted in the Mansuriya study site.

Maize

In Mansuriya, the field team selected seven fields in 1980 to evaluate varietal effects of Early American, Pioneer 514 and the Balady varieties on grain production.

The results are shown in Table 9. The highest yielding variety was Pioneer 514, with an average of 2.21 ton/feddan, then Early American with an average of 2.04 ton/feddan. Yields of Pioneer 514 and Early American were 19 and 18% respectively, greater than the Balady variety.

Pioneer 514 is a longer season variety, requiring a planting date which is somewhat earlier than that used in tests to obtain maximum performance. The need for a longer growing season might cause problems for farmers since the land is cropped continuously and farmers try to maximize total returns

Table 7. The Effect Of Foliar Applied Bayfolan On Four Yield Components of Cotton Grown at Abu-Raya (1978).

Treatment	Plant Height (cm)	Number of Bolls/Plant	Number of Fruiting branches	Seed Yield T/feddan
Control (traditional)	89.9	19.3	1.2	1.02
Foliar Fertilizer*	102.1**	25.8*	14.2	1.29**
% increase	14	34	16	26
LSD 0.05	3.5	2.10	NS	0.39
LSD 0.01	4.7	2.85	--	0.61

* Bayfolan at 0.8 liter per feddan

** Highly significant increase over the control

Table 8. Effect Of Foliar Application Of Bayfolan On Yield of Maize, Abyuha, 1979.

Treatment	Field			Mean Yield ardab/feddan*
	1	2	3	
Control	13.5	13.4	13.9	13.6
Bayfolan, 1 application 1 month after planting	15.1	15.0	14.6	14.9

LSD (0.05) - 1.3 ardabs/feddan

Table 9. The Yields Of Three Varieties Of Maize Grown On Seven Fields In El-Mansuriya (Ton/feddan).

Variety	Field							Mean Yield*
	1	2	3	4	5	6	7	
Pioneer 514	2.5	2.5	1.4	3.0	2.6	1.7	1.8	2.21
Early American	1.6	2.8	1.5	2.9	2.4	1.6	1.5	2.04
Balady Local Variety	2.4	1.5	1.8	2.7	1.4	1.3	1.4	1.78

LSD Variety Mean (0.05) 0.43 ton/feddan

with crops of higher value than corn. Pioneer 514 is about 20-30 cm shorter than Early American, and is uniform in height with short thick ears. Early American is tall with long ears and other characteristics similar to the Balady variety but is more uniform in height and conformation than Balady.

Balady is not as uniform as the improved varieties and considerable variation in plant characteristics is observed. The yield of Balady was higher than expected, especially when considering the low plant population. In some case, Balady was severely lodged because of corn borers, while Pioneer 514 and Early American were not as susceptible to borers.

The relationship between plant population and yield for each variety grown in El-Mansuriya was analyzed using regression analysis. The "r" values for Pioneer 514, Early American and Balady were 0.30, 0.05, and 0.57, respectively. This indicates that variations in plant population had a greater effect on yield for Balady maize than for the two improved varieties.

Pioneer 514 was introduced to Abu Raya during the 1978/79 summer season. Field tests with the two maize varieties Balady and Pioneer 514 were conducted on ten farms in 1978. The results, shown in Table 10, show that maize yields increased 1.5 tons per feddan (68%) when Pioneer 514 replaced Balady. A local crop survey of 22 farms conducted by the field team showed an average yield of 2.10 and 3.08 tons per feddan for the Balady and Pioneer 514 varieties, respectively.

Wheat

Wheat, a winter crop in Egypt, is planted to 1.4 million feddans annually. Giza 155 is the variety grown by most farmers. The MOA has developed a new variety for the Delta, Sakha 8, which has salinity tolerance. Because of considerable soil salinity throughout the Delta, the team designed a farmer-managed variety test to compare the new variety, Sahka 8, with the variety that farmers were currently planting.

During the 1979-80 winter season, these two varieties were planted on seven fields in Abu Raya. Grain and straw yields and several yield components were measured. The data are given in Table 11.

Sakha 8 grain yields average about 50% more than Giza 155 but straw yields were about the same. Seed weight, heads per plant, and head length were greater for the Sakha 8, but Giza 155 was about 10% taller. The taller Giza 155 plant was not associated with greater straw production. The yield

Table 10. Yields Of Local Variety Balady and Pioneer 514 In Abu Raya, 1978.

Field	Yield Ton/Feddan	
	Balady	Pioneer 514
1	3.2	6.0
2	3.7	6.4
3	3.3	3.8
4	3.5	4.0
5	2.8	3.4
6	2.7	3.7
7	2.5	4.9
8	2.8	4.8
9	3.8	5.1
10	4.7	5.8
Mean Yield*	3.3	4.8

LSD, Variety mean (0.05) - 1.49 ton/feddan

Table II. Yield And Yield Components Of Two Wheat Varieties Grown On Selected Farms Served By Hammad and El-Manshiya, 1980, Winter Season.

Variety	Ton/Feddan Grain	Ton/Feddan Straw	Weight of 100 seeds (g)	Number of Heads/plant	Head Length cm	Plant Height cm
Sakha *	1.57	5.15	44.8	4.18	8.82	102.2
Giza 155	1.08	5.25	42.1	2.25	6.57	114.7
LSD 0.05	0.1	NS	1.2	0.59	0.5	3.0

component measurements suggests that the greater yield was associated with greater seedweight, longer heads and more heads (tillers) per plant. This test indicates that Sakha appears to have considerable potential as an improved variety in the Delta.

Chemical Pest Control

Severe infestation of insects on crop plants were observed during the problem identification. On-farm testing was needed to determine a) the effectiveness of known chemical control methods under the farmers conditions and b) the magnitude of effect resulting from using chemical control.

Field cultural practices including water management affect the control of pests. Good irrigation practices encourage plant growth though may increase infestation by certain pests, especially leaf-feeding insects. It was observed that, with heavily irrigated cotton, the infestation with leafworm moths was heavy. Also, irrigation of clover is not recommended after the first week of May so that a lower humidity and higher soil temperature will reduce the number of emerging cotton leafworm moths. It appears that the management of irrigation water is an important factor in pest control. The team conducted pest surveys on the Project sites to get a better evaluation of the magnitude of effect by insects on crop yields in the Abyuha area. The survey revealed large populations of aphids on corn, beans, wheat and other crops grown both in winter and summer seasons. Apparently neither the farmers nor the village cooperative recognized the harmful effect of aphid infestations upon yield of the various crops. Moreover, neither sprayers nor chemicals were available within the cooperative to treat this problem.

Two farmers were selected to determine if aphid control could improve crop yields. The first farm was selected on Mesqa 9 and the second on Mesqa 22. When wheat was sprayed with "Kalthane 5" (1 liter per feddan) to control aphids, the yield increased from 9.6 to 11.3 ardabs per feddan, an increase of 18%. When aphids were controlled on corn, the yield increased from 9.5 to 13.4 ardabs/feddan (a 40% increase).

Tomato is an important crop in El-Hammami which faces serious insect infestation (white fly) leading to a very poor yield, both quantitatively and qualitatively. For this reason, farmers usually are discouraged from cultivating tomatoes in El-Hammami. After a field survey of this serious production problem in 1978, the field team proposed the following pest control

program for 1979. Spray the tomato foilage with a solution of 66% Tamaron every fortnight at the rate of 1 liter per feddan, white fly control to begin in the nursery (one month) and to continue for three months in the field. Farmers following this practice increased their tomato yields nearly 150% (Table 12). The data show clearly that the benefit from control of white fly lead to an increase in plant population (25%) and an increase in the number of harvests (from three to twelve). Similar results were obtained in El-Mansuriya.

A limitation of this tomato trial is that the white fly control treatment conducted in 1979 was compared with the farmers practices in 1978. Normally there is considerably deviation because of year to year variation. The 2 1/2 fold yield effect is so large that the field team believes the effect is real. Verification trials should be conducted to compare farmer practices and the pest control treatment in the same production year.

Insect control field trials were conducted with cotton in the Kafr El-Sheikh area during the summer of 1979. The trials included the three major pests threatening cotton in Abu-Raya, cotton leafworm, pink bollworm, and thrip. Two methods were tested for the control of cotton leafworm - chemical method (solar oil) and the hand-picking of egg masses. Solar oil was applied with irrigation water at the rate of 30 liters/feddan. This control method reduced the population of the pest, and had no apparent harmful effects on beneficial insects. The second control method, hand-picking of cotton leafworm egg masses, was also an effective measure. It was possible to pick about 85% of the egg masses. No crop measurements were made to evaluate the effect of insect control on the yield of cotton.

Field trials were also conducted on maize crop in Kafr El-Sheikh during the 1979 summer season to test chemical control of the borer infestation which normally reduces yields. The field team recommended the following: 1) burn the maize stocks remaining in the field to kill over-wintering larvae and 2) spray 85% Sevin on the crop in May and early June at the rate of 1 kg per feddan. When farmers followed the recommended practice, maize yields increased an average of 25%.

On-Farm Water Management Trials

During the 1980 summer season, the Kafr El-Sheikh team conducted field trials to test proposed irrigation and agronomic technologies on six farms in Abu Raya. The treatments were:

Table 12. The Effect Of White Fly Control On Plant Population, Number of Harvests, and Yield of Tomato, El-Hammami, 1978-79.

Factor	Farmers Practice*	White Fly Control Treatment**
Average Plant Population	6000	7500
Average Number of Pickings	3	12
Average Yield T/feddan	4.7	11.6

* Farmer fertilizer practices considered adequate both years.

** Tamaron - 66% at the rate of 1 liter per feddan

A_0B_0 Traditional farmers' methods

A_0B_1 Traditional farmers' crop production methods plus proposed agronomic practices (use of recommended pesticides, fertilizers and micronutrients).

A_1B_0 EWUP's proposed water management practices (land leveling, dead level-long furrow irrigation and irrigation scheduling) plus farmers traditional crop production methods.

A_1B_1 Combined EWUP-proposed water management and agronomic practices.

The four treatments were imposed as four plots on each farmers field. Six sub-sample yield measurements were taken from each plot, two sub-sample at the top near the marwa, two in the center of the plot and two at the lower end near the drain. For purposes of analysis, yield values from the top, middle, and lower sections of a plot were considered replications.

The results tabulated in Table 13, show that the mean yield for the A_1B_0 treatment (A_1 package) was about 29% greater than the mean for the A_0b_0 treatment (the farmers' traditional practice). The mean yield resulting from the A_0B_1 treatment (B_1 package) is only about 7% more than the A_0B_0). The combined package or the treatment A_1B_1 resulted in a mean yield of approximately 35% greater than the traditional practices (A_0B_0). The results suggest considerably greater advantage to improved water management practices than to improved agronomic practices. Other results presented herein with improved agronomic practices show yield increases of 20 to 40% and more with other crops as contrasted with 7% with cotton in this test. Farmers may be using the recommended agronomic practices with cotton more than with other crops. Research, through surveys, should be conducted to steady this hypothesis.

On-Farm Trials To Evaluate MOA Recommendations

The MOA recommendations are designed as the result of their Institute Research Program. Since most of the trials were conducted on-station, additional on-farm research is needed to determine if the recommendations fit the farmers conditions.

To evaluate MOA recommendations, fertilizer and variety trials were conducted on farmers fields. There were two treatments on each farm, the farmers traditional practice and the MOA recommended practice.

Table 13. Cotton Yields As Affected By Various Combinations Of Water Management and Agronomic Practices, Abu Raya, 1980.

Treatment	Average Yield Qintar/Feddan*	Relative Yield
Control		
A_0B_0	6.0	100
A_0B_1	7.3	107
A_1B_0	8.8	129
A_1B_1	9.2	135

LSD (0.05) - 1.5; (0.01) - 2.0 qintar/feddan

Testing MOA Fertilizer Recommendations

A wheat fertilizer trial was conducted in Abu Raya in 1981-82. There were two control farmers and four farmers using recommended practices. The results tabulated in Table 14 show that the farmers using the recommended fertilizer rates obtained higher yields than those using traditional practices.

It is difficult to determine the primary cause for the yield response to the MOA recommendations. The farmers practice was to apply 56 kg N/feddan, nearly the same as the MOA recommendation. The seeding rate and date of planting were about the same. The essential difference between the two treatments was the lack of phosphate fertilizer or chemical weed control by the farmer. Field observations by the team indicates that since weeds were not a major problem, the primary benefit of the MOA recommendation probably was the application of phosphate fertilizer.

The team conducted a preliminary survey of the farmers fertilization practices for maize and sugarbeet in Abu Raya. The farmers were applying from 50 to 100 % more nitrogen to maize and about 50 % more to sugarbeet than MOA recommendations. They applied no phosphate to sugarbeet, although 30 kg of P_2O_5 per feddan was recommended. This preliminary data indicated the need to conduct intensive farmer-managed tests to evaluate MOA fertilizer rate recommendations under farmers conditions.

A maize variety test was conducted on six fields in Mansuriya in 1982 with a new improved variety, Giza 2. The farmers followed MOA recommendations for fertilizer and for weed and insect control. Grain yields were 1.77 tons per feddan for the farmers variety (Balady) and 2.70 tons for Giza 2, a 50 % yield increase. There was no farmers traditional practice as a control treatment for this test, i.e., Balady maize was not grown at traditional fertilizer, insect and weed control levels. The new variety does have considerable potential, however, but additional evaluation under farmer traditional practices is needed.

A test with wheat was conducted in Abu Raya during the 1981-82 agricultural year. Most of the farmers were planting Sakha 8, which was recommended by MOA for saline soil. Five farms were selected, four of which were planted to Sakha 8, and one to Giza 155. The farmers followed MOA recommendations for nitrogen and seed rates, and the use of chemicals for pest control.

Table 14. Comparison Of Traditional and MOA Recommended Fertilizer Practices For Wheat In Abu Raya, 1981-82

Treatment*	Fertilizer kg/feddan	Seeding Rate kg/feddan	Weed Control	Average Yield tons/feddan	
				grain	straw
Farmers Traditional Practice	56 N	53	None	1.7±0.1	4.0±0.2
MOA Recommendation	70 N 15 P_2O_5	60	1 ℓ 24% Premonal in 150 ℓ water per feddan	2.2±0.2	3.6±.02

* Results are the average of two farmers for traditional practice and four farmers using MOA recommendations. All farmers planted during the recommended time (Nov. 15-30).

A comparison of yield for the two wheat varieties, Sakha 8 and Giza 155 is shown in Table 15. As with the 1980-81 test, the new variety developed for the Delta outyielded Giza 155 about 50%.

SUMMARY

On-farm crop management research was conducted in the three EWUP sites. The first-phase consisted of on-farm trials conducted to evaluate, under farmer management conditions, component technologies developed by the Egyptian Research Institutes. The second phase was on-farm testing to determine the effectiveness of MOA recommendations.

Results of the component technology on-farm trials may be summarized as follows:

- Based on plant densities on most farmers fields, an increase in plant density to about 80% of the optimum population for a given crop generally will increase yields 30% or more. Above 80% of optimum population, additional yield increases will be only about 10 to 15%.
- Nitrogen fertility is not a constraint for most crops in the current farm management environment. Higher fertilizer rates than needed are often applied.
- Low phosphate fertility appears to be a constraint for many crops. Significant crop response to the application of phosphate fertilizer generally was observed.
- Foliar application of "Bayfolan" (a complex commercial fertilizer mixture) was commonly observed. The reason for the response was not determined but a tentative evaluation indicated that it probably was a micronutrient response.
- Improved varieties of maize and wheat developed by the Research Institutes yields from 15 to 50%. Sakha 8, a maize developed specifically for saline soils, increased grain yields about 50% in the Delta.
- Chemical insect-pest control was highly effective for tomato and maize production and the introduction of chemical pest control should be initiated as soon as possible.
- A technology package of improved irrigation and agronomic practices increased the yield of cotton 35%.

Table 15. Grain and Straw Yields of Sakha 8 and Giza 155 Wheat Varieties Grown in Abu Raya, 1981-82.

Variety	Average Yield In Tons Per Feddan	
	Grain	Straw
Sakha 8	2.0	3.7
Giza 155	1.3	2.9
LSD (.05)	0.2	0.7

The on-farm tests to evaluate MOA recommendations revealed that the recommendations, as a package of practices, is very effective. The difficulty is that farmers generally do not apply the package but use only one or two of the components that fit their resource capability.

Additional on-farm trials and tests are needed in conjunction with economic evaluations to adjust the MOA recommendations to fit the farmers' limited resource environment.

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AMERICAN EQUIVALENTS OF EGYPTIAN ARABIC TERMS AND MEASURES COMMONLY USED IN IRRIGATION WORK

LAND AREA	IN SQ METERS	IN ACRES	IN FEDDANS	IN HECTARES
1 acre	4,046.856	1.000	0.963	0.405
1 feddan	4,200.833	1.038	1.000	0.420
1 hectare (ha)	10,000.000	2.471	2.380	1.000
1 sq. kilometer	100×10^4	247.105	238.048	100.000
1 sq. mile	259×10^6	640.000	616.400	259.000

WATER MEASUREMENTS	FEDDAN-CM	ACRE-FEET	ACRE-INCHES
1 billion m^3	23,809,000.000	810,710.000	
1,000 m^3	23.809	0.811	9.728
1,000 m^3 /Feddan (= 238 mm rainfall)	23.809	0.781	9.372
420 m^3 /Feddan (= 100 mm rainfall)	10.00	0.328	3.936

OTHER CONVERSION		METRIC	U.S.
1 ardab	=	198 liters	5.62 bushels
1 ardab/feddan	=		5.41 bushels/acre
1 kg/feddan	=		2.12 lb/acre
1 donkey load	=	100 kg	
1 camel load	=	250 kg	
1 donkey load of manure	=	0.1 m^3	
1 camel load of manure	=	0.25 m^3	

EGYPTIAN UNITS OF FIELD CROPS

CROP	EG. UNIT	IN KG	IN LBS	IN BUSHELS
Lentils	ardab	160.0	352.42	5.87
Clover	ardab	157.0	345.81	5.76
Broad beans	ardab	155.0	341.41	6.10
Wheat	ardab	150.0	330.40	5.51
Maize, Sorghum	ardab	140.0	308.37	5.51
Barley	ardab	120.0	264.32	5.51
Cottonseed	ardab	120.0	264.32	8.26
Sesame	ardab	120.0	264.32	
Groundnut	ardab	75.0	165.20	7.51
Rice	dariba	945.0	2081.50	46.26
Chick-peas	ardab	150.0	330.40	
Lupine	ardab	150.0	330.40	
Linseed	ardab	122.0	268.72	
Fenugreek	ardab	155.0	341.41	
Cotton (unginned)	metric qintar	157.5	346.92	
Cotton (lint or ginned)	metric qintar	50.0	110.13	

EGYPTIAN FARMING AND IRRIGATION TERMS

fara = branch
marwa = small distributer, irrigation ditch
masraf = field drain
mesqa = small canal feeding from 10 to 40 farms
qirat = cf. English "karat", A land measure of 1/24 feddan, 175.03 m^2
qaria = village
sahm = 1/24th of a qirat, 7.29 m^2
saqia = animal powered water wheel
sarf = drain (vb.), or drainage. See also masraf, (n.)

EGYPT WATER USE AND MANAGEMENT PROJECT

PROJECT TECHNICAL REPORTS

NO.	TITLE	AUTHOR
PTR#1	Problem Identification Report for Mansuriya Study Area, 10/77 to 10/78.	Egyptian and American Field Teams.
PTR#2	Preliminary Soil Survey Report for the Beni Magdul and El-Hammami Areas.	A. D. Dotzenko, M. Zanati, A. A. Abdel Wahed, & A. M. Keleg.
PTR#3	Preliminary Evaluation of Mansuriya Canal System, Giza Governorate, Egypt.	American and Egyptian Field Teams.
PTR#4	On-farm Irrigation Practices in Mansuriya District, Egypt.	M. El-Kady, W. Clyma & M. Abu-Zeid
PTR#5	Economic Costs of Water Shortage Along Branch Canals.	A. El Shinnawi M. Skold & M. Nasr
PTR#6	Problem Identification Report For Kafr El-Sheikh Study Area.	Egyptian and American Field Teams.
PTR#7	A Procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt.	H. Wahby, G. Quenemoen & M. Helal
PTR#8	Farm Record Summary and Analysis for Study Cases at Abu Raya and Mansuriya Sites, 1978/1979.	F. Abdel Al & M. Skold
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NO.	TITLE	AUTHOR
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PTR#16B	Irrigation System Improvement By Simulation and Optimization: 1. Application.	J. Mohan Reddy & W. Clyma
PTR#17	Optimal Design of Border Irrigation System	J. Mohan Reddy & W. Clyma
PTR#18	Population Growth and Development in Egypt: Farmers' and Rural Development Officials' Perspectives.	M. Sallam, E.C. Knop, & S.A. Knop
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PTR#36	Discharge and Mechanical Efficiency of Egyptian Water-Lifting Wheels.	R. Slack, H. Wahby, W. Clyma, & D. K. Sunada
PTR#37	Allocative Efficiency and Equity of Alternative Methods of Charging for Irrigation Water: A Case Study in Egypt.	R. Bowen and R. A. Young
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PTR#47	Water Budgets for Irrigated Regions in Egypt	M. Helal, A Nasr, M. Ibrahim, T. K. Gates, W. O. Ree & M. Semaika
PTR#48*	A Method for Evaluating and Revising Irrigation Rotations.	R. L. Tinsley, A. Ismail & M. El-Kady
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PTR#59* (Prelim.)	Management Plan for a Distributary Canal System	A. Saber, E. Wafik, T. K. Gates, & J. Layton
PTR#60	Hydraulic Conductivity and Vertical Leakage in the Clay-Silt Layer of the Nile Alluvium in Egypt.	J. W. Warner, T. K. Gates, W. Fahim, M. Ibrahim, M. Awad, & T. W. Ley.
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