

ENTER INFORMATION ONLY IF NOT INCLUDED ON COVER OR TITLE PAGE OF DOCUMENT 72781

1. Project/Subproject Number

596-0108-3-60011

2. Contract/Grant Number

596-0108-C-00-6060-00

3. Publication Date

February 1991

4. Document Title/Translated Title

"Asparagus Production Potential in Costa Rica and Guatemala"

5. Author(s)

1. John J. McGrady

2.
3.

6. Contributing Organization(s)

7. Pagination

15

8. Report Number

ST/90-17

9. Sponsoring A.I.D. Office

ROCAP

10. Abstract (optional - 250 word limit)

11. Subject Keywords (optional)

1. Asparagus production

2. Central America-asparagus

3. Asparagus crop management

4. Cultural management--asparagus production

5.
6.

12. Supplementary Notes

13. Submitting Official

Diane Bejarano

14. Telephone Number

(202) 466-5340

15. Today's Date

July 24, 1991

16. DOCID

.....DO NOT write below this line.....

17. Document Disposition

DOCRD [] INV [] DUPLICATE []

PROEXAG

NON-TRADITIONAL AGRICULTURAL EXPORT SUPPORT PROJECT

ASPARAGUS PRODUCTION POTENTIAL IN
COSTA RICA AND GUATEMALA

Assignment Number: ST/90-17

PREPARED BY:

John J. McGrady

THROUGH

Chemonics International Consulting Division
2000 M Street, Northwest
Suite 200
Washington, D. C. 20036
(Contract AID No. 596-0108-C-00-6060-00)

UNDER THE AUSPICES OF:

The Non-Traditional Agricultural Export Support Project
(Project No. 596-0108-3-60011)
United States Agency for International Development (USAID)
Regional Office for Central American Programs (ROCAP)
Guatemala City, Guatemala

February 1991

PREFACE

An introductory trip was made to Costa Rica and Guatemala from November 28 to December 7, 1990. The objectives were to (1) evaluate the current status of asparagus production, (2) evaluate research programs and (3) assess the potential of asparagus as a non-traditional export crop. To achieve these objectives I visited farms in production areas in each country and met with growers, prospective growers and/or production foremen on-site or at arranged meetings elsewhere. Asparagus research plots were observed and research personnel interviewed concerning the projects.

I appreciate the efforts of John Lamb and Dale Krigsvold in making this assignment possible. I am grateful to Diane Bejarano and Julia Hecton for their expertise in handling the detailed arrangements necessary for this venture. I greatly appreciate the hospitality of Jorge Noboa, Marco Moreira and Alfredo Nuñez in Costa Rica and that of Dale Krigsvold, Jorge Villatoro and Fernando Gonzalez Asturias in Guatemala. I am also thankful for the warm welcome extended to me by all of the growers and the efforts of the members of CINDE in Costa Rica and GEXPRONT in Guatemala.

EXECUTIVE SUMMARY

There is great interest and enthusiasm by the growers in both Costa Rica and Guatemala for the development of asparagus as a non-traditional export crop. The potential for high yields and good quality asparagus is excellent in certain areas of both countries.

Production sites in Costa Rica that were visited were located in the Cordillera Central within a 40 km radius of San Jose at elevations ranging from 1000 to 2000 meters. Asparagus production may also be possible in areas of Costa Rica with different elevations and microclimates (e.g. Guanacaste) but these areas were not visited. Most growers were inquisitive, attentive and eager to learn more about production practices. The potential for sustained and increased production is excellent given the constraints discussed later.

Production sites visited in Guatemala covered as wide a range of elevations and microclimates imaginable, from 200 meters above sea level in sugar cane plantations at Tierra Maya and the secluded John Luttman farm in the mountains to the almost inaccessible rain forest sites near Coban in the north. Some areas are well suited for asparagus production, others are marginal but could succeed with good management, and yet other sites should be abandoned.

Asparagus is a perennial horticultural crop. Successful production of the high quality product demanded for export in any area is dependent on intelligent planning and intensive, knowledgeable management of cultural practices. There are three major constraints to the success of the current area planted and /or in production:

- (1) Poor initial planning regarding
 - a. site selection
 - b. cultivar selection
 - c. quality of planting material
- (2) Limited access to technical information
- (3) Lack of grower experience

Large scale plantings involving any two of the factors listed in (1) above may need to be abandoned. Replanting of asparagus in the same fields will be difficult due to allelopathy (the suppression of growth of one plant species by another or, in asparagus, the same species, by release of toxic substances). Much research is needed on this topic, particularly since the crop may be short-lived in the tropics due to multiple harvests under adverse conditions.

Although technical information has been disseminated to growers by PROEXAG specialists via CINDE and GEXPRONT personnel or their agents, a formal information dissemination system is needed. Frequent and continued interaction with growers will provide feedback for researchers and generate questions that will need to be answered through in-country research.

Particularly discouraging was the widespread use of UC 157 F2 which has not, to my

knowledge, yielded well in many cultivar trials under the best of conditions. Equally disappointing was evidence that poor quality seed or crowns of this same variety had been sold to many growers eager to establish a planting of a promising new export crop.

It is absolutely essential that the best seeds (and/or crowns) of high yielding cultivars be made available to growers immediately. It was encouraging to see UC157 F1, Ida Lea, Jersey Giant and sometimes Brock 19 (red or blue) performing well in small plantings in some areas even though often this was limited to the research cultivar trials in grower fields. These small, variety trials established by PROEXAG and affiliates at several elevations and microclimates in each country will provide invaluable information for producers and enhance proper cultivar selection.

I am very concerned for the longevity of the crop given the tendency to harvest too early and for too long a period of time, the practice of "renewing the fern", and in some instances, harvesting twice per year. I would highly recommend waiting at least 18 months after seeding before the first harvest to facilitate establishment of vigorous plants in the field. I do not believe the practice of "renewing the fern" is beneficial to the crop. In theory, this practice involves selective pruning to remove senescent fern so that only vigorous healthy shoots remain on the plant. In practice, selective pruning is a very difficult and labor intensive practice and, more often than not, all of the fern is removed. Therefore, the practice may be doing more harm than good by depleting the carbohydrate reserves of the storage roots (removing the source of photosynthate) and initiating reserve bud break. The mother fern or Taiwan method of production was observed in research plots at the Fabio Baudrit research station in Costa Rica, and PROEXAG demonstration plots at the Central American Produce Company (CAPCO) plantations at Tierra Maya, Guatemala; the system was being employed very successfully at Finca Candelaria, Villa Nueva, Guatemala. This production system may be the best option available for sustainable, long-term, asparagus production in the tropics.

Excellent technical information and support for grading, packing and post-harvest storage for export was initially provided by PROEXAG. Chris Couture, a central California asparagus producer, has entered into contractual agreements with many of the Central American asparagus growers to market their product. Chris has also provided hands-on technical assistance in packing station design and operation as well production and harvesting procedures. This association was encouraged and enhanced by PROEXAG and has facilitated grower access to state-of-the-art packaging via personal visits and on-site demonstration of crate production by Chris.

Section I. Costa Rica
Asparagus Production and Cultural Management
Itinerary and Observations

28 Nov. 90 I arrived in San Jose, Costa Rica airport at 11:20p.m. I took a taxicab directly to Hotel Irazu.

29 Nov. 90 At 7 am Jorge Noboa met me at the hotel and he drove us directly to Fabio Baudrit research station. There I was introduced to Marco Moreira (Univ. Costa Rica) and Alfredo Nuñez and the four of us discussed general opportunities and challenges facing the asparagus industry in Costa Rica and Central America and the research program at the experiment station.

Seedling production is difficult due to damping off. Nursery seedbed preparation research is focused on soil fumigation, fungicides and solarization as a means of pathogen control; compliance with EPA guidelines was stressed. Weed control is always a problem and is even more so here in the tropics. Their research supports the use of linuron (Lorox) and metribuzin (Sencor) for broadleaves and Fusilade and other gramminocides for the grasses. Nutsedge is still a problem.

The asparagus planting/production cycle was described. Seedlings are established in a nursery in January or February and transplanted to the field in May or June just prior to the rainy season. This is timed so harvest can begin one year later (18 months after seeding). There are two market "windows" in June/July and late November through mid-January; the latter harvest period brought the best price. All product is exported to the United States. Current area in production in Costa Rica was estimated at 180 hectares.

Plant spacing, depth of planting in the field and density were indicated at 1.5 m. x 30cm, 15-20cm, and 22,000 plants/ha respectively. Because of rapid growth (24-30cm/24h) growers are harvesting twice each day, early morning and early afternoon.

Two cultivar trials were described; an old trial with 4 cultivars containing Greenwich, Jersey Giant, Mary Washington 500 and UC157 F1 and a new trial with Ida Lea, UC157 (F1 and F2), Brock 19 (red and blue) and Jersey Giant.

The rest of the morning we observed the research plots at the station. There was not much to see as the fern had just been removed and spear production was just beginning. Experimental plots were well groomed and well designed; a cold storage room was under construction. Jorge Noboa had set up an itinerary as we toured the station facilities.

29 Nov. 90 (afternoon). Alfredo and Marco drove me to the farm of Ilse Rodriguez near the research station. This is a coffee plantation and there was one field of slightly more than 1 ha in asparagus. She had cleared the fern off eleven days ago and was very concerned that there was not very much asparagus for harvest. They had completed the afternoon cut; quality was good but spear diameter was in the low marketable range and yield was low. Alfredo mentioned it had been cold and rainy for 3 days prior to my arrival. A common, government-supported packing shed is shared by 14 growers and each day's harvest is transported there in covered containers. A small amount of insect damage was observed and nutsedge was rapidly colonizing the field.

We traveled to Hacienda Ojo de Agua where we were met by Ricardo Gaspar. This is a sugar cane/pineapple plantation with 18 ha asparagus (14 ha UC157 F2; 4 ha Brock 19 blue). The UC157 will be harvested for the first time this year. Jim Brock, an asparagus breeder/researcher is a partner in this operation. Ricardo's main concern was nutsedge control.

The next field was a 1 ha planting of Brock 19 blue with excellent, vigorous fern. Santiago, the foreman, Alfredo and Marco discussed green-chopping the fern and harvesting for 2-3 weeks. I recommended against doing this but they are anxious for the grower to see a return on investment.

At dusk we visited a 2 ha planting of Brock 19 blue at the farm of Señora Joyce Zurcher managed by Enrique who met us at the entrance. We drove over fern stacked high on the edge of the field. There were 3 plantings here. The oldest was 8 months, fern had been removed, and harvest was planned. A second was 6 months old and was scheduled for the fern to be green-chopped so the last half of the market window could be captured.

30 Nov. 90 7am. Alfredo and Marco picked me up at Hotel Irazu and we drove to Hacienda La Argentina near Grecia (elevation 800 m). We examined a rudimentary but efficient cool room. Workers were busy cutting down boxes used for packing spears so they could market a higher quality, shorter (8") spear through Couture. The tips did not remain tight if they waited to cut it at 9"; perhaps this is due to stress conditions early in establishment of the plants and the resultant reduction of crown vigor and carbohydrate reserves.

They have harvested for 8 days this season and have reduced culls from 40% to 10% by marketing the shorter spears. The manager is more motivated because of a new marketing agreement with Couture. They did not get paid last year and consequently did not take good care of the fields. Stands are thin as is spear diameter but quality is good; bermuda grass was extensive. A sprinkler system was set up in one field. If harvest continues to be good this year they are planning to expand to 20 ha next year.

We drove to Naranjo at a higher elevation (1100 m) to Hacienda San Jeronimo. Jorge Noboa joined us for the visit to this farm, an old established coffee plantation where I met Antonio and Roberto Kopper. They have 4 ha of 1 year old Brock 19 red and plan to expand

to 40 or 50 ha if this harvest is good. Fern had been removed a week ago, piled at the edge of the field and was now being loaded on wagons; paraquat was then sprayed on weeds in the field.

Crowns were planted very deep (25 cm to the top of the crown) in a flat field. I expressed my concern to Roberto and he replied that is what he was advised to do. He also does not agree with the necessity of 'renewing the fern' in May or June

After lunch in Santa Barbara de Heredia we drove to Finca Los Guayabos where Rosemund Grew was attending to coffee harvest. She joined us in the 2 ha. field of 2-3 month old seedlings of 'Brock 19 blue' in fern. She was very grateful for the irrigation water delivery system that Alfredo had designed for them. Crowns here had mounds of soil on top and were very deep. Alfredo explained that heavy rains would remove much of that.

Helmuth Hempel's Finca La Jolieta near Cartago was the last farm visited late in the day. This was a 8 ha field formerly in potatoes. It was much cooler at this altitude and spears were slow to emerge; tips were tight and quality excellent for UC157 F2. Fog was rolling in as we departed.

1 Dec. 90. In the morning I reviewed my notes in preparation for a meeting at CINDE headquarters at 1:30 p.m. Those present were Roberto Kopper, Ilse Rodriguez, Ricardo Gaspar, Helmuth Hempel, and Alfredo Nuñez. Grower concerns discussed focused primarily on growth and development of asparagus, particularly the buds and fern, a way to concentrate the 'breaking' of large buds, and the use of non-harvestable spears as 'mother-fern'. I spoke briefly about some of my research on carbohydrates in the storage roots. I indicated that I was very optimistic for the future of asparagus in Costa Rica. I also indicated my concerns for the widespread use of UC157 F2, double harvesting and green chopping young ferns less than one year after transplanting. Helmuth brought in several spears with severe tip curvature. This could be a serious problem as he rejected almost 10% of today's harvest because of this defect alone. I had no answer as to how to correct this. The meeting adjourned around 5:00 p.m.

2 Dec. 90. I departed San Jose at 10:00 a.m.

MAJOR OBSERVATIONS AND ANALYSIS

The asparagus research program at Fabio Baudrit is extensive; many aspects of production and cultural management that will benefit the growers are being investigated. Asparagus research is extremely time consuming and it was my understanding that Marco had only one assistant. Cultural management techniques effective elsewhere, particularly the United States, should be tested in experimental plots under local conditions before recommendations are given to growers. With the amount of experimental evaluation and verification that is needed at this stage in the development of this commodity, additional, temporary personnel on the project is justifiable. With a perennial crop like asparagus it will take years to develop a local data base and even then this information will not be appropriate for all microclimates in Costa Rica.

5

If time and personnel limitations permit, it might be productive to investigate the timing and frequency of fertilizer application. Frequent applications of small amounts during the fern growing season might reduce loss to leaching or runoff.

There is good report between Alfredo Nuñez and the growers. This will facilitate appropriate technology transfer to growers. The establishment of small test plots of research-generated information or of producer-generated ideas in growers' fields is highly encouraged.

The one serious impediment to the required advancement of asparagus production for export may be the many variations in production practices observed throughout the country. While growers everywhere never do things exactly the same, general cultural management - particularly with regard to cultivar selection, establishment and cycle manipulation - would be expected to be more uniform. The variations indicate either a lack of information and material available to the grower or several sources of information, some better than others. This is unfortunate because asparagus yield and quality are very dependent on the management and care of the seedlings and young crowns during the establishment phase. Neglect of care at this stage of development also might have been influenced by the prior experience of most of the growers as producers of plantation crops. Many of these crops (e.g., sugar cane) require intensive management inputs only during certain stages of the cropping cycle as opposed to annual and/or perennial vegetable crops which require intensive cultural management at many stages of development, particularly during seedling establishment.

A few cultural practices deserve attention: (1) Cultivar selection. UC 157 F2 does not appear to be well adapted for production in the tropics - at least not under most of the conditions observed. This may be closely tied to the practice of beginning harvest before 18 months after seeding. F2 is less vigorous than F1 and thus establishes more slowly. Stress during establishment results in reduced vigor and yields. In those cases where F2 was performing well, it had not been stressed; there was no harvest before 18 months and the first harvest was of short duration. Results of cultivar trials from many areas should be available to the growers to allow selection of those varieties which have performed well under environmental conditions similar to their own. (2) Depth of planting. In many cases, crowns had been planted too deep. It is generally accepted that 10-15 cm is the best depth for established crowns. While it is also understood that there is some adjustment of this depth as provided with the normal growth of the crown, 25cm is too deep and not beneficial to the crop. (3) Cultivation. It also appeared to me that some growers tended to regard asparagus, since it is a vegetable, as an annual crop and cultural management practices were performed accordingly. This is particularly true for weed control and cultivation; I observed many fields where cultivation equipment had worked between the rows. I highly recommend against any cultural practice which disturbs or damages the storage roots or the crown/rhizome in any way after the seedlings have been transplanted to their permanent location in the field. I cannot emphasize that point strongly enough. It is crucial to all future success with asparagus production.

The longevity of asparagus in the tropics may be much less than the 10-15 year expectancy in the United States of America. It might be appropriate to evaluate higher density plantings in conjunction with alternative production systems, i.e., the Taiwan System.

6

CONCLUSIONS

1. Transportation systems, cold storage facilities and marketing infrastructures are adequate for current production of asparagus for export. Chris Couture is in close contact with growers contracting with him and continues to provide counsel on harvesting methods, grading, quality control, packaging, and cold storage.
2. High yields of excellent quality asparagus are possible with appropriate technology and intensive management; plant stress should be avoided at all times. There is excellent potential for asparagus production in all areas visited but the best quality may come from the higher, cooler locations.
3. The cultivar trials, management trials and climatological site trials initiated by PROEXAG in 1986-87 are now a source of invaluable information for growers. Prior to the availability of information from these trials, several entrepreneurial growers were eager to capitalize on the potential of this new export crop. This, and their lack of experience, left them vulnerable to unscrupulous "experts" selling asparagus seed and/or crowns and production advice, both of which were often inappropriate. This is evidenced by the current poor status of the crop on a few farms.
4. Additional research personnel and funds are justified, particularly at the Fabio Baudrit research farm where the research program is extensive. Marco Moriera has done an excellent job with limited resources. Proven technical information needs local re-evaluation. Alternative production systems need evaluation, especially the 'mother fern' or Taiwan system of production. The unique, identifying feature of this production system is the presence of green, mature, photosynthetically active stalks or fern on the plant during the harvest period as well as during most of the fern growing season. This system requires much more intensive cultural management than conventional asparagus production for several reasons: (a) harvest is generally of longer duration (b) workers need to take more care when passing through the field so the mother ferns are not damaged (c) fertilizer must be applied in small amounts and more frequently (d) the mother stalks need to be removed as they begin to senesce, probably after 2 - 3 months and (e) implementation of the system requires constant observation by management personnel.

- 1

Section II. Guatemala
Asparagus Production and Cultural Management
Itinerary and Observations

2 Dec. 90. I arrived in Guatemala City at 11:52 am. Dale Krigsvold met me at the airport and drove me to the hotel.

3 Dec. 90. Departed Guatemala City with Dale Krigsvold, Jorge Villatoro, and Wilby Hubbel for Finca El Riscal at San Jose Pinula. Juan Carlos Barillas is the owner.

Chris Couture, who is marketing much of the asparagus from Central America, met us at the farm as did four other growers and interested parties: Rafael Bolaños, Baltazar Arevalo, Francisco Viteri, and Jorge Matzdorf, president of The Asparagus Committee in GEXPRONT, the Guatemalan Guild of Exporters of Non-Traditional Products. There were 40 manzanas in production (15 mz UC 157 F1 and 25 mz UC 157 F2) and harvest was in progress; this was the best F2 observed. One area of F2 had been replanted because of a severe Fusarium problem. Juan Carlos mentioned the high cost of irrigating in the dry season. We observed a replicated cultivar trial established by PROEXAG/CHEMONICS. We toured the packing shed and a high quality, large, cold storage room.

Jorge Villatoro and I headed for Chimaltenango where we visited Finca Belen, owned by Miguel Alvarado. This was the first harvest of 'Mary Washington' and they were cutting too deep with up to 10 cm of white at the base of the spear. I explained that there is increased possibility of damage to the crown and adjacent spears with this practice and recommended a cut closer to, but not above, the soil surface. There is only one harvest period per year at this location. I reviewed and approved Miguel's fertilizer program; excellent records. We observed another PROEXAG/CHEMONICS replicated cultivar trial cared for by a local student. Chris Couture arrived as we were finishing our visit and was advising Miguel on crate specifications.

We stopped briefly at ICTA where there were asparagus cultivar trials and asparagus intercropping experiments with tomatoes and other crops. Another brief stop was at the Cooperativa Cuatro Pinos to observe a small cultivar trial. These plots were in poor condition and I recommended they be abandoned as no useful information will be forthcoming; Jorge agreed.

Finca San Sebastian in San Miguel Duenas is at 1400 meters elevation. The owner, Mario Falla, joined us as we were observing his field of 'Mary Washington' and talking with his production foreman. He supplies local restaurants and practices sequential harvesting to maintain a steady supply. This may be another viable production system. Great coffee!

We arrived at Finca San Geronimo in Alotenango at dusk. The owner, Antonio Maldonado, introduced us to Paul Bosch from Nicaragua, who is interested in blackberries and asparagus. Antonio mentioned poor care of the asparagus last year and their plans for this year (they have UC 157 F1). In our discussion of cultural management I stressed the importance of good management practices early during the establishment of the crop. Another PROEXAG/CHEMONICS cultivar trial had been established here.

After a long journey on a treacherous road, we arrived at Finca Magdalena after dark and toured the packing shed and cold storage room. Each day's harvest data is tabulated and entered on a computer in the packing shed. At dinner with Fernando Gonzalez and Carlos Carbajal we discussed the research program of EXOTICA de Guatemala. They were awarded a contract for research on asparagus by GEXPRONT (Gremial de Exportadores de Productos no Tradicionales) to be completed in 18 months. The following is a brief outline of the research program:

1. Field trials
 - a. cultivar evaluation
 - b. seedbed fertilizers and application
 - c. herbicide trials (2 at different elevations)
 1. San Jose Pinula
 2. Coban
 - d. fungicide trials (2 at different elevations)
 1. Amatitlan
 2. Coban

2. Technical bulletins
 - a. Phytopathology (complete)
 - b. Entomology
 - c. Physiology
 - d. Nutrition

3. Technology Transfer
 - a. visits to growers
 - b. resolution of specific problems
 - c. 3 field days
 - d. 3 demonstrations
 - e. review GEXPRONT technical bulletin
 - f. prepare EPA document and update frequently

4 Dec. 90. We continued to discuss the research program of EXOTICA. The entire program was being conducted by 5 people: Fernando Gonzalez, Carlos Carbajal, and 3 others (not named) in private business and at San Carlos University. The field trials were planned to generate information for the technical bulletins. Carlos gave me a copy of "Manual Fitopatologica del Cultivo del Esparrago" which he had prepared; this is an illustrated guide to most of the potential tropical asparagus pathogens. Although prepared primarily from the literature, it may be useful for preliminary diagnosis. They have had 2 field days and one demonstration. One fertilizer experiment is at Magdalena (Three fertilizers are being compared in a demonstration block with no replications). Carlos was in charge of the field trials and was aware of experimental design techniques.

We toured a 35 mz field that had been planted with 30,000 plants/mz. Fernando and Carlos were concerned about low yields and thin plant stands. We dug up several crowns. In two instances we found 3-4 small crowns where one should have been. Buds on the rhizome

were small and most were not viable; the interior of the crown was yellowish. Paraquat (Gramoxone) herbicide had been applied immediately after fern removal last season and they inquired about phytotoxicity. This is a possibility; if paraquat contacted emerging spear tips it could kill the plant. A 67 mz field (also UC157 F2) only 13 months after seeding was scheduled for a 15 day selective harvest (small spears will be left to fern).

Fernando remained at Magdalena but Carlos accompanied us to Las Lagunas where the International Cultivar Trial had been planted recently. There was no emergence after 18 days and the few seeds dug up were dead. There was also a seedbed fertilizer trial in the same area and UC157 F2 seedlings were emerging.

Carlos travelled with us to Finca Monte Maria. The 30 mz of F2 was in harvest and yielding mostly thin spears. They had 15 mz Ida Ica which was 15 months old (from seed) and scheduled for harvest but very slow in starting. We dug up two crowns, both appeared very vigorous with healthy thick buds, milky white centers and many fleshy storage roots. The owner, Bobby Dalton, flew in via helicopter as we were leaving the field. We discussed our observations and I mentioned that F2 may not be well adapted for tropical production.

Finca El Tesoro is a sugar cane plantation also owned by Fernando Gonzalez. A small 1/2mc. plot of UC157 F2 had been established 6 months ago with 5 month old seedling crowns. The field had been cleared 10 days ago; stands were thin.

We continued the 'south coast' tour to Finca Tierra Maya operated by Central American Produce Company. Fernando del Gusto was our host. We observed the replicated harvest management system experimental plots established there by PROEXAG/CHEMONICS. The Taiwan (mother-fern) system employing a single continuous harvest was outyielding the other three systems. Beetle grubs feeding on the storage roots could be a serious problem.

As dusk approached, we arrived at Finca Santa Anita. We were greeted by John Luttman and his wife who had expected us for lunch. This farm was very secluded, in a difficult to access mountainous terrain. Land now in asparagus had been in potatoes. We dug up a crown which was large with healthy buds and storage roots. John attributed this vigorous growth to his application of 1500 lb of gypsum last year. He will only harvest once this year. He had also replanted a small field and no typical replant problems were evident (yet). They had constructed an excellent, small, cold storage room and were modifying an old military jeep to carry product to market.

5 Dec. 90. Departed Guatemala City for Salama and Domingo Oche's Finca Santo Domingo. A small field with fern remaining had roughly 10% of the spears emerging with crooked tips. Although asparagus is very tolerant of boron (indicating less active uptake), I suggested a test application fertilizer with boron to a 10 m x 10 m area. The largest fields had been cleared and were in harvest. Grass weeds were a problem and were being cultivated. They had established an excellent raised-bed nursery with UC157 F1 seedlings; this was the best nursery I had the opportunity to observe.

Across the road was Gilberto Sosa's Finca Los Jocotes. UC157 F2 was planted in a heavier clay soil - weed problems were serious but yields were steady according to Gilberto. There was a small packing shed and cold room which appeared to be adequate for observed yields. Quality at both farms was excellent.

Two farms at Coban: Finca Xilaxito and the farm of Leo Maldonado. Both were located in very difficult-to-access, mountainous areas, plant stands were thin and individual plants were not vigorous (few short shoots/plant). There was evidence of *Stemphyllium* and *Cercospora* damage.

6 Dec. 90. The workers at Willy Stixrud's Finca Candelaria in Villa Nueva were managing UC157 F2 using a modified, Taiwan, mother-fern system. Fern was short but yields were excellent as was quality of spears marketed (although they mentioned 50% were culls used in soup). They brought the field into production gradually and have an excellent fertilizer/fungicide program which compliments the harvest system. This was the best managed and most productive farm we had visited. There was another PROEXAG/CHEMONICS management trial here but yield data was mixed across replications.

Finca Monte Norte was the final farm visited. Soil was ashen grey and crusty, probably due to the use of waste water from a nearby gravel pit for irrigation. F2 plant population was low and many spear tips were crooked; here this was clearly due to knife damage and some resistance by the soil crust. The water situation needs to improve for this farm to prosper. A third PROEXAG/CHEMONICS harvest management trial was established here and just coming into production. At 2:00 pm. we met at GEXPRONT headquarters to discuss current and future asparagus production. Main points emphasized:

1. Cultivar evaluation and selection is important before planting; UC157 F2 may not be well adapted but does respond to certain management systems.
2. Management systems need more extensive evaluation.
3. Disease problems are manageable.
4. Crop longevity may be shortened when harvested twice a year.
5. Fertilizer and mineral nutrition requirements need evaluation in the various microclimates.
6. Asparagus is a horticultural crop and requires intensive management.

Growers requested additional information on plant density, Sencor use in seedbeds, and crops that could be planted after asparagus. The meeting adjourned at 5:00 pm.

MAJOR OBSERVATIONS AND ANALYSIS

Research

There are two research programs in Guatemala: EXOTICA de Guatemala and PROEXAG/CHEMONICS. There is little overlap of projects and the two programs compliment each other well. Successful completion and/or continuation of each will benefit Guatemala asparagus producers and workers.

EXOTICA has designed a very extensive, well-balanced program. Fernando Gonzalez and Carlos Carbajal are enthusiastic, dedicated and hard-working individuals as I'm sure are the others on their teams. But even with Herculean efforts on their part they may fall short of completing such a monumental task given the time constraints, personnel and monetary limitations, and the location of some field trials. A 3-5 year time frame might be more realistic. The international cultivar trial will have to be replanted. Seed for the trial had not been stored under optimal conditions and was probably not viable when EXOTICA received it. I mailed seed sources to Fernando should they decide to replant.

Their nursery fertilizer project is well-designed and will provide information on seedling nutrition. More emphasis in other aspects of production should be on assuring the vigorous growth of the seedling and young plants in the field.

The PROEXAG/CHEMONICS research program is focused on (1) cultivar evaluation and (2) harvest/production systems. Replicated trials of the cultivar trials were observed at several locations in the 'highlands' and 'central valley' while the management systems were observed at three locations in the 'south coast' and 'central valley'. Where these trials can be maintained by the growers and data collected accurately by local well-trained students, there is good chance for success and much needed information on cultivar microclimate adaptability. These trials are time-consuming and interfere with normal daily operations to such a great extent that I believe it is unrealistic to expect even the most cooperative, well-intentioned grower to collect data accurately for an extended period of time. I was particularly impressed with the management system trial at CAPCO; trials like this will provide invaluable information for asparagus growers throughout Guatemala and Central America. I would highly recommend establishment of additional management systems trials where feasible.

The low plant populations and reduced vigor in some fields may have been due in part to improper herbicide use. Proper application rates and timing are essential to maintain the selectivity of some herbicides. Part of the technology transfer process of both PROEXAG/CHEMONICS and EXOTICA should include not only the planned reviews and updates of pesticide technical bulletins but also seminars and field days to ensure understanding of labels and restrictions on use.

Production

(1) Cultivar selection. As in Costa Rica, UC 157 F2 is the most widely planted variety but results were slightly different; it performed either very well or very poorly. This cultivar's performance is closely tied to early, cultural management practices beginning in the seedbed and through an 18-month establishment stage. All of the farms which had F2 which was yielding well had grown the plants without stress, with a good fertilizer and fungicide program, with no mechanical damage to storage roots or crowns, with no chemical (primarily herbicide) stress, and with no early, prolonged harvest. Very productive, high quality F2 was observed at Finca Santo Domingo, Finca El Riscal, Finca Candelaria and Finca Santa Anita. In each case, it was evident that intensive cultural management practices were conducted with concern for the well being of the crop.

Harvest.

Several growers had initiated harvest before 18 months in order to realize a return on investment. In most cases this resulted in reduced vigor in the subsequent crop. Harvest is not recommended until the crop is firmly established in the field.

The practice of green-chopping the fern and then harvesting for several weeks may not be the best management system in marginal production areas, especially those with very high rainfall and heavy disease pressure. Fern removal en masse opens many surfaces at the soil level for pathogen entry and weakens the plant, facilitating pathogen establishment.

The mother-fern system has the advantage of reduced biomass which opens up the crop canopy for air movement and creates a potentially less favorable condition for pathogen development. The employment of alternative harvest systems (eg. the Taiwan mother-fern system) is recommended but research is needed to determine adaptability of cultivar and systems to microclimates.

Removal of all the fern at once stresses the plant by eliminating the source of carbohydrates (and auxins) and stimulating massive bud break which reduces carbohydrate reserves in the storage roots. It is essential to maintain high levels of carbohydrates in the storage roots. These are the source of energy for all spear production. The additional stress of harvest depletes sugar levels even more and further weakens the plant, presenting a prime target for pathogens. The mother-fern system maintains a steady supply of photosynthates, hormonal balance and gradual bud elongation.

Replanting

There is a significant number of manzanas that may need to be abandoned because of low productivity, disease or other problems. Replanting into old asparagus fields is not usually successful due to allelopathy (autotoxicity); asparagus root exudates are also toxic to a wide variety of other crops. A replant may be successful at El Riscal; Juan Carlos meticulously removed all of the old storage root pieces from the area before transplanting. John Luttman has also attempted a replant at Finca Santa Anita without removing the root pieces. Allelopathy

needs research. If asparagus is indeed shorter lived in the tropics, there will large areas out of production after 5-7 years. We need to investigate rotations, intercropping or other systems that will enable the land to be replanted.

CONCLUSIONS

1. The potential for asparagus production for export in Guatemala is excellent. Of those areas visited, Coban in the north zone and some lowland areas of the south coast zone will encounter the most difficulty in establishing the crop and maintaining productivity. The highlands, central valley, Salama area of the north zone and higher elevations (Finca Santa Anita) of the south coast zone are producing very high quality asparagus and it is expected that yields from those areas will also be high.
2. Yield in any production zone will depend on cultivar selection, production/harvest system and intensive cultural management. The Taiwan system (or variations) may facilitate production in marginal areas. It may also be the best system for production in all areas except the highlands and where there is only one harvest season. Additional research is needed.
3. Appropriate technical information should be available to growers when they are planning production. Technology transfer can be expedited via EXOTICA and/or PROEXAG/CHEMONICS specialists.
4. Access roads to some production areas, particularly near Escuintla and Coban, will need to be improved to facilitate transport to market.