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9. ABSTRACT

As a result of the Regional Workshop on Aquatic Weed Control and Management, held in Khartoum, Sudan, November 24-29, 1975, Dr. Richard R. Yeo and Mr. William Bailey were asked by the National Academy of Sciences to deliver Chinese grass carp and dwarf spikerush to Egypt and spikerush into Sudan. The Chinese grass carp is being used in many countries for removal of undesirable submersed aquatic vegetation in canals, ponds, lakes, and other water systems. The fish can eat its own weight in vegetation each day, and is a palatable source of protein. The spikerush is a short-growing aquatic plant that displaces rooted aquatic weeds. The dwarf spikerush, which thrives in low elevations and warm climates, has completely displaced dense growths of weeds in some canals in California. On May 20, 1976, Yeo and Bailey flew to Egypt with plastic, insulated bags and boxes containing 60,000 six-day-old fry of Chinese grass carp (bred in Arkansas) and four vials of dwarf spikerush seed. In Egypt the spikerush seed was delivered to the Farm Research Station of Cairo University for start-up of a spikerush nursery. The grass carp fry were delivered to Egyptian biologists for rearing at the Sirw Fisheries Research Station. Detailed in this report are the observations of the Egyptian facilities, meetings held, with whom, and types of aquatic weeds noted in various canals visited. On May 27 Yeo and Bailey flew to Sudan and delivered spikerush seeds to Sudanese scientists, who planned to construct a spikerush nursery at the Gezira Agrciultural Research Station. Detailed are research sites visited, meetings held, lectures given, and aquatic weeds identified in various canal systems. Recommendations for further international exchange of research techniques, seeds, and fry are included.

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REPORT OF TRAVEL BY DR. RICHARD R. YEO AND MR. WILLIAM BAILEY TO EGYPT - SUDAN MAY 20 THROUGH JUNE 4, 1976

Report to the Board on Science and Technology for International Development (BOSTID), Commission on International Relations, National Academy of Sciences, of advisory activities resulting from the Regional Workshop on Aquatic Weed Control and Management, held in Khartoum, Sudan, November 24-29, 1975. Travel funds for Dr. Yeo and Mr. Bailey were provided by the BOSTID under Contract AID/csd-2584, Task Order No. 1 with the Office of Science and Technology, Bureau for Technical Assistance, Agency for International Development. Local expenses were provided by the Egyptian Academy of Scientific Research and Technology and the Sudanese National Council for Research.

Background Information

During November 24 through 29, 1975, a Workshop on Aquatic Weed Control and Utilization was held in Khartoum, Sudan. Numerous scientists from many countries with expertise in various areas of weed control and utilization attended, including a panel from the U. S. Academy of Sciences. Several representatives from Egypt attended. The Sudanese Workshop was followed by a meeting with members of the Egyptian Academy for Scientific Research and Development in Cairo, Egypt November 27 through December 2, 1975. At both workshops the potential use of herbivorous fishes, including the Chinese grass carp (Ctenopharyngodon idella Val.) and the aquatic weed competitor, dwarf spikerush (Eleocharis coloradoensis (Britt.) Gilly) was discussed.

The Chinese grass carp is being used in many foreign countries for the removal of undesirable submersed aquatic vegetation in canals, ponds, lakes, and other water systems. The fish is unique in that it is capable of consuming quantities of aquatic vegetation equal to its own body weight in a single day. In addition to removing unwanted aquatic vegetation the flesh is palatable and provides a valuable source of protein. The grass carp has been used in Arkansas for the past several years and has removed all major weed growths in waters where it has been stocked.

The spikerush is a short-growing aquatic plant that displaces rooted aquatic weeds. Two aggressive aquatic plants that demonstrate this ability are slender spikerush (Eleocharis acicularis (L.) Roem. & Schult.) and dwarf spikerush. The dwarf spikerush appears to favor low elevations and warm climates, thus is more suitable for use in Egypt and Sudan. It has completely displaced dense growth of weeds in some canals in California.

Recommendations resulting from these meetings included suggestions to bring the seed of spikerush into Egypt and Sudan for study. The grass carp had already

been introduced into both countries; however, those imported into Egypt had died. The fish in Sudan were being held until authorization to release them could be obtained.

The National Academy of Sciences asked Mr. William Bailey and me if we would pursue these recommendations and take the grass carp and spikerush seed into Egypt and the seed into Sudan. Permission by our responsible organizations was given.

Itinerary

On May 20, 1976, Mr. William Bailey, Fisheries Biologist, Arkansas Game and Fish Commission and I left for Egypt and Sudan. Mr. Bailey placed on board the airplane one cardboard box with two smaller styrofoam boxes inside, each containing a plastic bag. Each bag was partially filled with water, inflated with oxygen, and contained approximately 60,000 1 and 6 day-old fry of the Chinese grass carp. The fry were to be left in Egypt and reared there for use in weed-infested channels. I hand-carried a small insulated box containing four vials of dwarf spikerush seed. The vials were covered with crushed ice to prevent the seed from germinating. A roll of 4 mil black polyethylene sheeting that was to be used for construction of the two spikerush nurseries was also shipped. We were met at the airport in Cairo by Dr. Mustafa Imam Mahmoud, Director, Institute of Natural Resources, Cairo University; Dr. Hamdi A'Ziz Moursi, Secretary-General, Academy for Research and Development; Engineer Jean Kamil Abdel Seed, Director, Institute of Channel Maintenance, Ministry of Irrigation; and Dr. Bolok, Fisheries Scientist, Institute of Oceanographic Research.

The seeds were given to Dr. Mahmoud. He placed them in a refrigerator to keep them chilled.

The fish were immediatel/ taken to the Fish Garden in Cairo and placed in

"hoppas" to acclimate them to the new water. While we were there, Mr. Thomas George, Aquaculturist, Fisheries and Hydrobiological Research Section, Khartoum, Sudan stopped by for a short visit (Mr. George is in charge of the grass carp project in Sudan). He was on his way to Japan to participate in an International Meeting on Warm Water Fish.

The following day Dr. Hamdi Moursi guided us to the offices of several government officials where we discussed the purpose of our visit to Egypt. They included, Mr. Abdel Hamid Abdallah, Vice-Minister of Ministry of Irrigation; and Dr. Abu-El-Futuh, Director, Institute of Oceanography; Dr. Ahmed G. Abdel-Samie, Vice-President, Academy of Scientific Research and Technology; Engineer Jean Kamil Abdel Seed; Dr. Ahmed Mohammed El-Esawy, Head of Inland Fisheries, Institute of Oceanography; and Dr. Abdel Moneim Abou-El-Azm, President, Academy of Scientif: Research and Development.

On Sunday, May 23, we visited the Bahtim Research Station to determine the feasibility of a site there for a spikerush nursery. However, the station was too remote and it was decided to place the nursery at the Farm Research Station, Faculty of Agriculture, Cairo University. Dr. Bakir Oteifa is in charge of the station and is very interested in this aspect of biological weed control.

When completed the nursery will be a shallow pond, 4 m by 15 m. The bottom will be lined with a sheet of 4 mil black polyethylene plastic and covered with approximately 5 cm of sandy clay loam. The ridges of the pond will be formed with construction bricks stacked 3 high around the perimeter. The soil will be submersed with water 10 cm deep and sown with the spikerush seed. After the spikerush has shown considerable growth the water level will be lowered and the plants allowed to flower and develop seed.

We returned to the Fish Garden later in the day to observe the grass carp fry. They had been re-distributed into six 3 m by 10 m ponds to reduce crowding.

Their development was proceeding as predicted. We were pleased that no observable mortalities had occurred from the time the fish left Arkansas. Mr. Bailey had done an excellent job in handling the fry and making suggestions to the Egyptian biologists in preparing for the arrival of the fish.

The evening of May 25, Mr. Bailey and I presented talks on aquatic weed control using grass carp and competitive plants and how each could be utilized in Egypt. A discussion followed. Those in attendance included: Dr. El-Esawy; Dr. Mahmoud; Dr. Futuh; Dr. Bolok; Dr. Moursi; Engineer Kamil; Dr. Bakir Oteifa, Head, Nematology Department, Cairo University; Dr. Maher, Institute of Oceanography; Dr. Kamal Zahran, Research Specialist, Chemical Weed Control, Cairo University; Engineer Zeinab El-Gharably Ministry of Irrigation; and Dr. Kamil Beshir El Tigani, Head, Waterhyacinth Control Section, Plant Protection Administration, Agricultural Research Council, Sudan.

Late in the morning of May 25, after having obtained permission with difficulty from the Egyptian Air Force to travel by automobile in a restricted area, we journeyed to the Sirw Fisheries Research Station to observe the rearing ponds for the grass carp. The Station was apparently staffed by two or three professional people. Many cement-lined ponds were present, but only a very few were being utilized. Two 1-acre ponds had been set aside for the grass carp. It was anticipated that the fish would be reared to 30 to 35 cm long before being released into weedy canals. The size would reduce the losses to predator fish.

It was of interest to note that in one of the unused ponds where canal water entered freely without interference that Tilapia zillii Gerv. were abundant. A dense growth of coontail (Ceratophyllum demersum L.) persisted but was unaffected by the herbivorous tilapia. This was unusual as the same species is being effectively used in Southern California to control aquatic weeds in canals. This fish is found in abundance in most canals in Egypt, but is not controlling the vegetation.

We continued on our automobile trip north along the Nile River and returned from

the north after visiting El Matariya. It was here that Dr. Mahmoud had previously found a short-growing plant, barbed spikerush (Eleocharis parvula (Roem. & Schult.) Link ex Bluff), growing extensively in a rice field. Unfortunately the field was in crop rotation and Egyptian white clover was currently being grown. We stopped along several canals at sites that were considered militarily safe to our scrutiny.

Several aquatic weeds were observed. They usually occurred in mixed stands rather than in extensive growths of a single species. Their incidence, in descending order of abundance, was curlyleaf pondweed (Potomogeton crispus L.), common coontail (Ceratophyllum demersum L.), sago pondweed (Potamogeton pectinatus L.), American pondweed (Potamogeton nodosus Poir.), watershield (Brasenia schreberi Gmelin), inflated duckweed (Lemna gibba L.). Cattails, Typha domingensis Pers. and Typha elephantine Roxb. were frequently found along the canal banks, but were more prevalent in the drains. An aquatic grass, Echinochloa stagninum (Retz.) Beauv., was common along slow moving canals and drains. It rooted along the bank waterline and shoots grew extensively out towards the center of the channel. It not only enhanced the formation of birms, but ofttimes closed off the water surface, further slowing the waterflow, and ensnaring floating debris.

A search for competitive plants on the field trips was unsuccessful, partly because of the few stops we were able to make and the nature of the flora. Although there appeared to be a considerable number of different plant species associated with the channel flora, the total number were limited when compared to the wide variations in aquatic flora in the United States.

The following two days were spent visiting with Engineer Jean Kamil, Dr. Mahmoud, and Dr. Moursi discussing the spikerush nursery specifications and use of the grass carp, sight-seeing, and report writing. Mr. Bailey went on a tour of Eastern Egypt the morning of May 26, to see the site of the battle that occurred in 1967 and the Suez Canal.

That afternoon, Mr. Bailey and I went to the U.S. Embassy in Cairo to see Mr. W.R. Templeton, in charge of the AID Program in Egypt and Mr. Addison Richmond, Science Attache. Both were out of the country; therefore, we spent some time with Mr. R. Maushammer, Program Officer, AID. We sought permission to forward all future correspondence to the various contacts in Egypt through the Embassy for redistribution to the concerned parties. Regular land mail takes almost three months to-the-day to reach individuals in Cairo. By our sending the mail through the Embassy the mail ordinarily will arrive at its destination in two weeks. Also, because there was some confusion as to which agencies were responsible for the research studies and the application of the research findings, we found it necessary to send all future communications to the Secretary-General of the Academy of Scientific Research and Development.

Dr. M. Kassas, Chairman, Weed Research Committee in Egypt was out of the country and we were unable to visit with him during our stay in Egypt.

We traveled to Khartoum, Sudan on May 27. We were met at the airport by Dr. Ali Mahyad Bannaga, Director, Agricultural Research Council, National Council for Research; Dr. Mohammed Obeid, Vice-Chancellor, Gezira University, Mr. Moawia Dardiri, Atomic Energy Commission, National Council for Research, and Dr. Kamil Beshir who preceded us to Khartoum from Cairo on a different airline.

The spikerush seeds I was carrying were given to Mr. Dardiri who placed them in a refrigerator for temporary storage.

Friday, May 28, was spent at the Shegara Fisheries Research Station where approximately 5,000 grass carp were being reared for use in canals. Mr. Osman M. Saeed, Acting Head, Fisheries and Hydrobiological Research Section, during the absence of Mr. Thomas George, took us on a tour of the station.

Some of the grass carp were netted for our observation. Very little growth

had taken place since my visit in November 1975. It was suggested that the fish be given supplement feed. Nile tilapia (Tilapia nilotica L.) were being reared with the grass carp. These, too, were stunted.

As this was the first opportunity of the entire trip to observe the flora in detail I made good use of the time. Three potential weed competitors were found. One plant, and the only plant observed to grow underwater and emersed was a Cyperus sp. It was found along the Nile River visibly growing to a depth of 0.5 m in turbid water and to 20 m inland. Both submersed and emersed shoots were up to 8 cm long and did not form a dense sod. Examination of the rootstocks showed them to be coarse, woody, and with tuberlike structures at the nodes. Another plant belonging to the Family: Cyperaceae, but not a Cyperus sp., was growing along the shoreline of a pond and in an adjacent bank seepage site. It grew to 10 cm tall and formed a dense sod. The other plant, tentatively identified as belonging to the genera Fimbristylis, was growing along the shoreline of one of the fish ponds. It was short-growing and also formed a dense sod. The latter two plants may have potential as bank weed competitors and shoreline stabilizers. Mr. Saeed took specimens to Dr. Iklass Bari, Acting Head, Botany Department, University of Khartoum for identification.

We rejoined Dr. Bannaga and Dr. Obeid at noon and had luncheon with Dr. Hussein Idris, State Minister of Agriculture, and dined later in the day with Mr. Dardiri at his residence.

On Saturday Dr. Obeid, Dr. Bannaga, Dr. Beshir, Mr. Bailey, and I motored south to Wad Medani to visit the Gezira Agricultural Research Station of the Agricultural Research Corporation, a Sudanese government agency. The U.S. Embassy had placed a vehicle and driver at our disposal for the various field tours and travel in Sudan. Dr. Mirghani Tag El Seed, Hydrobiological Research Unit, University of Khartoum, accompanied the tour in another vehicle.

The Gezira Agricultural Research Station is the research center for the 2,000,000 acre Gezira Scheme. It is the largest farm under a single management in the world. It was here that the Sudanese wished to construct a spikerush nursery.

The next day we drove to the Research Station. Immediately upon our arrival we stopped at the office of Dr. Abdalla Hamdoun, Weed Specialist at the Station. From there we went to the proposed spikerush nursery site. After concurring that the area was suitable we visited the Director of the Station, Dr. O.M.O. Silah. He appeared enthusiastic with the prospects of using both biological control techniques for controlling weeds in the Gezira canals. We also met Mr. Farbrother, a Britisher and FAO representative who had been working on the Gezira Scheme for 14 years.

When the meeting was over Dr. Surioni, Head of the Plant Pathology Department and the Laboratory, took us on a tour of their new Pesticide Residue Laboratory. The laboratory was well-staffed and currently equipped for gas chromatographic analyses. Their present emphasis was on the determination of 2,4-D residues in crops, soils, and human fatty tissues. The latter material was obtained from the hospital in Wad Medani.

After the tour we returned to the nursery site which had now been cleared of debris, and leveled. Bricks had been brought to form the supporting ridges around the nursery pond. When completed the nursery will be similar to the one in Egypt.

That afternoon we surveyed several canals on the Gezira Scheme. The major, or largest of the canals, was deep enough so that rooted submersed aquatic weeds were rarely abundant. However, the minor canals which were smaller and shallower, were inhabited by dense infestations of weeds. Examination of several minor canals indicated the following weeds were present, the most prevalent first: perfoliate pondweed (Potamogeton perfoliatus L.), curlyleaf pondweed (Potamogeton crispus L.), naid (Najas armata Lindb.), Ottelia alismoides (L.) Pers., fanwort (Cabomba

caroliniana Gray), American pondweed (Potamogeton nodosus Poir.), floating-leaf pondweed (Potamogeton natans L.), common coontail (Ceratophyllum demersum L.). The aquatic grass, Echinochloa stagninum (Retz.) Beauv., was also problem by severely interfering with water flows and trapping floating debris.

On Monday morning Mr. Bailey and I each presented a seminar to the staff and student employees at the Research Station interested in weed control, approximately 40 people. Mr. Bailey's talk was, Use of the Grass Carp (Ctenopharyngodon idella Val.) to Control Submersed Weeds in Arkansas. My presentation was, Life History and Use of Dwarf Spikerush (Eleocharis coloradoensis (Britt.) Gilly) to Control Rooted Submersed Aquatic Weeds. We returned to Khartoum that afternoon.

The next morning we met with Dr. Sayed Wadie Habashi, President, National Research Council to discuss our goals and anticipations of the trip to Sudan. That evening Dr. Habashi held a banquet for us sponsored by the National Research Council.

Wednesday, June 2, we met with Ambassador Brewer at the U.S. Embassy to inform him of our activities and possible ways we might further help the Sudanese. We were interested in seeking ways to help enlarge the spikerush nursery at Wad Medani, to expand it beyond a token size to a facility that could provide sufficient quantities of seed for large scale applications. Two possible ways were suggested. The Ambassador receives some money from the U.S. that is used to initiate projects that are beneficial to the Sudanese people, "self help" funds. Possibly some of this money could be used. Another way might be through the use of PL-480 funds held by the Egyptians. To pursue this further the Ambassador cabled Dr. Chester Gordon, Director, European Regional Research Office, IPD, ARS, USDA, Rome, Italy to inform him of our forthcoming visit to Rome and suggested we contact each other to explore this possibility.

We left Sudan that afternoon for Rome, Italy.

I contacted Dr. Gordon's office in Rome. He was out of the country, but Dr. Ely, his assistant, indicated that there was a good chance that a PL-480 project in Sudan could be made using Egyptian Funds. Correspondence with the Egyptians regarding this had been initiated.

I also attempted to visit with Dr. William Furtick, Plant Production and Protection Division, FAO, Rome. Dr. Furtick was in the U.S. at the time. I intend to keep him abreast of our activities in Egypt and Sudan.

Several recommendations have been made as a result of the trip and the events that occurred.

Sudan

1. Greatly enlarge the spikerush nursery at Wad Medani so it could provide ample seed for both Sudan and Egypt, and possibly some to the U.S. There are 40,000 acres of canals (quote: Mr. Farbrother) on the Gezira Scheme. Spikerush could be utilized on one-third to one-half of this area and in new canals systems before they are made operational. Funding for the expansion may be available through Egyptian PL-480 and/or U.S. "self help" funds held by the U.S. Ambassador in Khartoum.

2. Bring propagules of the three potential plant competitors to Davis, California for study and possible use. Seed of the Fimbristylis sp. is maturing now. A request is being made to Mr. Thomas George to collect some of this seed now and of the other plants later after they form seed. The plants were found at the Shegara Station.

3. Although several promising weed-competing plants were found and need investigating, a more thorough survey to discover new plants that could be used in Sudan, Egypt, and the United States is needed.

4. Bring a Sudanese fisheries biologist to Lonoke, Arkansas for training

to artificially spawn the Chinese grass carp. There is a definite need for professional personnel to acquire the techniques for spawning grass carp in order to obtain a sufficient number of the fish to control the weeds in water systems. Mr. Bailey has been very successful in his attempts to select gravid fish, dose them with the necessary hormones, fertilize stripped eggs with milt, and culture the newly hatched fry. The Joe Hogan State Fish Hatchery at Lonoke, Arkansas has adequate facilities for this training.

Egypt

1. Bring seed of barbed spikerush (Eleocharis parvula (Roem. & Schult.) Link ex Bluff) to Davis, California for study and possible use as an aquatic weed competitor. Dr. Mustafa Imam Mahmoud discovered an area where the barbed spikerush was flourishing. The site was in a rice field and was now being rotated with another crop. Dr. Mahmoud will collect seed of the spikerush this fall when the field will be planted with rice. Herbarium files at Davis, California show barbed spikerush has been found in California, but previous attempts to locate the plant have been unsuccessful.

2. Take fry of the herbivorous fish, Tilapia zillii Gerv. to Egypt for study. The native T. zillii does not visibly graze the aquatic vegetation. This species has been used in Southern California for the past few years to control submersed aquatic weeds. Cold temperatures and predation reduce the fish populations and the canals must be restocked each year. However, the water temperatures in Egypt are safe for the fish. The extent of predation is unknown. By bringing T. zillii from California to Egypt for study and comparison with their native species they might find that significant differences in grazing qualities exist in the U.S. fish to justify its use as another tool for aquatic weed control.

PICTORIAL ACCOUNT OF TRAVEL

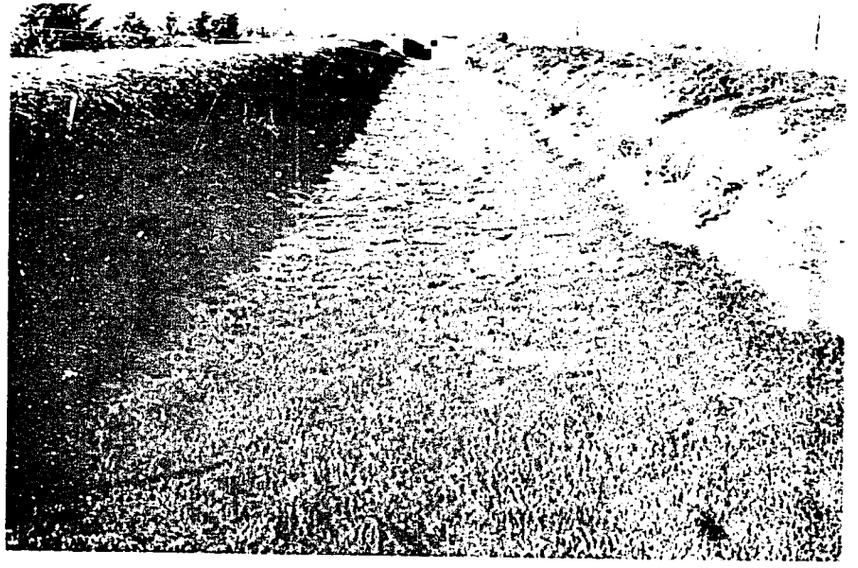
BACKGROUND PICTURES

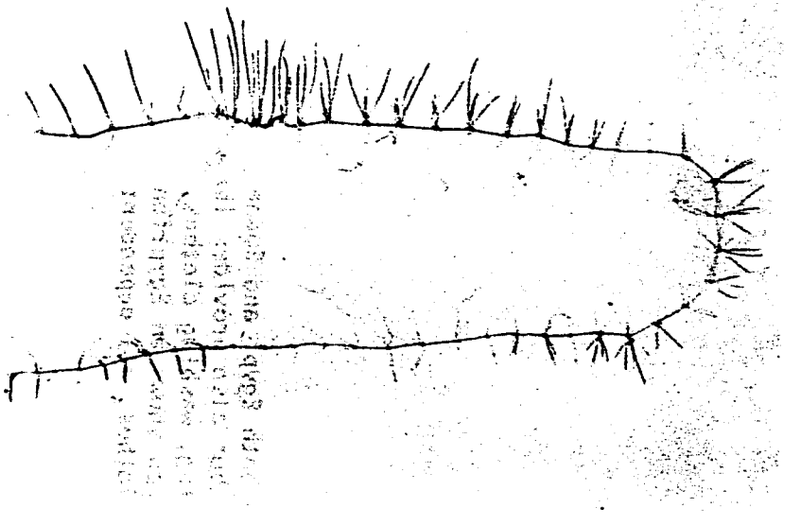
A short-growing aquatic plant, dwarf spikerush (Eleocharis coloradoensis (Britt.) Gilly) has been observed to competitively displace tall-growing rooted aquatic weeds in canals and reservoirs. The plant forms a dense sod and is often referred to as an "underwater lawn"

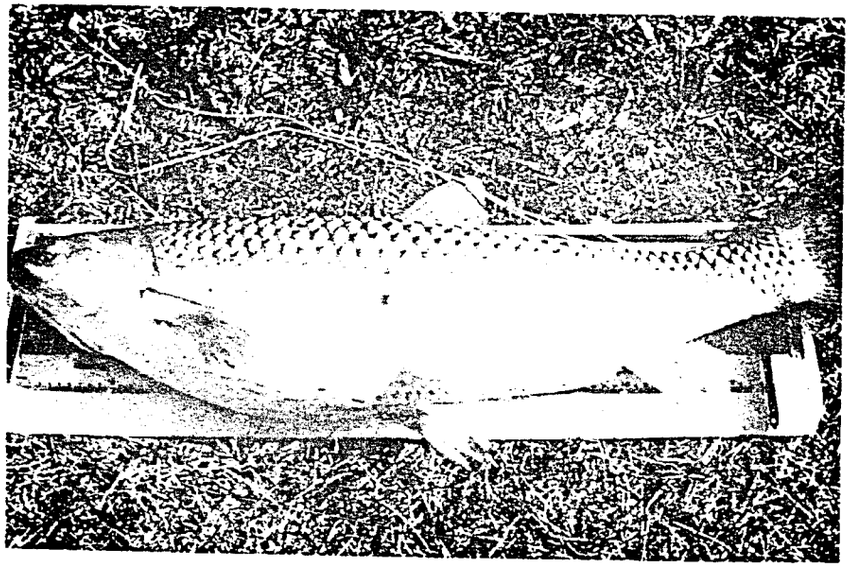
A single plant consists of a series of nodes separated by a short section of rhizome. Each node develops several leaflike culms and many fibrous roots. Seed are borne on the apex of the culms and tubers on specialized subterranean rootstocks.

The Chinese grass carp (Ctenopharyngodon idella Val.) is a herbivorous fish that consumes enormous quantities of submersed aquatic vegetation. It is capable of clearing weed-choked canals, thus restoring reduced water flows to normal deliveries. (Photograph by Dave Sutton)

Grass carp are entirely herbivorous except for a short period when they are very young; then they feed on zooplankton. This fish must approach the vegetation from the exposed end so the pharyngeal teeth located deep in the throat can macerate the plant tissues.

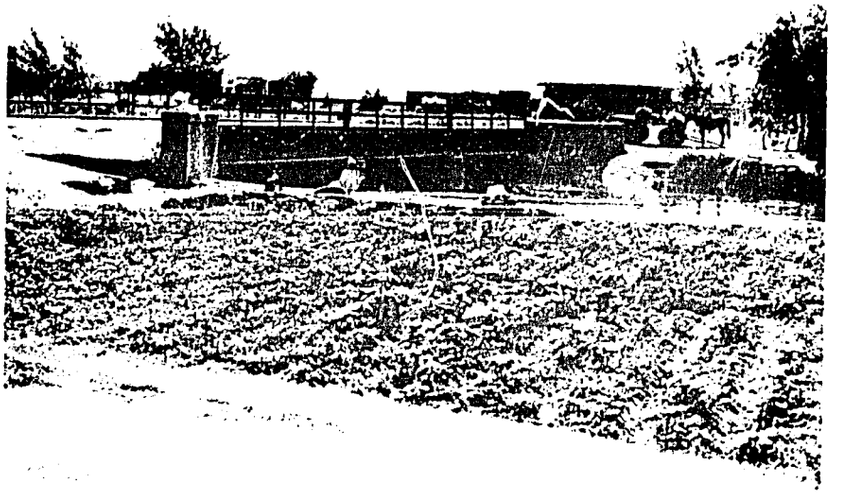


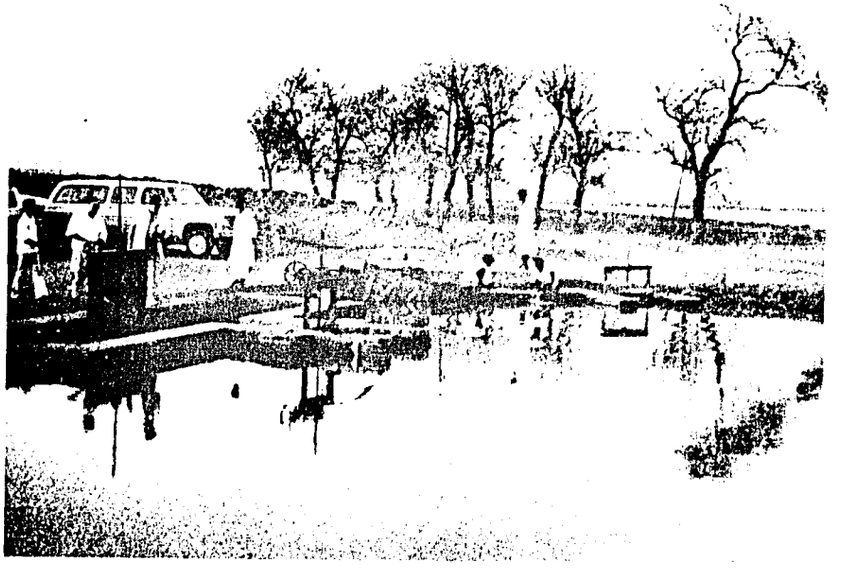




The network of canals and drains in both Egypt and Sudan not only delivers water to crop fields, but also provides the sole source of water for drinking, cooking, washing clothes, and bathing in many areas. The photograph shows an Egyptian garden, a donkey, and a woman washing clothes, all dependent on the raw canal water.

Two young Sudanese men (center of photograph) are washing clothes in one of the major canals.





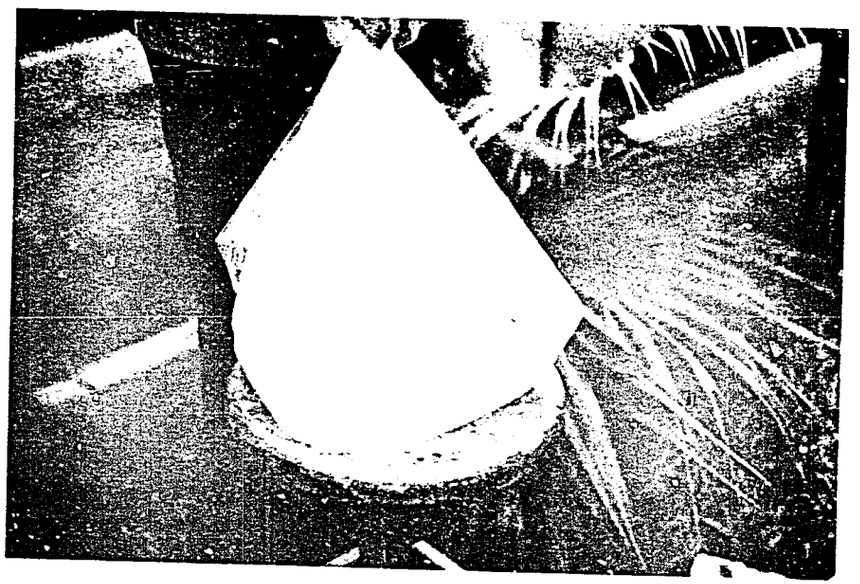
One of the major problems associated with canals in Northeast Africa is the disease, schistosomiasis, or bilhazia. Part of the life cycle of this infectuous parasite is hosted by snails. One of two kinds of snails that carry the organisms is shown. A protective glove was used to prevent the infecting cercariae, if present, from coming in contact with the skin. This snail was found attached to the roots of floating waterlettuce (Pistia stratiotles L.)

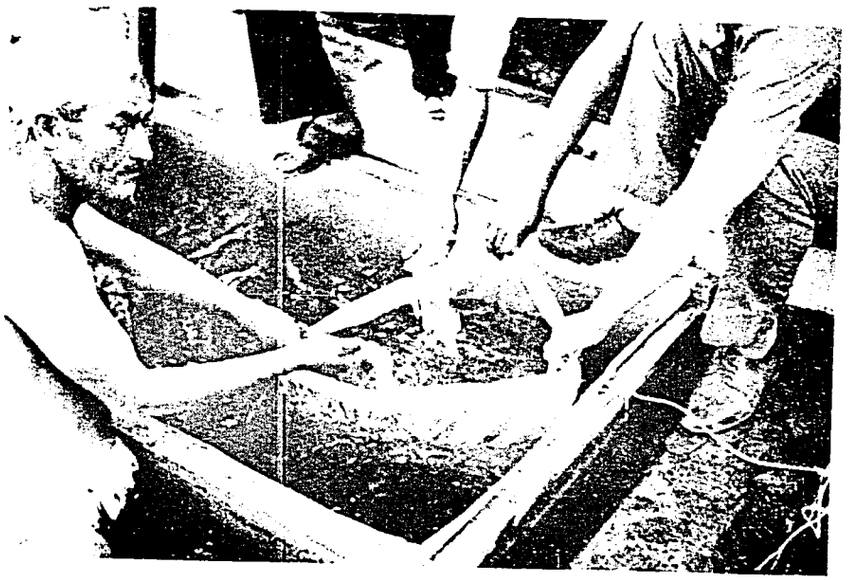
Two styrofoam boxes with a total of 120,000 two and six day old grass carp were shipped to Egypt. Each box contained a plastic bag with sufficient water and oxygen to maintain the fry for several days.

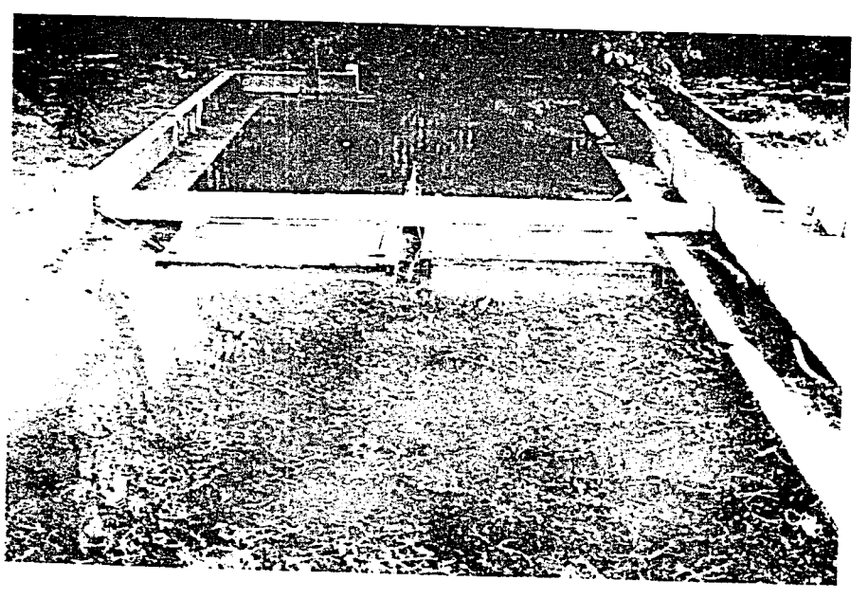
The fry were placed in two "hoppas" made of plastic mesh screen and gradually acclimated to the new water by pouring off some of the old water from the bag and then gently splashing in the new water. Water temperatures in the bag and the hoppas were similar.

The pond water had been prepared in advance by the addition of animal manure. This insured a good population of zooplankton which the fry are dependent upon during the early period of their growth. After two days the fish were redistributed into several ponds to prevent overcrowding. Very few, if any fish were lost during the entire period of shipping through acclimation.

In the background is the headquarters building at the Fish Garden in Cairo where the grass carp were taken upon arrival in Egypt.





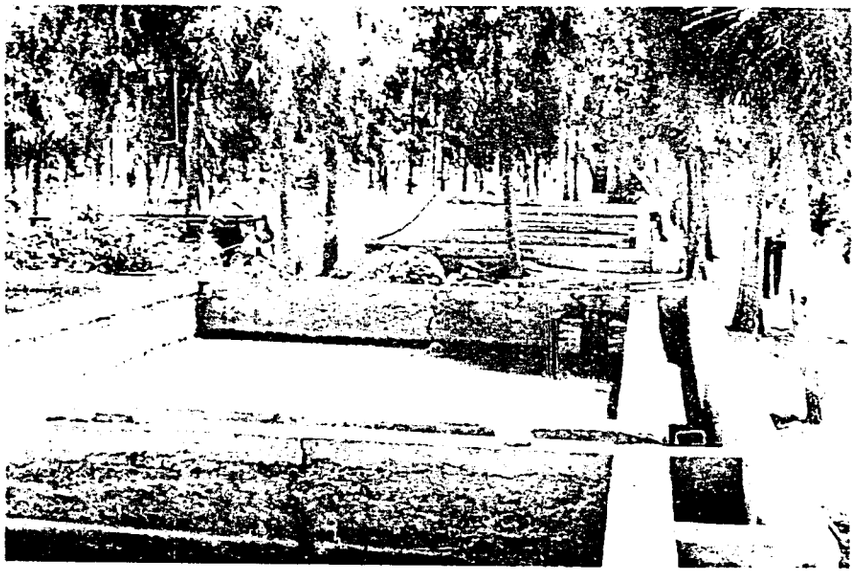


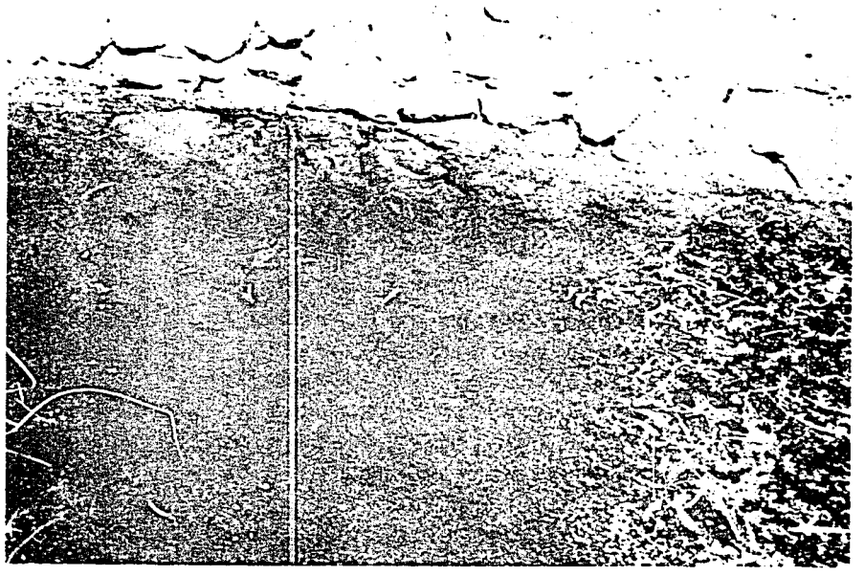
After the grass carp have been held at the Fish Garden for 2 to 4 weeks they will be transferred to the Sirw Fisheries Research Station located northeast of Cairo. Many cement-lined fish rearing ponds have been built at the Station.

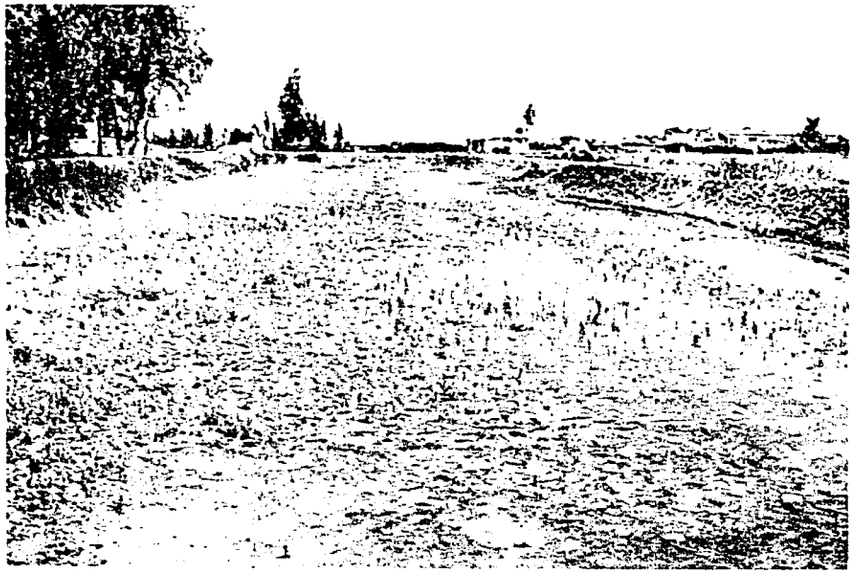
When the grass carp are brought to Sirw they will be placed in two 1-acre ponds for rearing to a size suitable for stocking canals This will reduce fish losses due to predation by native fishes.

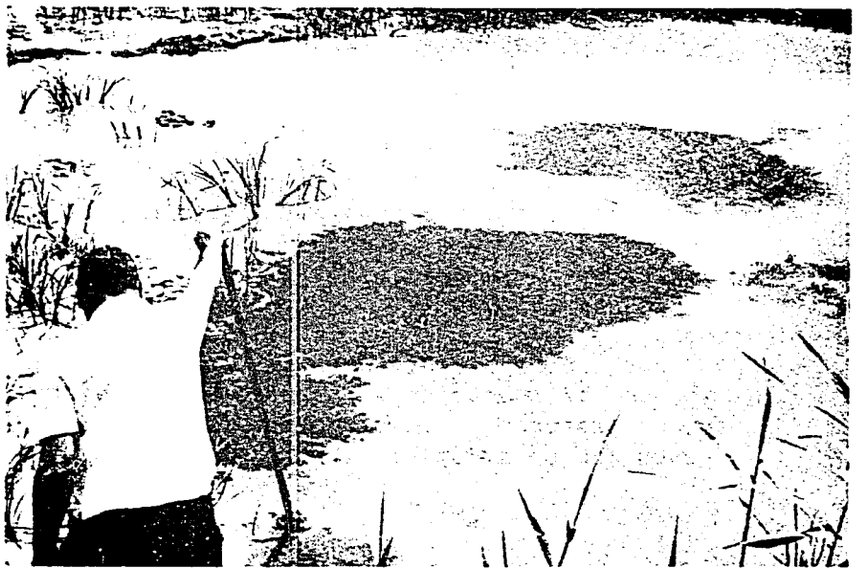
Several ponds were unused. One pond had its head gate left open to canal flow and fish had entered the pond and remained there. Most of the fish were Tilapia zillii Gerv. Aquatic vegetation had become established including coontail (Ceratophyllum demersum L.) and duckweed (Lemna sp.). The tilapia had not noticeably grazed the plants. This species of tilapia is also abundant in most of the canals in Egypt and reportedly does not eat the vegetation there either. However, the same species is being effectively used to remove aquation vegetation in irrigation canals in Southern California.

Some aquatic vegetation, curlyleaf pondweed (Potamogeton crispus L.), was already growing in the ponds. However, additional vegetation will be brought to the ponds as feed for the fish. Supplemental feeding with prepared fish foods will also be necessary.







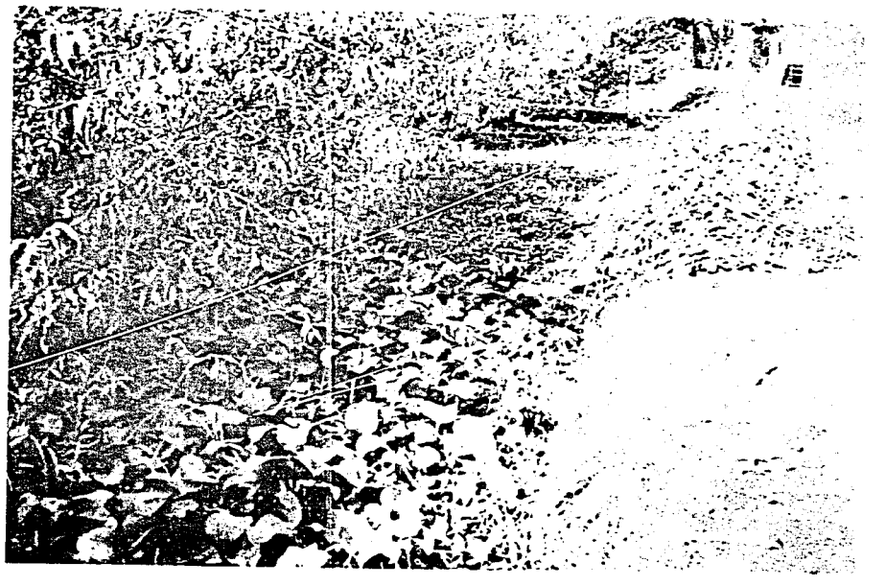


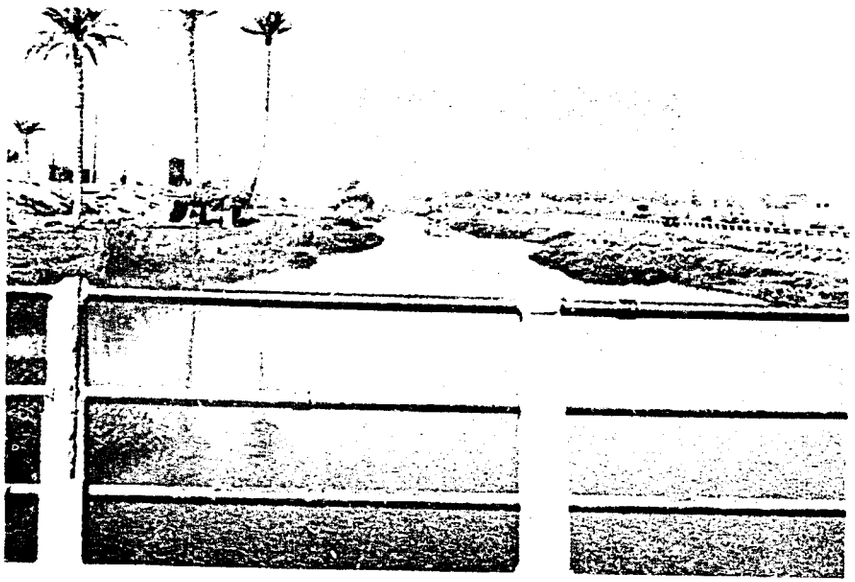
Many drains in Egypt are infested with aquatic weeds that prevent adequate discharge of waste water. Common coontail, curlyleaf pondweed, and cattails are common in most drains.

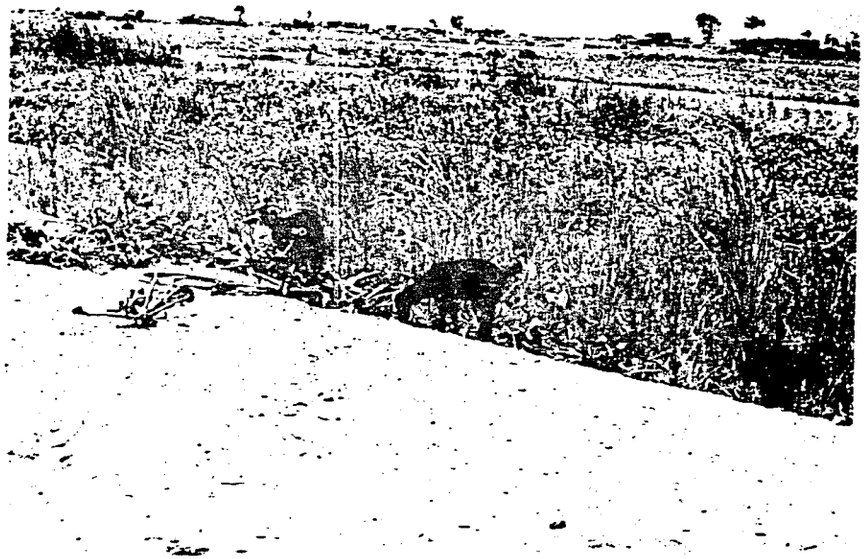
Many of the canals in Egypt do not have roadways along the banks or free access to the canals from the banks. Consequently, much of the weed removal is done by hand, and hand labor in some situations is not very efficient. The photograph shows how a dense growth of willows along one bank of this shallow canal has hampered the removal of waterhyacinth. The waterhyacinth (Eichhornia crassipes (Mart.) Solms-Laub.) in the background was removed by hand. A large portion still remains to replenish that already removed.

An aquatic grass (Echinochloa staginum (Retz.) Beauv.) has been observed by Dr. Mustafa Imam Mahmoud of Cairo University to be strongly associated with waterhyacinth. The grass becomes rooted in shallow water and along the bank above the waterline and "ensnares" waterhyacinth as it floats downstream. The snared plants then proceed to rapidly multiply and form large rafts of the weed. The grass also forms wide birms that gradually obstruct the channels.

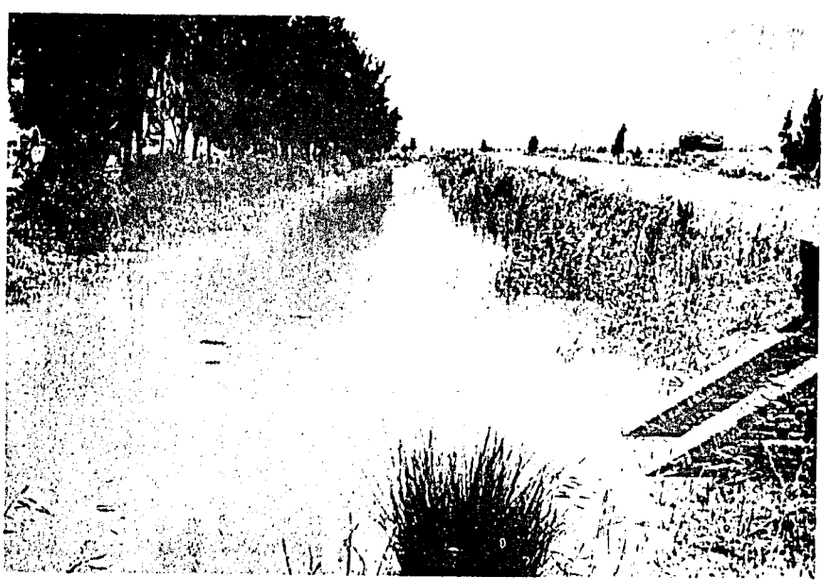
While at the Sirw Fishery Research Station we observed goats feeding on waterhyacinth that had been placed on the bank of a drainage channel. We were rather excited at the prospect of finally observing an animal that relished this scourge of tropical waterways. However, our hopes were dashed when the goats realized what they were eating was not so tasty and they moved on to better feed.







A few channels show the lack of, or at least sufficient, maintenance. This was not a lack of care but was a result of rapid regrowth. The importance of E. stagninum as a noxious weed has been under-emphasized and a separate research study to control or displace it should be made. Bermudagrass, bluegrass, red fescue, or similar short-growing grasses would be desirable replacement bank stabilizers and weed competitors.

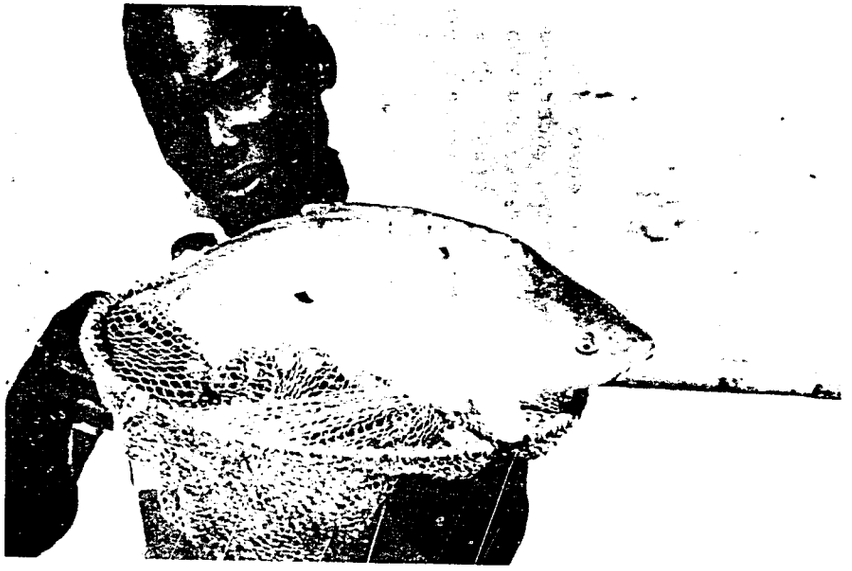


The herbivorous grass carp has already been into Sudan. Mr. Thomas George, Fisheries Biologist at the Shegara Fisheries Research Station is rearing approximately 5,000 for research pruposes. These were obtained from India. The photograph shows the carp jumping as a result of the stress created by the seining attempts.

The mirror carp, a strain of the common carp (Cyprinus carpio L.), has large, infrequently placed scales. It is being reared at Shegara to determine its feasibility as a food fish. It will eat considerable amounts of aquatic vegetation and pulls out rooted aquatic weeds in its search for food which consists mostly of insects and worms. It reportedly will control aquatic weeds at a stocking of 50 fish per acre.

Tilapia nilotica L. were being cultured with the grass carp. This species will consume algae. Vegetation in the rearing pond was completely absent, the macrophytes had been consumed by the grass carp and the algae by the tilapia. Lack of supplemental feeding had stunted both fishes.

Coordination between the fisheries agencies and the plant protection agencies is needed in the Gezira Scheme. The photograph shows several tilapia that were killed by an aerial application of an insectide. Losses of grass carp will be high unless good communications between the diferent agencies concerned are established.

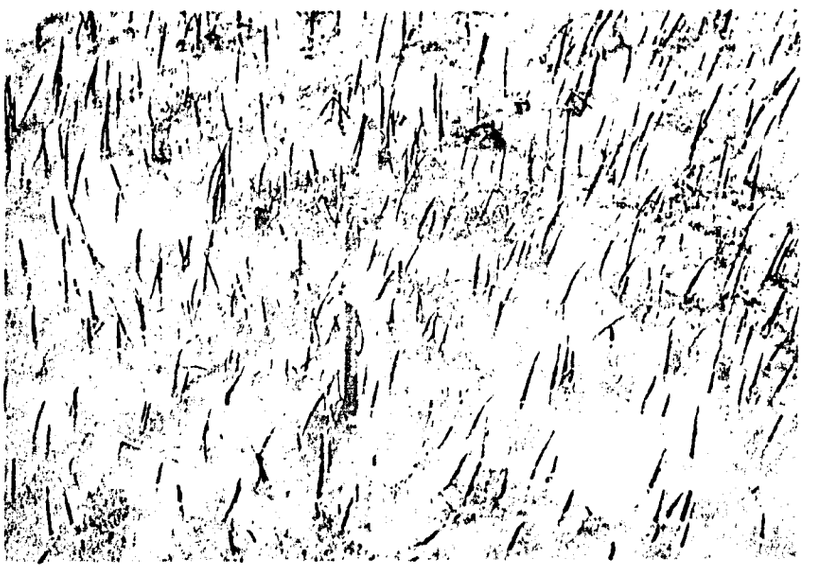


Several plants that may have potential as weed competitors were found in Sudan, all belonging to the Family: Cyperaceae. The plants have been tentatively identified to genus. Further identification is being made at the University of Khartoum.

One plant, Cyperus sp., was found growing along the White Nile. It was visibly submersed to a depth of 0.5 m.

The plant grew up to 20 m inland.

The emersed leaves did not form a dense sod; however, examination of the underground parts showed the roots and rhizomes to be dense and woody. Tuberlike growths were observed at the nodes. This section of the White Nile is covered with 6 additional meters of water during the rainy season. The plant appears to have a high capacity for survival and competition. It may be promising as a competitor of submersed rooted aquatic macrophytes, bank weeds, and a shoreline stabilizer.



Another plant belonging to the Cyperaceae, but not a Cyperus sp., was found.

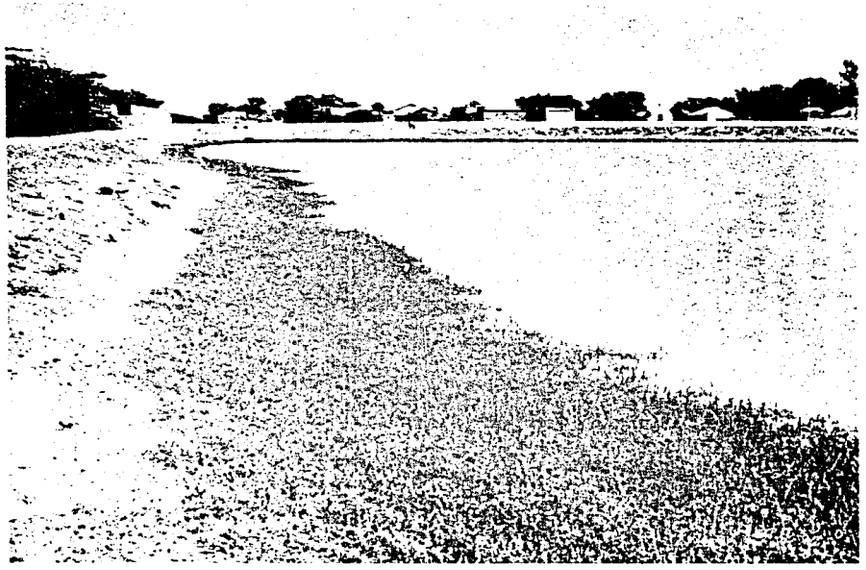
A. It was growing along the shoreline of one of the fish-rearing ponds at Shegara. The plant's area of inhabitation was limited by the waterline on one side and the lack of water on the other.

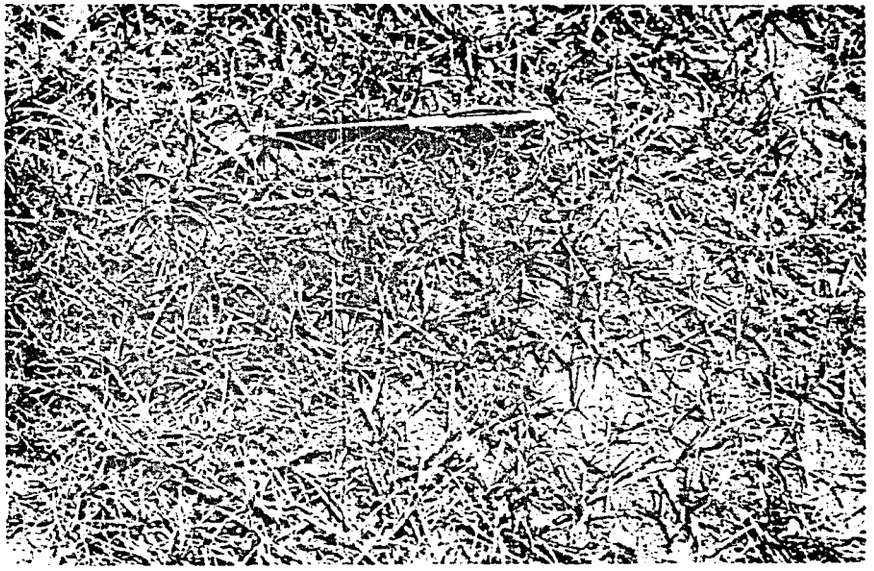
The plant grew up to 10 cm tall. It did not consistently form a dense sod and became stunted as the soil became dry. It may have possibilities as a bank weed competitor and a shoreline stabilizer.

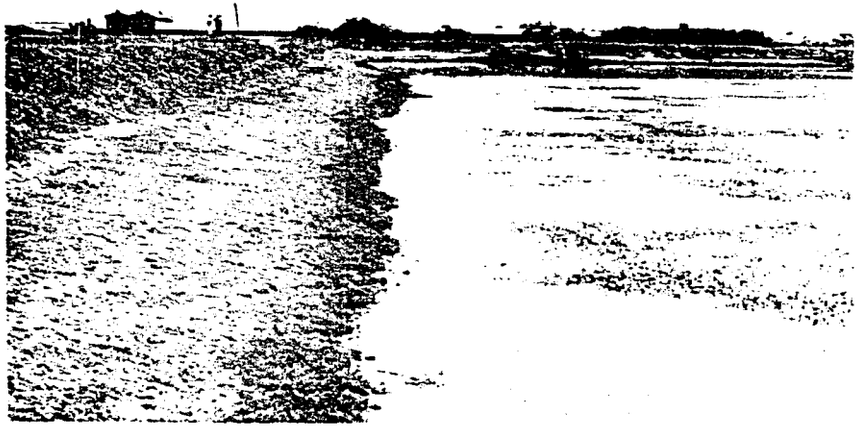
A short-growing plant was observed along the shoreline of another fish-rearing pond.

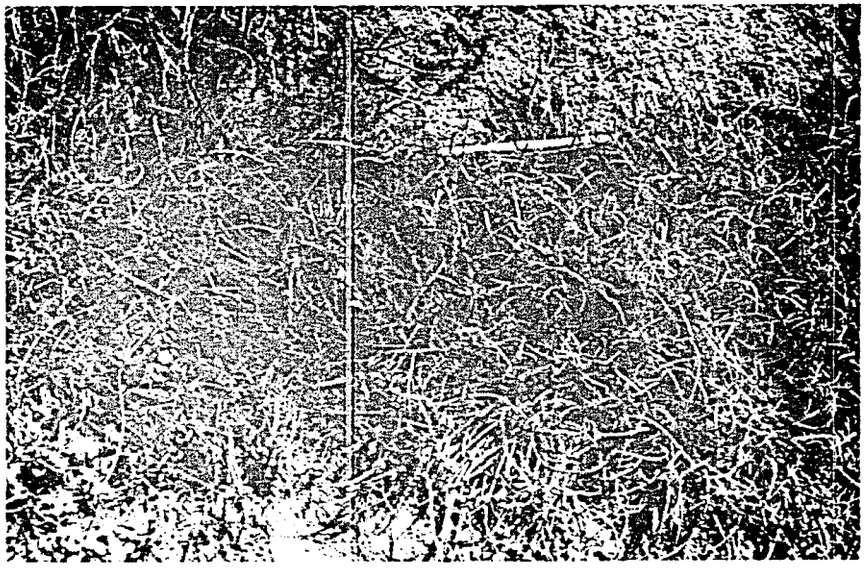
A. The plant has tentatively been identified as a Fimbristylis sp. It formed a band approximately 0.75 m wide around the pond. (The plant is not to be confused with the perfoliate pondweed infesting the pond.)

The plant formed a dense sod. The leaves did not exceed a height of 5 cm. The plant appeared to be more restricted in its area of inhabitation due to dryness and inundation. It may have possibilities as a bank weed competitor and a shoreline stabilizer.



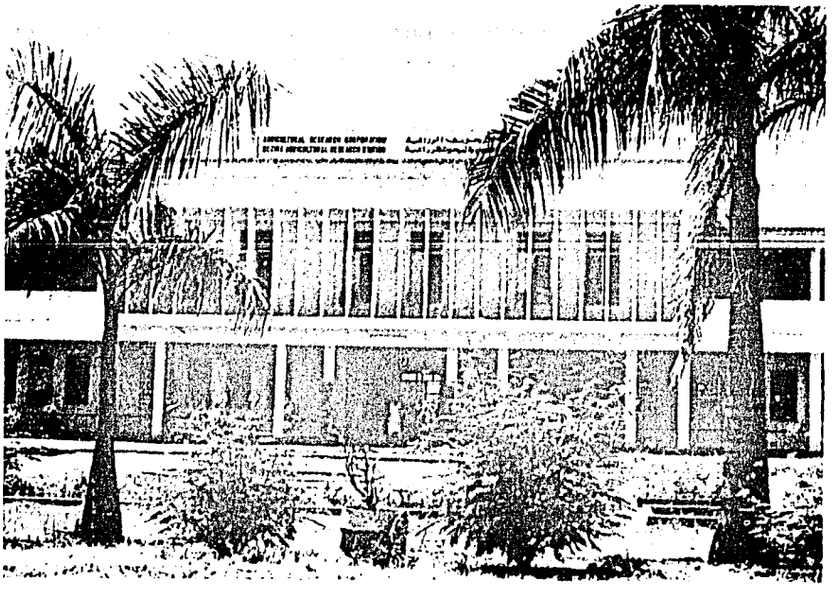






The Administration Building for the Gezira Agricultural Research Station, Agricultural Research Corporation is located at Wad Medani. Most of the crop research investigations relative to the Gezira Scheme are conducted here.

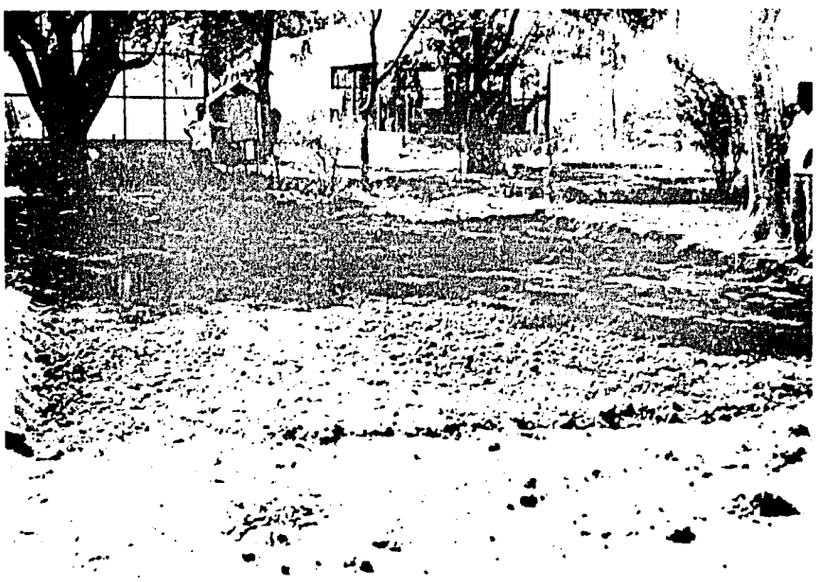
Construction of a new pesticide residue laboratory had just been completed at the GAR Station. Current emphasis was being placed on 2,4-D residues in soils, crops, and human fatty tissues. Research material for the latter was being obtained at the local hospital. The facility was very well equipped with the latest instrumentation for this type of research.

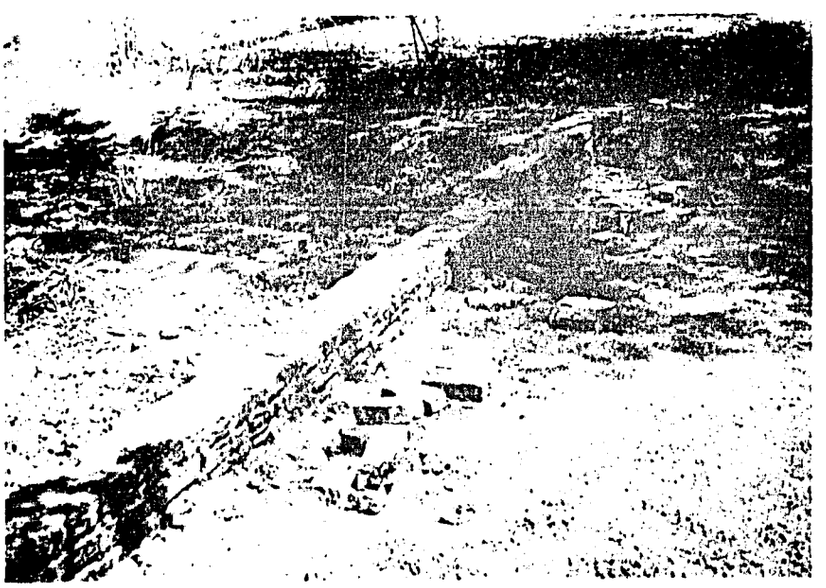


The site for the spikerush nursery is located at the GAR Station. Preparation for the site is being discussed. Third from left is Dr. Abdalla Hamdoun, weed specialist, who will be in charge of the spikerush nursery. Continuing from left to right are Dr. Ali Mahyad Bannaga, Director, Agricultural Research Council, National Council for Research; Dr. Kamil Beshir El Tigani, Head, Waterhyacinth Control Section, Plant Protection Administration; Bill Bailey, Fisheries Biologist and Projects Coordinator, Arkansas Department of Fish and Game; and Dr. Mirghani Tag El Seed, Hydrobiological Research Unit, Faculty of Science, University of Khartoum.

Work on the spikerush nursery began a few minutes after the site had been selected. By late afternoon the soil had been leveled.

Construction bricks were used to form the ridges. Upon completion, a sheet of 4 mil black polyethylene plastic will be draped over the ridges to complete the pond basin. Soil will then be placed on the sheet to provide a substrate for the spikerush, water 10 cm deep will be added, and seed sown over the surface. The seed rapidly sink to the bottom and germinate within 36 hours. After the seedlings become rooted the water level will be dropped and thereon the soil will be kept wet. This environment will encourage good flowering and subsequent seed production.



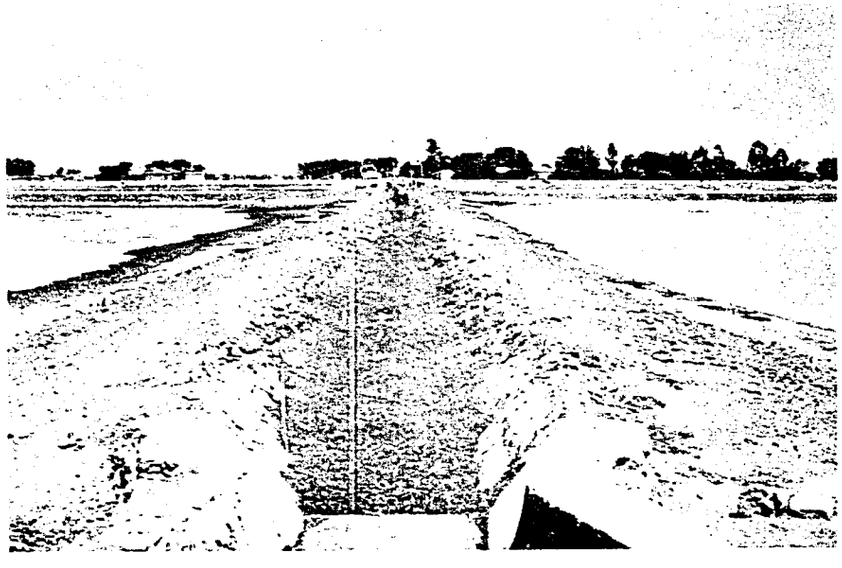


There are three kinds of canals: the Main, major, and minor canals. A. The Main, primary canal for carrying water on the Gezira Scheme.

The major canals branch off from the Main canal. Occasionally weed infestations occur in these canals.

The minor canals are offshoots of the major canals. They have smaller capacities than the majors, are shallower, and can usually be depended upon to be choked with vegetation.

Small intermittently used ditches are often covered with Bermudagrass (Cynodon dactylon (L.) Pers.). The soil on banks and ditch bottoms is stabilized by the presence of this grass. It causes some reduction in waterflow, but less than from many other weeds. In most areas it is kept short by grazing goats.

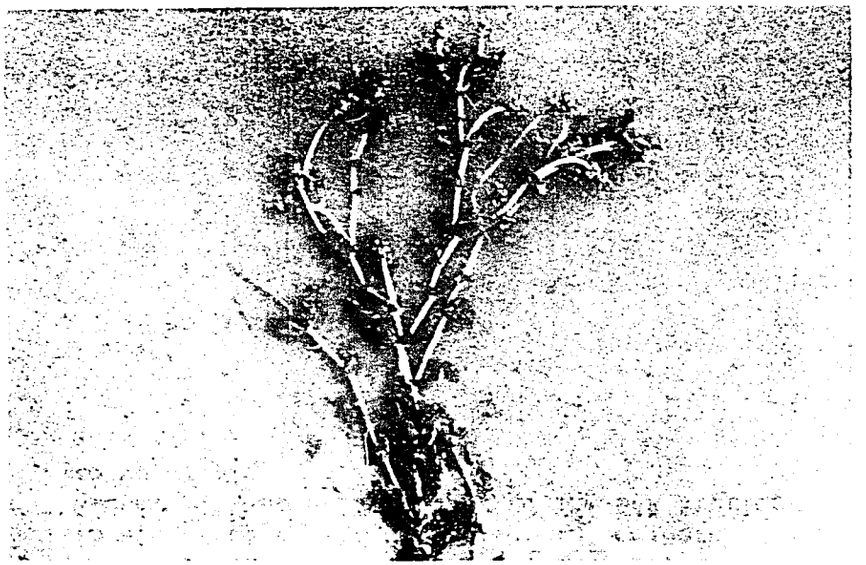


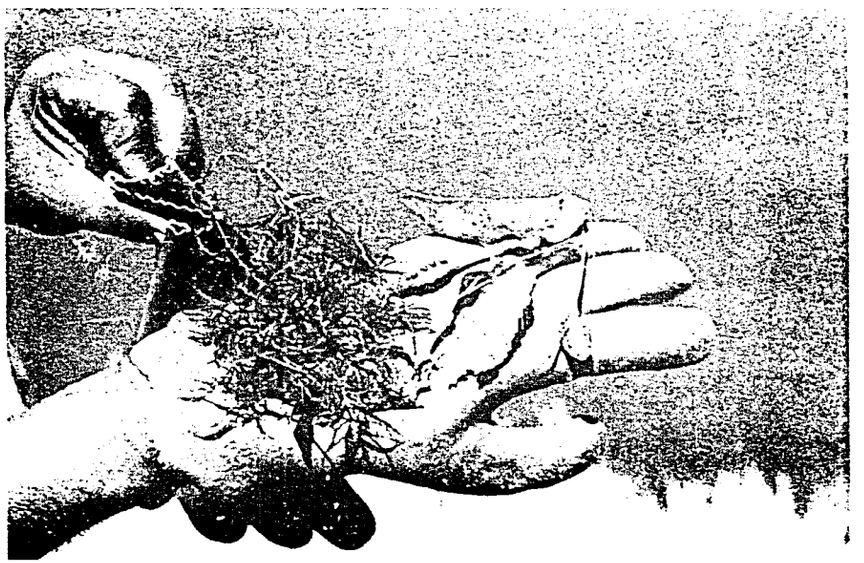
Numerous aquatic weeds occur in the Gezira Scheme. A. Perfoliate pondweed (Potamogeton perfoliatus L.) appeared to be the most common waterweed in the canals.

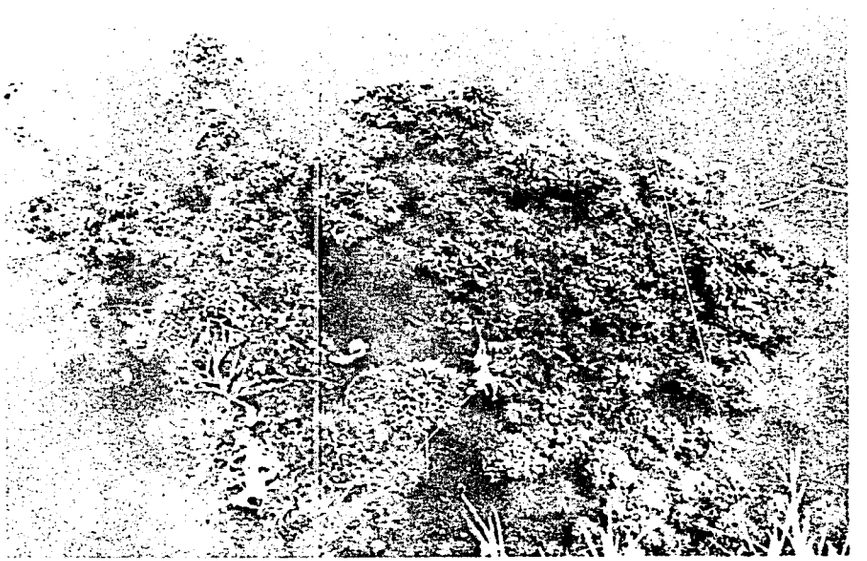
Perfoliate pondweed has stagnated the water-flow in this small delivery canal.

Najas armata Lindb. (left) and Ottelia alismoides (L.) Pers. (right) were also observed in mixed stands of other weeds.

Fanwort (Cabomba caroliniana Gray) was interspersed with the perfoliate and curlyleaf pondweeds.





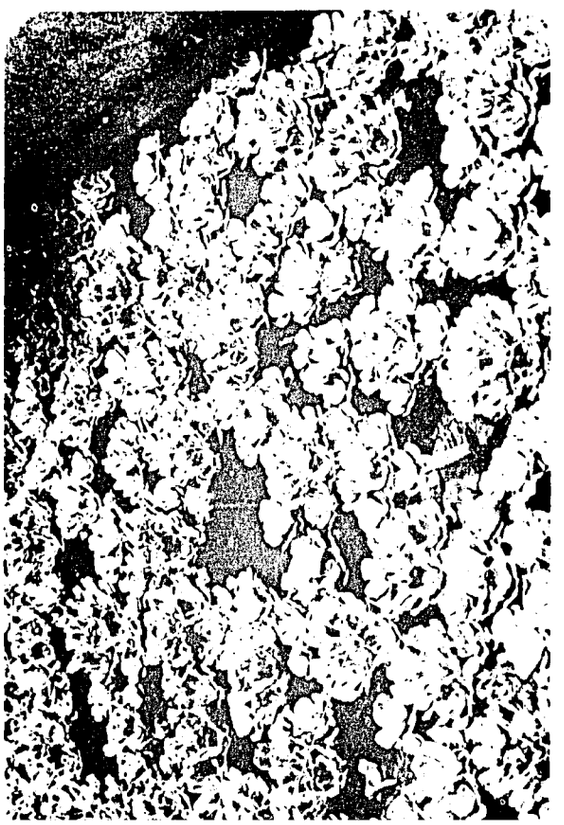


American pondweed (Potamogeton nodosus Poir.) was found growing in slow-flowing and ponded waters.

An aquatic plant similar in appearance to American pondweed and also found in slow-flowing shallow waters was floatingleaf pondweed (Potamogeton natans L.). They can be easily distinguished from each other by the presence of submersed leaves and subterrean tubers on the American pondweed.

Waterlettuce (Pistia stratiotes L.) occurs in abundance on the Nile River in Southern Sudan. It had been brought to the GAR Station to be studied.

The thumb-like shoots in the small drain are common coontail (Ceratophyllum demersum L.). Other weeds include floatingleaf pondweed and E. staginum which has been grazed, but still continues to grow across the bottom.



The aquatic grass, Echinochloa stagninum (Retz.) Beauv. also found in Egypt, is a serious weed problem. Shoot fragments collect at head gates and culverts. If not removed they form dense mats that obstruct the flow, raising water levels sufficiently to cause flooding and breaks in canal banks.

Green vegetation was scarce on the Shegara Fisheries Research Station. Goats were allowed to range freely. They will eat most everything; rank growth of weeds to a minimum. Their usefulness in controlling bank weeds could be extended.