

## **ADVISING ON BIOLOGY AND CONTROL OF ALLIUM WHITE ROT IN EGYPT**

Fred Crowe

### **Summary**

Temporary Foreign Assignment was accepted to Egypt on 2-22 December, 2004, via the agency ACDI/VOCA, funded by US AID and organizations within Egypt. Technical assistance and training on Allium white rot biology and control was requested by and delivered to Farmer Associations throughout Upper Egypt facing production and packing problems related to onion and garlic white rot (*Sclerotium cepivorum*). Additional information was requested and provided for Botrytis neck rot (*Botrytis allii*) control and other onion diseases. Discussion focused on appropriate solutions to lowering the incidence of these problems using the latest fungicide or cultural controls available that were cost effective within the capabilities of the Egyptian farmer. Over the period of 3 weeks, 15 village meetings were held with both farmers and local extension agents present, 50 on-farm visits were made with both farmers and extension agents, and formal seminars were presented to extension agents and university researchers at two universities. All interaction was translated by a nationally recognized Egyptian horticulturist whose English was superior, and who participated in discussions on onion and garlic production situations in Egypt, which were different in many respects from those in the United States. A white rot control program was developed and specifically oriented for cultural and environmental conditions in Egypt. This control program can lead to control of the white rot disease if appropriately implemented – Egypt has a rather specific and unusual environmental situation that lends itself to control of this disease, unlike in many colder parts of the world. An extension bulletin suitable for Egyptian farmers and CARE agents is being developed by F. Crowe and Egyptian cooperators, and should be published in Arabic. A number of other recommendations were made, including (a) the need for regional soil temperature equipment currently unavailable in Egypt, and (b) the need for Egyptian scientists and extension personnel to attend world conferences on onion white rot. The final report, along with the daily report, was made to ACDI/VOCA and other cooperating agencies.

## Final Report, January 10, 2005

FROM: Fred Crowe ACDI VOCA Volunteer  
TO: Mohamed Khafagy, El-Shams Project Director

PROJECT INFORMATION: Agricultural Export and Rural Incomes (AERI)  
Horticulture  
Onion and Garlic White Rot Control, Assignment No. 456003-001. Requesting  
Organization: CARE Egypt / El-Shams Project  
El-Shams Project Director and Technical Liaison: Mohamed Khafagy

### Dates of assignment: 3-20 December, 2004

**Scope of work:** For 2 weeks, I visited with scientists, administrators, extension agents, and farmers' organizations throughout Egypt to advise about the current status of information about Allium white rot (*Sclerotium cepivorum*) worldwide, to better understand crop production and environmental conditions in Egypt that are important with respect to exacerbating and/or ameliorating this disease, and to (I hope) recommend local approaches to control of this disease in Egypt. I presented two seminars on the overall biology and control of white rot to audiences of scientists, extension personnel, and farmers. Secondly, I hoped to discuss similar issues with respect to Botrytis neck rot of onions. During the tour and discussions, it took some time and effort to better understand the local environmental and cultural constraints that might impede and/or allow such control in Egypt, but I think great progress was made.

Further, I looked for opportunities for possible future cooperation and interaction on either a research or extension basis. Several such opportunities arose, and are discussed in detail below.

**Recommendation summary:** A program for control of onion and garlic white rot in Egypt is suggested to take advantage of Egypt's high soil temperatures, diverse onion cropping systems, and relatively inexpensive labor force. This includes:

1. Rouging of all white rot-infected plants from fields during the season for symptoms. This prevents further intensification of the sclerotial population, and even allows for population reduction because the fungus commits all prior sclerotia towards current disease.
2. Rotate the white rot-susceptible export onion crop that matures during March and April with trap crops that mature too early for white rot development on the bulbs. Such trap crops could include green bunching onions or non-export bulb onions that are harvested in December and January. Sclerotia of the white rot fungus will germinate in response to the presence of trap-crop roots, but the fungus will fail to rot the bulbs because of delays in growth from high soil temperature (and perhaps with the contribution of unfavorable planting depth and plant spacing for some trap crops), resulting in a great population decline of sclerotia. Sufficient decline in soil populations will result in minimal white rot incidence in the export bulb crops (or any other Allium crops grown when white rot is favored). Failure to do

- so will allow populations to resurge. For fields already abandoned because of excessive white rot, several trap-crop cycles are recommended before planting a crop during the more conducive white rot season.
3. Do **not** fail to rouge rotted plants even when control is assisted by fungicides or biocontrol products, because even a few rotted onions or garlic can increase the population of sclerotia so that fungicides or biocontrol agents may fail in future plantings. Fungicides and other products must be considered only supplementary to white rot control, not the primary control measure.
  4. Because growers farming land not yet infested may not know what white rot looks like, an extension brochure should be produced with clear pictures, and including the above recommendations. Of course, this brochure would be useful to growers with white rot experience, too. I am willing to assist with preparation of such a brochure. Hopefully, someone can soon provide good, local pictures of white rot symptoms on onions to be included in this brochure (I was not in Egypt when symptoms occurred).
  5. No public soil temperature records were available in Egypt to clarify the specific period when the white rot fungus would be active on bulbs, and upon which to base fine-tuned white rot rotational recommendations. I am confident with recommendation number 2 above, but this could be fine-tuned with good soil temperature data. It is recommended that soil temperature be added to any established public weather/climate data-gathering system. This may be as simple as adding a few soil thermometers to an established system. Eventually, such soil temperature data should prove useful for many other reasons. (To represent irrigated cropping conditions, soil temperature probes should be placed in irrigated soil. Typically, permanent plant covers such as turf or perennial ornamentals are planted in this soil to simulate a crop.)
  6. I strongly recommend that Egyptian scientists and extension people interact informally and formally with white rot workers worldwide. An international white rot conference exists, which selected Egyptians could attend, and Egypt should consider hosting this conference in future for even greater exposure to world activities on this disease.

An opportunity exists for cooperation between me and Dr. Ahmed Hassan Mitwally (Plant Pathology Institute) on current research on white rot control by means of applying germination stimulants to soil to reduce soil populations of the white rot fungus. This research may also include scientists from Australia and Canada. I will provide Dr. Mitwally with a copy of our proposal and protocols for research.

With respect to Botrytis neck rot, farmers can probably lower neck rot incidence by better fertility, curing, and handling practices, but the many overlapping onion crops in Egypt may prevent high levels of control because spores are always present. Farmers should meet with export people in the presence of both a qualified Botrytis neck rot expert and an onion horticulturist to discuss proper crop management and handling. This would probably best be done when the export crop is being harvested and shipped.

**Body of the Report:**

**Host organization:** El-Shams and CARE Egypt, cooperating with each other and other organizations. The key people at the field level are the CARE extension agents who have direct contact with growers through small farmer organizations. El-Shams and CARE provide a network of national and regional trainers, and other cooperating groups provide training and expertise.

**Problem addressed: White Rot Control in regions that already have the problem:**

*Issue/Problem:* White rot disease has reduced the productive area for onions and garlic in several parts of Egypt, and threatens other regions with similar fate, i.e., infested land has been abandoned in past. Growers remain unaware of white rot research tools generated worldwide in the last 10-20 years.

*Recommendation:* After several weeks of discussion and observation, it seems clear to me that Egypt has perhaps a greater opportunity to control the difficult white rot disease of onions and garlic than perhaps most other areas of the world. However, this does not mean such control will be achieved easily, as there are strong cultural (and perhaps some economic) barriers in implementing my suggestions; for that matter, there are similar cultural and economic difficulties in most other parts of the world also. Nevertheless, Egypt has a natural advantage in that much onion and garlic production occurs at temperatures in the upper soil profile that limit growth of the white rot fungus, and thus bulb infection. Further, Egyptian labor is rather cheap, allowing control methods not available in many other countries.

The pathogen commits all of its propagules toward bulb infection. By planting onions during warm seasons, sclerotia may be stimulated to germinate, but by harvesting an *Allium* trap crop prior to the time (March, April) when soil temperatures allow bulb infection and high fungal reproduction, farmers can escape white rot disease at the same time that the population of the white rot fungus declines in the soil. In this process, the fungus population can be reduced to very low levels that will induce only a trace of disease. Full eradication is never possible because some small reproduction occurs in deeply placed onion and garlic roots. Making this system work only requires farmers to plant onions in already-infested fields so that harvest occurs prior to the cool time of the season when white rot symptoms develop (when bulbs are infected). In Egypt, "trap" crops available for this purpose include the bunching or green onion crop or the early non-export bulb crop that is harvested in December and January, before symptoms develop in March and April. Preventing the historical losses in the full-season export onion crop that matures during or later than March and April, then, would depend on rotating the susceptible export bulb crop with the suggested bunching onions or the non-export bulb crop. If fields already are highly infested, planting of several such trap crops might be required to sufficiently lower populations to sub-damaging levels. Thus, the semi-eradication process might take several years of planting bunching onions to be harvested in the December-January period.

Such trap cropping will not fully eradicate sclerotia from infested fields; however, as some sclerotial reproduction will occur on roots at lower soil depths where temperature is

suitable. Thus, farmers must pull out and destroy (rouge) *all* white rot that occurs in lightly infested fields to avoid rapid population increase of sclerotia of this fungus. Such rouging must continue in all infested fields, irrespective of crop rotation and fungicide usage, because any infected bulbs remaining in a field will serve to increase populations rapidly. The combination of trap-crop rotation and rouging alone may allow regular cropping of the more susceptible export bulb crop. Any additional contribution from fungicide use or biocontrol agents would be useful but not the primary means of control. As rouging already is practiced by many farmers, this should be an easy concept to grasp, but sometimes farmers give up rouging, depending instead on fungicides.

While fungicides can contribute to disease control, they rarely are totally effective. Failure to continue rouging when fungicides are utilized can result in enough fungal reproduction on diseased bulbs to overcome future fungicide applications. Thus, continued rouging is emphasized even when such products are available.

*Action:* The difficulties in implementing the above control program include:

- a. Over-dependence of farmers on quick and easy fungicide control of other crop diseases. This will not work effectively on white rot as the primary control program, but farmers commonly will not believe this.
- b. Difficulties in educating farmers that the trap-cropping rotation can work, and convincing them to try this on heavily infested fields. Many farmers no longer wish to risk crop failure from white rot once it has occurred. Perhaps some farmers' associations might underwrite the risk of such plantings in the first test cases, to assist in such risk taking?
- c. Farmers would need to economically justify production of the trap rotation crops. I don't think this should be a major limitation, however, as it seems they make money on these crops, too.
- d. Educating farmers that it remains important to rouge *all* white rot that occurs, especially when the disease is partially controlled by other means, *or* when they don't recognize white rot very well. Teaching them to simply rogue *all* prematurely dying plants can suffice, however.
- e. Recommendations could be made with a higher confidence level if good multi-year soil temperature records were available. No public records seem to be available from Egypt, which is surprising.

**Problem addressed: Training farmers to recognize White Rot in regions not yet infested, and providing information to assist in avoiding contamination.**

*Problem/issue:* In regions where white rot was not an established problem, there is a general lack of recognition of the disease. Many farmers called anything that was damaging below the soil as white rot, but none of these cases in fact was this disease. There should be more tools and training available so that farmers can recognize the disease and respond quickly if and when it arrives, in addition to having a better understanding of how to prevent white rot introduction.

*Recommendation:* An extension publication showing typical white rot symptoms would be useful. I can assist with providing pictures from elsewhere, but local pictures would

be best, because specific symptoms can vary among regions of the world. Continued training in prevention techniques is always useful, as a reminder of how white rot moves from infested to non-infested areas with equipment, soil, plant materials, or manure (and soil mixed with manure).

*Action:* Someone should travel to white rot-infested regions during March and April to gather good pictures of disease symptoms. By whatever mechanism available, a publication could result. I am willing to prepare and/or contribute to the publication, but someone local would need to gather the pictures – someone with previous white rot experience. I understand that Dr. Ron Voss (University of California, Davis) will be in Egypt in April. He recognizes white rot and may be able to obtain photographs from the field. I will attempt to coordinate with him in obtaining photographs, and then prepare a draft extension bulletin to provide to Mohamed Khafagy for publication in Egypt. I will include the recommendations listed in the previous "problem" section (rouging, crop rotation, etc...) as information in the bulletin.

It should also be noted that preemptive practices to control white rot are effective, including the crop rotational program described above. With such a crop rotation, white rot may be eradicated when the first several sclerotia infest a field, and the disease may never appear.

**Problem addressed: lack of Egyptian presence and activity in the small but connected world White Rot community of scientists and extension specialists.**

*Problem/issue:* On the first day of my visit, I met with university and government scientists and administrators in Cairo, along with El-Shams and CARE staff. The structure and missions of the various organizations were outlined. In general, research pathologists were relatively knowledgeable about basic white rot biology, but did not seem well connected with other pathologists worldwide to be aware of emerging research and control issues elsewhere. Most white rot research takes many years, even decades, to publish, as the work is quite slow to develop. Additionally, it was unclear to me how much these Egyptian pathologists participate in training of extension agents around the country. Both are related problems. Egyptian researchers and extension personnel need to communicate regularly with the world community, or they will regularly be left behind.

*Recommendation:* CARE, AERII, and El-Shams could assist both Egyptian pathologists and extension personnel to become better connected with the small but worldwide network of active white rot researchers elsewhere. Additionally, if there is not an available mechanism for these pathologists to have input into extension training, this should be changed.

*Actions:* The International White Rot Workshop has been held every 4 years since the early 1980's, with meetings occurring in white rot-infested regions each time. The latest such conference was the Sixth International Workshop on Allium White Rot, held in the United States (California). The next such meeting likely will be held in Canada (Toronto) in 2006. Previous meetings have occurred throughout Europe and in Mexico.

I strongly recommend that resources be provided to a small set of scientists and key extension personnel to attend and participate in this conference. This conference encourages participation from industry people from around the world, and even farmers local to the meeting region attend. Thus, there is an important and dynamic mix of research and practical knowledge shared. Because a lot of white rot information remains unpublished for many years, this informal conference is critical to keeping up with world knowledge about this disease. As an example, Mexico was an infrequent attendant in previous years, but has become a world leader in white rot progress since more Mexicans began to attend. As much Mexican work is unpublished, this may be the only place to acquire such knowledge. The workshop is conducted in English, so people attending should be reasonably facile in English. Egypt could consider hosting this workshop in future, perhaps as early as 2010, which would allow a wide range of Egyptian scientists and extension personnel to be exposed to international work. In Mexico in 1998, the meetings were conducted in English, but Spanish interpreters were provided to translate for the abundant audience of Mexican industry and farmers.

**Problem addressed: Botrytis Neck Rot:**

*Issue/Problem:* Neck rot disease occurs at high levels in the export onion crop, in storage and after shipment. As a result, Egyptian onions may not be favored by foreign clients purchasing such onions. How can this situation be improved?

*Recommendations:* I did not have many significant discussions over Botrytis neck rot with farmers and extension agents. In fact, I felt they were reluctant to discuss this disease. I suspect such discussions might best be developed in cooperation with exporters together with farmers, and that these be held when the export crop is being cured and handled. Farmers need to learn to take some ownership and responsibility for Botrytis infection; they do not understand well that the disease starts in the fields even though it shows up in storage. On the other hand, I think Botrytis neck rot may be particularly difficult to control in Egypt, because there are a succession of overlapping onion crops, which the fungus infects and from which spores are always available for infection. While growers might lessen neck rot incidence with better fertilization, curing, and handling practices, they may not be able to lower the incidence to some export standards without isolating the export crop from other onion crops nearby.

*Actions:* I suggest inviting into Egypt another pathologist with more extensive, practical knowledge of Botrytis neck rot control. The best person in the world may be Dr. Jason Dennis in Australia, who coordinated industry efforts for Botrytis neck rot control in the Tasmanian export onion crop to Europe. His knowledge of the crop and this disease are perhaps foremost in the world. He formerly was with the Australian government, but was hired by the Tasmanian onion industry for 5-7 years to exert controls over their export system. More recently is his private consulting practice in Australia. He might charge a fee for participating, and he may have allegiances to the Tasmanian onion industry, which probably competes with the Egyptian export crop. I can also provide other names of people nearly as qualified as Dr. Dennis who might participate, should Dr. Dennis be unavailable.

**Additional and General Comments:**

I finally understand something that had been confusing at first: garlic in Egypt seems to not suffer as much white rot, which is the reverse of the situation in most of the rest of the world. What I concluded was this: garlic in Egypt is planted at the soil surface rather than 3-6 cm deep, as in the western United States. In areas of the world where shallow soil freezing may occur, garlic is planted substantially deeper. The difference in depth of planting accounts for relative control/avoidance of white rot rising to the stem plate due to higher soil temperatures in Egypt compared to the United States. In contrast, onions in the United States are direct seeded at 2 cm, whereas onions in Egypt are transplanted so that the stem plate is at 5-6 cm, thus onions in Egypt are in soil temperatures more conducive to white rot, and onions in the United States may escape (in warm areas, at least). If onions in Egypt could be direct seeded at 1-2 cm, white rot would be substantially less; perhaps this could be a topic to address with growers, agents, and researchers, although this would be rather a major cultural shift. On the other hand, both onions and garlic in Egypt are spaced rather widely compared to those in the United States, which does limit white rot substantially; plant-to-plant movement is slower in less dense plantings. The trade-off between shallower but perhaps more dense plantings would need to be investigated, but could lead to substantially better white rot control, and perhaps higher yields with denser plantings.

Dr. Ahmed Hassan mentioned the *Trichoderma* work of Teyfik Hafez, who worked on white rot control for some years and released a product (Landguard). Apparently, Hassan thinks some control is achieved with this product, but during this visit we found no farmers who used it. I suspect that either the product works only moderately well at best (as has been true in other regions) and/or farmers are reluctant to try it at current cost. Perhaps associations could apply for grants to procure some to test in some fields? This might be a reasonable recommendation, as it would both promote an Egyptian product and demonstrate the product's effectiveness, and assist such organizations in being more progressive and proactive.

**Key Contacts:**

*Mohamed Khafagy, El-Shams Project Director* is the key coordinator for all activities. He is particularly interested in follow-up activities and communication resulting from volunteer visits such as mine.

*Dr. Hassan Mitwally, Horticulture Research Institute*, is interested in cooperating on current and future research into application of germination stimulants to artificially induce large sclerotial population declines. I had more difficulty talking with other researchers because of translation problems, and there may be others who are interested in such cooperation. I will send him a recent proposal, including methods.

*Dr. Amed Hassan, University of Cairo*, is a world-class vegetable horticulturist/breeder, who also has a wide knowledge of vegetable disease issues.

*Dr. Mohamed Samy, AERI*, is highly interested in the export market situations and might be in a position to facilitate research funding and cooperation. He expressed interest in



knowing about extension agents or agricultural engineers who might be particularly promising in taking greater future roles and responsibilities. Tentatively, I would suggest considering the following: (1) Agricultural Engineer Mohamed, with the Rural Development Association West Tata Project, Sohag area, and (2) Agent Halif Hassen, Rural Development Association, Menba/Matai, Minya area. No doubt there are many more, but these two impressed me with their progressive, proactive ideas, and their successes. Dr. Samy attempted to locate soil temperature data, but I heard later that none were available.

*Peter Wetzel, Nile Valley Group*, is interested in elevating the quality of local agricultural products on international markets, and working within the El-Shams project to achieve this. He seems to be well connected at all levels.

National and regional CARE/El-Shams personnel: I was impressed with the knowledge and commitment of all personnel I met. I am a little unclear of their specific role in training and coordination. The ones I met include:

*Ayman Khalil Abdel-Salam, CARE, El-Shams Local Marketing Technical Advisor*. If I recall correctly, his English is good, and he might be a logical choice to send to the International White Rot Workshop.

*Mamdouh Sobhy Abdel Aziz, Care, El-Shams Marketing Training Officer*.

*Mohamed Zahair El-Shandeweilly, Care, El-Shams North Upper Egypt Area Manager, Beni Suef*

*Mohamed Hisham Mohamed, Care, El-Shams Marketing Training Officer, Assuit*

*Hend Nabil Mahmoud, Care, El-Shams Organizational Development, Assuit*

*Nancy Al Walla, Care, El-Shams Marketing Training Officer*. She assists farmer organizations with grant proposal preparation.

Farmer association extension agents and agricultural engineers: Refer to the daily notes for names. Some were more noticeable than others, perhaps because of personality, and two are noted above with respect to Dr. Samy's interest. All seemed reasonably trained but some seemed more progressive with respect to grant writing and trying new materials and concepts.

## **Report of Daily Activities for ACDI/VOCA Egypt**

**3-11 December, 2004**

FROM: Fred Crowe, ACDI VOCA Volunteer

TO: Mohamed Khafagy, El-Shams Project Director, and Peter Wetzel, El-Shams Technical Liaison and Nile Valley Group

PROJECT INFORMATION: Agricultural Export and Rural Incomes (AERI)  
Horticulture

Onion and Garlic White Rot Control, Assignment No. 456003-001. Requesting  
Organization: CARE Egypt / El-Shams Project  
El-Shams Project Director and Technical Liaison: Mohamed Khafagy

### **Saturday, 4 December**

Mohamed Khafagy briefed me on the project and various groups and people involved:

- A. ADCI/VOCA is providing me as a technical expert.
- B. El-Shams is the project under which I am working. Led by CARE, the project is building organizational, marketing, and technical capabilities of small farmers.
- C. CARE Egypt is the administrative structure and personnel that provides information to farmers in Egypt, via local agents to farmer organizations and regional technical specialists.
- D. Nile Valley Group (NVG) is a private company involved in export of various commodities, interested in elevating the quality of all products. NVG is partnering in the El-Shams project and has taken a role in identifying and facilitating training of various sorts.
- E. ACIDI/VOCA's role was bringing technical experts such as myself and arranging us to meet with people and provide training.
- F. AERI is an international program (unsure of structure or funding) that can provide AID-funded program grants in support of projects such as this.
- G. I probably will meet with government scientists from the Horticultural Research Institute and Agricultural Research Center to better understand what research has been done on white rot in Egypt, what may be in process, and what might occur in future.

Mohamed Khafagy discussed the project and various cooperating groups and their roles and relationships. It seems complicated. Accompanied by Mohamed Khafagy, I participated in a series of discussions.

1. Led by Dr. Mohammed Samy, AERI Institutional Linkage Project Coordinator, who also translated much of the discussion.  
Also participating: Dr. Ahmed Kamal El Kafoury and Dr. Ahmed Hassan Mitwally. Dr. Mitwally is a pathologist who has worked with white rot.  
Onion and garlic production and export situation were discussed, including that onions had been rejected in Europe (recently?) because a load arrived with abundant active white rot. Improvement of quality of the export product is desired, especially with respect to white rot and botrytis neck rot. Further, they hope to expand the window of time over which Egyptian product is exported, perhaps to as many as 6 months rather than just 2. The current export crop is limited by availability of product that meets international standards (primarily EU). I outlined what I had done in the white rot arena over many

years, including basic biology, control by reducing sclerotial populations using germination stimulants, control by fungicides, and integrated control programs. I mentioned that I was a recent coordinator of an international working group on Allium white rot, and hoped scientists and onion/garlic industry leaders from Egypt might participate in future with this group. I indicated that I had been active with Botrytis research on a more limited basis, but that I was quite aware of current research in a few other areas of the world by researchers I felt were quite progressive in this area. I had spent a sabbatical in Tasmania in 2003 with several of those researchers (Dean Metcalf, Tasmanian DPI, and Jason Dennis, FieldFresh Tasmania, Australia), and cooperated with Dr. Lindsey Du Toit (Washington State Univ., U.S.) on other projects. These are among the most active onion Botrytis neck rot researchers today. I suggested that scientists from Egypt might be interested in participating with me and others in new and ongoing international effort to test repeated applications (via irrigation) of low rates of germination stimulants (both petroleum-derived DADS and natural products) to control white rot. Such efforts would follow upon many years of research and some commercial success using single applications of high rates of such products. The group seemed eager to join this effort, and I agreed to forward Dr. Mitwally a proposal that I have submitted elsewhere, including protocols. I pointed out that one of the stimulants (DADS) currently is unavailable, but that we hope soon to obtain it from Chinese sources. Currently, there are no specific natural products available to growers, nor guidelines on how to develop on-farm sources of such stimulants (e.g., garlic juice, onion juice), but this research may result in such guidelines.

2. Nile Valley Group, including Peter Wetzel (Chief Operating Officer) and Dr. Ahmed Hassan (Professor of Vegetable Crops, Univ. of Cairo and NVG Veg Crops Consultant). NVG is a commercial business involved in agricultural exports, and is vitally interested in improving the quality of onion and garlic products. My understanding is that this group has some responsibility for implementing aspects of this project. (Dr. Hassan accompanied me on my tour and both translated and provided technical expertise to facilitate my comprehension of Egyptian onion and garlic production.) Dr. Hassan is a distinguished professor of vegetable production at Cairo University, conducting research, teaching classes and graduate students, and he has written a number of production books of use in Arabic countries. Once again, I discussed some of my past work, and hoped that I might assist in ways yet uncertain until I better understood the local situations. Dr. Hassan outlined the various onion and garlic crop cycles in Egypt, varieties, etc.... and such discussions continued as we traveled together during the week.

3. A group of horticulturists and pathologists met at the Horticultural Research Institute, led by Dr. Assem Shaltout.... but I think the pathologists were from the Department of Plant Pathology. All were from the Agricultural Research Center (ARC):

Dr. Assem Shaltout – Professor of Pomology, HRI

Dr. Kamal Emam – Institute of Plant Pathology

Dr. Abdall El-Shehaby – Professor, Plant Pathology

Dr. Abd Elmonem Abd El-Hameid – Plant Pathology Institute

Dr. Ahmed Hassan Mitwally – Professor, Plant Pathology Institute

I once again but briefly mentioned some of my past work, but also requested that this group convey to me what has been done in Egypt in recent years with respect to white rot of onions and garlic, and what problems they see that need to be addressed. I also was curious what contact they have with industry and extension agents and how information is transferred each direction. I must admit that I had some difficulty understanding some of the conversation, combined with the fact I was tiring from a long day. I did register that Prof. El-Shehaby had worked with white rot directly and had shown effects by intercropping and crop rotation. I intend to contact him to find out more about these investigations. It was explained to me another insidious way that white rot spreads: dirt from infested fields may be used to line milking areas, they then mixed with dung from the milking areas and placed onto un-infested fields. (Later in the week, this practice was discussed with several farmer groups.)

I ended the day understanding that a list of goals included:

- a. Extend the export season (white rot, Botrytis)
- b. Improve export quality (white rot, Botrytis)
- c. Prevent new regions from becoming infested (white rot)
- d. Find ways to allow Allium cropping in older, infested areas (white rot)

Possible follow-up activities:

1. Cooperate with studies on applications of germinations stimulants for control of white rot, both DADS and natural products (e.g., garlic or onion juice)
2. Get updated information from Australia and United States to Egyptian pathologists and industry, with respect to Botrytis and white rot information.

At this point in my visit, I had the following questions: What relationships exist between researchers, extension system, and industry? How are agents trained and managed, and what is their knowledge level? How much do farmers and industry actually use extension, i.e., researchers may know how to best control white rot, but do the agents understand and do they listen and respect the agents? How much influence do foreign export people have towards training and forcing changes in field practices, and are these export people knowledgeable?

### **Sunday, 5 December**

Farm visits to Fayoum area, facilitated by Mamdouh Sobhy Abdel Aziz, Care Egypt (regional) marketing Training Officer, El-Shams Project. Also participating was a leader of a local organic farming group in the Fayoum area (get his name and title!!!).

Early morning: Met with onion and garlic farmers of the Kaser El-Basil Association. Observed nutritional problems probably created by a combination of soil nutrient or type variation in one field, and probably by too-high seeding rate and perhaps salts rising to top of raised beds when incompletely flooded. I observed probable fusarium basal rot on scattered onions in one field. Dr. Hassan took the lead in general horticultural issues, but I asked questions about production and disease control practices. A number of other onion and garlic fields were observed in the area visited.

Afternoon: Met with several small farmers of the Demasgin Association. We questioned the apparent wide spacing of onion bulbs planted for seed crops, but the farmers showed us that they used very large bulbs that they felt justified in widely spacing. They indicated very high seed yields with such a practice. Similarly, they discussed exceedingly high fertilization rates on commercial bulb crops, but again indicated they obtained very high yields. No white rot occurred in this area, but one farmer indicated experience with white rot in another farm on which onion production had been abandoned because of this problem. I asked if he had taken steps to avoid moving the disease to these plantings, and he claimed to take great care in avoiding movement of equipment and other materials that might do so. We also discussed the latest fungicides. He seemed to have experience with Sumislex, but wondered if other products might be available that provide better control. I discussed Folicur, but pointed out that this product likely is not registered for use in Egypt (neither is it available in the United States yet either). All interactions took place via translation with Dr. Hassan.

Perhaps I should have become more involved in many of the discussions that took place today. For example, even where no white rot is present, I can discuss what the growers are doing to keep free of it. Also, I can find out more about what they are doing to control various diseases, in particular Botrytis.

### **Monday, 6 December**

Continuing in Fayoud, Mamdouh Sobhy Abdel Aziz continued to join us. Also present for the first visit was Mohamed Zahair El-Shandweily, North Upper Egypt Area Manager. The first farmer's group we met was Hogmein, whose members were quite concerned about control of purple blotch, downy mildew, and pink root. They did not have white rot in this area yet. We discussed fungicides and their proper use at length, and explained about the pink root situation in long-standing onion areas. Later we met with a young group of farmers recently from university and given land in the newly reclaimed sandy regions. The agent for this farmer's group (Kharegeen group) was with us, but I failed to record his name (get??? He has very thick glasses). With new land, few soil-borne diseases of onion were of concern except nematodes. One of the farmers showed us his field of tomatoes, which was badly infected with one of the white-fly-transmitted viruses; Dr. Hassan believed that the wrong tomato variety was planted for this time of year, as this virus tends to attack this variety at this time of year on this variety, but another variety tends to withstand the attack. This was not a situation over which I could contribute, but I was impressed with both the high level of local knowledge, but also the great gaps in knowledge in some key areas of critical concern. These farmers were perhaps poorly capitalized in their new ventures, so it was of great concern to Dr. Hassan and me to find substantial virus problems in their greenhouse pepper operations nearby. Greenhouses are given to these new farmers in addition to land. We suspect enough virus may be present to result in crop failure for several of the greenhouse units, if not all of them. We were not certain of the virus(es) involved, but tobacco mosaic was one possibility. No convenient diagnostic service seems available to discern which virus(es) is present, so it was difficult to provide a firm guideline for either how the problem developed or future control. We at least explained how to manage tobacco mosaic in future, which is fully in control of the growers via cultural means. If

vectors were active, they were not obvious at the time we inspected the greenhouses. It is possible that virus-infected transplants were acquired, and there seems to be no certification available to assure clean transplants. We left hoping but skeptical that these undercapitalized farmers would not suffer high losses in their pepper crop.

In general, I participated at a substantially higher level than on the previous day.

### **Tuesday, 7 December**

Flew to H, and drove to Soheg. Met with Ayman Khalil Abdel-Salam, Local (national/international) Marketing Technical Advisor, CARE and El-Shams Project. He travels to all regions and coordinates or oversees activities nationally and I think internationally. Also present was Mohamed Hisham Mohamed, (local) Marketing Training Officer. Both traveled with us to meet with the farmers of the Baithalet group in the Soheg area. A farmer association agent did not seem to be present. Perhaps 15 farmers were present. We first observed onions in several fields, especially discussing the group's pressing concern with chronic thrips problems. In the field, no large disease concerns emerged, but later we met over tea with most of the same growers (some added, some left) and discussed white rot control, as they know this disease from nearby areas even though it currently is not present in this immediate area. It also emerged that they had interest in pink root, downy mildew, and purple blotch, and we discussed these also even though they were not their most pressing problems. I discussed old and new fungicides available for each disease. There was good interest in our approach to stimulated germination of sclerotia with either onion/garlic juices or DADS, and much discussion occurred on how to achieve white rot control using such products. Of course, the group was concerned about other horticultural issues on onions and tomatoes, which were addressed by Dr. Hassan. In total, we met with this group for perhaps 3 hours or more. At the end, we visited the local group's melon packing shed and shared melon slices. I was impressed with the organization and professionalism of this farmer association.

This day was even better in terms of my involvement in discussion and sharing. Some of this was due to the interest of the group itself.

### **Wednesday, 8 December**

Continuing in the Sohag area: In the morning we met with a group called the "Rural Development Association, West Tahta Project". This was a very progressive, dynamic group and included an agricultural engineer, Mohamed, and several on the board of directors. The group seemed very oriented toward expanding their export opportunities and toward quality products. Onion diseases were discussed as in other areas.

Driving to Assuit in the afternoon, we met with the Mosha Village Association. This again was a highly dynamic, progressive group, including their board of directors. They have written successful grants to aid their ventures in fresh bean production, mushrooms, etc. We discussed downy mildew, Botrytis, thrips, and white rot. They do have some white rot in this area, and insist that they obtain only local manure, rather than risk obtaining it from outside sources that could be contaminated. This is the type of group

that should be approached to test new ideas and concepts, where such concepts are ready for commercial attempts.

#### **Thursday, 9 December**

I needed a little more time to prepare my seminar on Wednesday night, but found myself unable to work the projection device provided. This was finally resolved prior to the seminar by using one available from Assuit University. My seminar was presented to perhaps 30-40, including members of the departments of Crop Protection, Horticulture, Extension, and perhaps other faculty at Assuit University, but also several farmer association agents, agricultural engineers, and local growers. I spoke for about 2 hours and we discussed white rot issues for another half hour. The audience seemed reasonably interested and receptive, but I felt the seminar was too long, perhaps too detailed and that I should shorten and simplify it for the next offering. Dr. Hassan agreed, and suggested that I provide a practical summary. I would have done so for this seminar if I hadn't been occupied with the equipment problems the night before. I suspect, however, that all audiences will be somewhat disappointed that there are not available more simple and available tools that allow them to control white rot easily. Unfortunately, white rot control will require thought, planning, and some changes in cultural practices wherever it will be achieved in the world, and this is difficult to explain to agents and growers used to simple solutions and not wanting to change their established practices.

I was impressed with a CARE/El-Shams regional person named Nancy Al Walla who helped introduce the seminar. She is involved in assisting farmer associations with grant proposal writing. Her English was quite good.

#### **Saturday, 11 December**

I was accompanied by Mohamed Khafagy to the Beni Suef region, as Dr. Hassan was not available. In some ways, this was advantageous because it forced the discussion more narrowly around disease issues. On the other hand, it was disadvantageous because clearly growers have many questions about their crops beyond strictly diseases. We first met with the Dandee farmer's organization, and observed one of their onion fields. I was informed that several local agents were present, but did not record their names. Also present was a Mrs. Salwa, a local El-Shams area officer. A number of diseased plants were found that the farmers feared might be white rot, but I determined that it was much more likely that we were observing fusarium basal rot, a much less severe disease on onions although it can worsen over many years. We discussed a number of soil-borne and foliar onion diseases and their control. We drove to another location and met with the West Elafshin Association, and including Mrs. Salwa. Again, I did not record the name of any local extension agents present. As we did earlier in the day, we observed a field and discussed all the important onion diseases. This group was more familiar with white rot as it exists in a nearby region, so we discussed avoidance issues extensively, and what to do when the first white rot is observed.

#### **Sunday, 12 December**

On Sunday, I presented a seminar to an audience of perhaps 35 people, including some of the faculty of Beni Suef University, area extension agents, some local farmers, and

several El-Sham area personnel. The seminar lasted perhaps 90 minutes, with perhaps a half hour for questions and answers. This seminar was more extension oriented, with less actual data from U.S. experiments, and was perhaps better for these changes.

### **Monday, 13 December**

On Monday, we met with the Rural Development Association in Menbal/Matai, Minya area. The local extension agent Halif Mons Hassen was most impressive with his local knowledge of crops. We inspected several fields of potatoes that had been over-irrigated close to harvest, such that lenticels were enlarged and the quality reduced. These were not experienced potato growers. Several fields of garlic planted with either the local variety or the exported Chinese variety were observed. Purple blotch, downy mildew control, and rust diseases were discussed. We discussed white rot prevention by exclusion of sheep that had perhaps been grazing on infested fields elsewhere. I learned that such exclusion is difficult because an Egyptian farmer has little control over such flocks of sheep that may pass near to his field, perhaps wandering through the field if he is not there to prevent this. Of course, the problem is that such sheep may defecate sclerotia of the white rot fungus onto previously uninfested fields in the process. I was most interested in Halif's interest and method of assisting local farmers into trying new crops and varieties this area; for some years he has personally invested in such new ventures by cost-sharing such new items with local farmers. Of course, he then works closely with them to assure success, and also shares in the profits. Over the last several years he successfully has introduced several new potato, bean, and other plant materials by this means. When I suggested that his association consider writing a grant for funds to test the Egyptian source of Trichoderma product for white rot control, it turns out that Halif already tried an earlier version of this product (Plantguard). Only 50 percent white rot control was achieved, which is comparable to the level of control I have observed elsewhere in the world. I nevertheless suggested they try the more modern version of this product (Landguard). I strongly suspect that this association is a leader in innovation due to efforts such as Halif's, but I do not know if the way he has personally invested in such innovation is a model that can easily be adapted elsewhere – presumably, the grant process might function similarly. In the afternoon, we met with the Al Amenadin Association and visited several onion fields. Growers seemed to have few problems or issues to discuss. They did not have white rot nearby, and seemed to understand some of the ways that it might enter their area and had taken some measures to prevent this. No agent was present, but several members of the association board were present.

### **Tuesday, 14 December**

We met with the Shirouk Association at the office of Zamin Mohamed Hassen, one of the board members and also the mayor of this village. This area also seemed to have few onion or garlic disease problems, and seemed to be a somewhat new Allium area. The level of white rot awareness was comparable to the previous association.

### **Summary (some of this included in the "draft" final report)**

I met with a number of farmer organizations, including one or more of their assigned extension agents, board member, or area CARE personnel in each case. We discussed



ongoing onion and garlic problems. Quite clearly, a tremendous organizational effort by the national, regional, and local CARE personnel and agents had preceded my on-farm visits. In all cases, local/regional CARE officers participated in the visits, knew many in each organization, and had a clear idea of where we were going at all times – no small achievement in rural Egypt! I greatly appreciate their time, interest, and concern. In general, I found all regional CARE people highly knowledgeable. Local agents participated at various levels in the discussions; it was sometimes difficult to determine whether their knowledge levels were all high, but this was mostly a distinction in personality, I suspect.

Visits were focused on field production issues, which in particular included thrips control (thrips are a problem in all onion production regions of the world at the moment), pink root (*Pyrenchaeta*), purple blotch (*Alternaria*), and downy mildew (*Peronospora*). It was also clear that many farmers interpreted *any* root and bulb disease as white rot, especially in regions where this disease was not well established. The most common misdiagnosis was over a fusarium basal rot disease that was found at low incidence in many fields. More information is needed at the farmer level to recognize white rot in the early stages, so that effective early rouging can be done.

During the first several days of visits, it seemed difficult to lead conversations to issues of export concern, such as Botrytis. Botrytis seems to be an issue either people don't want to discuss, or perhaps it is an issue the growers don't take any ownership over since it manifests after they have sold their product. However, there needs to be a way of making the point to farmers that practices such as over-fertilization (which we found to be very common), handling practices (bulb damage, neck drying procedures, etc....) do impact botrytis incidence. I make a few suggestions in the final report.

*Botrytis ideas:* Clearly Botrytis is a difficult issue for farmers and industry to grasp. A major problem I see is that there are many overlapping onion (and garlic) crops on which the Botrytis fungus can persist and remain active during the year, thus spores are always present. If the many overlapping onion crop cycles could be broken in a subregion, it is possible that Botrytis does not survive in soil, culls, etc. in the Egyptian heat (although this needs to be proven). If clean seed could be used, then subsequent crops in that region might be free of Botrytis. This undoubtedly is at best a theoretical consideration, because I can't see all farmers in a subregion agreeing to an onion-free period. It might be a consideration in some of the more corporate production regions, however. I'll recommend that Jason Dennis be approached for his ideas on Botrytis, if he would cooperate – he's probably the most "complete" Botrytis person on onions in the world at the moment, but as he is tied in with Australian onions that compete with Egyptian onions in the EU, he might be reluctant. As he now is private, he likely would not volunteer but would need to be paid.

Discussions were regularly extensive with respect to white rot. Regions and subregions varied in their experience with white rot. With some, it was a strong local issue with many associations that experience white rot, especially prevention and further intensification and control, and in bringing infested fields back into production. With

others, white rot was not in the region, but even in these cases farmers seemed aware of its threat, and were interested in how it spreads and what controls might be available. As with farmers worldwide, Egyptian farmers want a simple, easy solution to white rot, such as a highly effective fungicide. As with elsewhere in the world, it was difficult to get people to consider concepts such as crop management variations toward lowering sclerotial populations, rather than depending on fungicides. I regularly emphasized that fungicides that offer foolproof control are not available, and that fungicide usage would improve if both rouging and crop rotations are utilized to advantage. Further, a quality fungicide such as Folicur may not yet be available for usage in Egypt, nor may it last as an effective product. The most fundamental issue with respect to white rot control in Egypt is rouging of diseased plants, and farmers seem to grasp this issue pretty well already; however, the message may not be widespread or clear enough.

I finally understood something that had been confusing at first: garlic in Egypt seems to not suffer as much white rot, which is the reverse of the situation in most of the rest of the world. What I concluded was this: garlic in Egypt is planted at the soil surface rather than 3-6 cm deep as in the Western United States or elsewhere; e.g., in California, garlic is planted at 3 cm by machine, in Oregon at 6 cm by machine and deeper to avoid winter injury. The difference in depth of planting accounts for relative control/avoidance of white rot rising to the stem plate due to higher soil temperatures in Egypt, compared to the United States. In contrast, onions in the United States are direct seeded at 2 cm, whereas onions in Egypt are transplanted so that the stem plate is at 5-6 cm, thus onions in Egypt are in soil temperatures more conducive to white rot, and onions in the United States may escape (in warm areas, at least). If onions in Egypt could be direct seeded at 1-2 cm, white rot would be substantially less – perhaps this is a topic to address with growers, agents, and researchers, although this would be rather a major cultural shift. On the other hand, both onions and garlic in Egypt are spaced rather widely compared to those in the United States, which also limits white rot substantially – plant-to-plant movement is slower in less dense plantings. Such practices that limit white rot compared to some world regions, combined with hot soils present much of the year, indicate to me that Egypt has a natural advantage with respect to white rot control – a natural advantage that can be fully taken advantage of with better understanding of the situation.

In general, I believe that white rot should be easier to control in Egypt than in colder regions of the world, as this fungus is highly favored by cool and cold soils and Egypt's soils are too warm at the level of bulb formation for much of the year. I am told that white rot symptoms occur primarily during March and April. Soil temperatures near the bulb may be conducive to disease somewhat earlier, but (just as in other parts of the world) the fungus is initially delayed in reaching the stem plate of the bulb by earlier warm temperatures – it takes the fungus some time to grow through the soil once soil temperatures are suitable, so symptoms are not immediately seen just because the soil cools. As symptoms develop in March, the fungus finally has grown onto the stem plate and begun to rot bulbs and remaining roots, thus leaves begin to die. Combined with the planting depth and plant spacing considerations above, white rot is controllable by planting trap crops in the seasons prior to when white rot symptoms occur at bulb level. It would be best to obtain extensive soil temperature records for one or more regions to

base this analysis in more detail on soil temperatures, but I cannot seem to acquire such soil temperature data yet. It would be great to obtain year-around soil temperature data (daily maximum, daily minimum at 10 cm soil depth in irrigated soils – or weekly or monthly if daily records are not available) before completing my final report.

It appears to me that certain Allium crops can be grown such that all or most white rot can be avoided – a combination of shallow seeding and harvest prior to the cool season when white rot reaches the stem plate. Such escape crops might include onion set and transplant crops, but more importantly (because of larger areas planted) the bunching onion crop harvested in December and January. These could be used as trap crops to reduce sclerotial populations in rotation with Allium crops susceptible to white rot. This was discussed with Dr. Hassan, and emphasized in the seminars. Hassan also suggested that the local Kurrat (a variety of leek, planted in summer) crop also satisfies this consideration, but that this might be of limited utility. I plan to continue this discussion with respect to production of short-season sets, transplants, green onions, etc....

Hassan mentioned the trichoderma work of Teyfik Hafez, who worked on white rot control for some years and released a product (Landguard). Apparently, Hassan thinks some control is achieved with this product, but we have found no farmers who have used it. I suspect that either the product works only moderately well at best (as has been true in other regions) and/or that farmers are reluctant to try it at current cost. Perhaps associations could apply for grants to procure some to test in some fields? This might be a reasonable recommendation, as it would both promote an Egyptian product and demonstrate the product effectiveness and assist in such organizations being more progressive and proactive.

Getting farmers to consider crop rotations toward this goal will be important. In addition, because the white rot season is abbreviated in Egypt compared to cold regions; it is possible that fungicides and biocontrol agents could work better here than in many areas where protection is required for substantially longer periods of time.

With the CARE system in place, it seems logical to encourage local farmer organizations to write grants to attempt some of these controls, perhaps providing capital to encourage risk-taking (e.g., sharing in any losses on the final export bulb crop – the crop most susceptible to white rot because it is harvested during the period of March and April; when symptoms are seen). Obviously, trap-crop rotations will take several years to evaluate, and key infested fields and progressive farmers would need to be approached to demonstrate the system. Participating farmers would need to be expected to continue intensive rouging practices during the rotational periods.