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SUBPROGRAMA I.

LEGUMINOSAS DE GRANO
(Evento 2.3.8.)

CONSULTOR:

Dr. Earl T. Gritton

PROGRAMA COOPERATIVO DE INVESTIGACION AGRICOLA PARA LA SUBREGION ANDINA

BID/IICA

238

Report of

PEA (*PISUM SATIVUM* L.) CONSULTANCY

October 17 - December 5, 1987

For

PROCIANDINO

(Programa Cooperativo De Investigacion
Agricola Para La Subregion Andina)
IICA - BID
Subprograma I. - Leguminosas De Grano

by

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INTRODUCTION

During the period October 17 - December 5, 1987, I visited with researchers in the countries of Bolivia, Colombia, Ecuador, Peru and Venezuela, Appendix Item 1. The purpose of these consultations was to observe present pea (Pisum sativum L.) production and research activities and to provide recommendations for the future. More specifically, I was to consider the areas of genetic improvement and agronomic management of the crop. This included techniques of genetic improvement, methodology, hybridization techniques, selection methods, sources of pest resistance, production systems, agronomic management, varieties, seed production and production problems.

A portion of the approximately ten days in each country was spent viewing growers' pea fields. Another portion was spent looking at the researchers' trials or research, if such was being carried on. The facilities available for research were viewed. A considerable amount of time was spent in consultation with individual researchers. Five seminars with slides covering pea production, breeding and genetics were given during these visits. The seminar in Colombia was given at the La Selva station. There were 30 people in attendance. Two seminars were given in Peru. The first, at the Universidad Nacional de Cajamarca was attended by 20 people. The second, which was given at the INIPA office building that houses the North Carolina Mission in Lima, was &2given to 14 people. No seminar was given in Bolivia. At the Santa Catalina station at Quito, Ecuador, 12 people attended. The final seminar, at the FONAIAP offices in Merida, Venezuela, was given to 7 people.

I wish to acknowledge the excellent hospitality of my hosts, for I occupied a great deal of their time and efforts during the period I was with each. They have been most helpful.

It is my hope that this report will do more than just give observations and recommend future actions. I have tried to report details as accurately as possible yet am well aware that there will be instances where I misunderstood and have failed to properly portray the situation. This report then, should serve as a starting point for discussions and plans of action. Where I have been wrong, I trust those who know will bring the correction to the attention of all those to whom it will be important. If I have misinterpreted a situation, then the correct interpretation should be brought out.

Peas are already an important grain legume in the production practices and diets of these five countries. They can be even more significant.

Observations and recommendations pertaining to each country follow, in the order in which I visited them.

The appendix contains additional information which may be of value to researchers. The information dealing with publications is intended to supplement the publications already supplied to researchers during my visit or after my return to the United States, Appendix Items 2, 3, 4 and 5 list the pea lines in the &2collections of the five countries. Appendix Item 6 lists pea breeders or contact persons at the major companies supplying pea seed for canning and freezing production in Wisconsin. The list does not include garden seed suppliers as they do not generally have pea breeders on their staffs. Appendix Item 7 is a partial list of persons who are members of the National Pea Improvement Association. This group meets every second year to discuss pea research. The meetings are held in conjunction with researchers for beans (Phaseolus vulgaris). The next meeting of these groups will be hosted by the Guelph, Canada researchers and will be held in Toronto, Canada, November 6-10, 1989.

Appendix Item 8 contains information about the Pisum Genetics Association and includes the table of contents for the most recent annual volume of the publication, The Pisum Newsletter. This publication will be of most interest for those involved in genetics and breeding. A list of members of the Pisum Genetics Association copied from Volume 18 of the Pisum Newsletter (1986) is given in Appendix Item 9.

Appendix Item 10 is the Table of Contents from a publication which describes the effects of many genes known in peas at the time of publication. Appendix Item 11 provides information on a book dealing with physiology of the pea. Appendix Item 12 is the cover sheet and table of contents for a publication dealing with description and culture of dry peas. Two books translated from Russian are presented in Appendix Items 13 and 14. Item 13 refers to general information on peas and their production. Item 14 deals with genetics and breeding.

COLOMBIA

PERSONNEL:

Personnel associated with pea research in Colombia are listed in Table 1.

Table 1. Personnel associated with pea research in Colombia.

1. Dr. Pedro Leon Gomez
   Multiple Crops Division
   ICA (Instituto Colombiano Agropecuario)
   Apartado Aereo 151123
   El Dorado
   Bogota, Colombia
   Telfs: 864257

2. Dr. Mario Blasco, Director. IICA
   (Instituto Interamericano de Cooperacion para La Agricultura)
   Bogota, Colombia
   Telfs: 697100

3. MS, Ing. Emile Girard Obregon
   Hortalizas, ICA. La Selva
   Apartado Aereo 100
   Rionegro Antioquia, Colombia
   Telfs: 2712459

4. Dr. Mario Lobo. Genetic Investigations
   ICA. La Selva
   Apartado Aereo 100
   Rionegro Antioquia, Colombia
   Telfs: 2712459

5. Ing. Pablo Julian Tamayo
   ICA. La Selva
   Apartado Aereo 100
   Rionegro Antioquia, Colombia
   (Presently studying for M.S. degree in phytopathology in Brasil)

6. Ing. Jaime Osorio B.
   Jefe Nacional Hortalizas
   ICA
   Apartado Aereo 151123
   El Dorado
   Bogota, Colombia

Table 1, cont'd

7. Ing. Jorge Velandia, Fitopatologia
ICA
Apartado Aereo 151123
El Dorado
Bogota, Colombia

8. Ing. Hugo Calvaihe, Entomologia
ICA
Apartado Aereo 151123
El Dorado
Bogota, Colombia

9. Gilberto Bastidas
National Food Legume Coordinator
Palmira, Colombia

10. Dr. Jorge Enrique Llanos. Director General
ICA. La Selva
Apartado Aereo 100
Rionegro Antioquia, Colombia

Emile Girard is actively engaged in pea breeding at the La Selva station near Medellin. He has been working for a longer time and has a larger program in peas than any other researcher I visited in the five Andean countries.

Mario Lobo, also at La Selva, is actively engaged in pea genetic investigations which includes the manifestation and performance of different genetic types. He and Emile have a very cooperative working relationship.

At Bogota, Jorge Velandia is a plant pathologist who devotes a portion of his efforts to research on pea diseases.

Also at Bogota is Hugo Calvaihe, an entomologist. He has not yet become involved in pea insect research but is in the position appropriate for such efforts.

RESEARCH FACILITIES:

La Selva - Laboratory facilities are fairly adequate for pea breeding, genetics and phytopathology research. There is wet lab space available as well as facilities for working with dry seeds. Laboratory equipment is quite limited but some is on order and is expected to be received.

Small quantities of seed can be stored in the laboratories. A very limited temperature and humidity controlled area for storage of especially valuable seedstocks will soon be available with the completion of a seed storage building. Seeds stored under ambient conditions generally germinate 60% or better after 5-6 years.

A plastic-roofed "greenhouse" with wire mesh sides has recently been built. This complements some older greenhouses also used for pea research.

Good field plot areas for growing peas are available on station and are being used. Peas are planted on ridges in the field nursery and are supported by strings attached to overhead wires. Weeds are controlled by hand.

Reference publications are obtained by individual researchers and are usually kept in the individual offices. These references are very limited at La Selva so researchers periodically visit the more extensive library at Bogota.

Bogota - Both wet lab and dry lab facilities are available at Bogota. Facilities and equipment are available but limited for phytopathology research and improvements are needed in order for the phytopathologist to make the desired contribution to pea disease research. I did not see the facilities for entomology research.

Little field research is performed on station. Most efforts involve cooperation with growers and use of their fields.

Library facilities are better than at La Selva but still the number of references is very limited. Few journals or other publications are currently being added.

Some computing capability is available at the La Selva station. However, it would seem to be more efficient if a stand-alone personal computer were located with the breeding and genetics programs.

RESEARCH EFFORTS:

La Selva - Pea research has been conducted for some years under the legumes section but not with a strong emphasis. Crosses had been made among local varieties and in 1984 Emile received 45 lines from the hybridization program. The number has been reduced to 7 through evaluation and selection.

Crosses have also been made by the genetics section. Emile received 17 F_3 lines in 1984 and on the basis of seed type separated these into 60 lines. In the F_5 he selected 11 promising lines which are undergoing further evaluation. Plant pathologists provided 10 lines in the F_5 - F_6 generation and 3 superior lines have emerged from these.

Emile has 16 local varieties which he will use in crosses with other lines to develop improved varieties.

The La Selva program has been designated the primary emphasis center for peas by PROCIANDINO and as such, the stocks of germ plasm are being improved. A list of lines presently held by Emile is provided in Appendix Item 2.

Hybridization of peas is carried out both in the field and in the greenhouse. Some outcrossing has been encountered, possibly due to Paratrigona lineata or a similar insect. Thus, Emile has found it desirable to protect pollinated flowers with a gelatin capsule. Most local varieties are very tall and late in maturity while introduced germ plasm tends to be considerably earlier. This causes problems in crossing because flowering of the earlier lines is over before the later lines begin. Pollen storage would be helpful, as is staggered planting dates and removing the growing tip of early maturity plants to cause late-flowering tillers to be produced. By using the greenhouse as well as the field, 3 1/2 generations of peas can be grown per year.

Because of the importance of pea diseases, considerable emphasis is being given to breeding for disease resistance. There is an effort to develop earlier, shorter plants with longer pods containing more peas per pod.

Mario Lobo has been investigating the performance and characteristics of different foliage types. He is looking at nitrogen fixation through experiments involving nod and non-nod genes as well as response to local and introduced strains of rhizobia. He is characterizing all pea lines using 41 descriptors. He is interested in the inheritance of disease resistance.

There is at present no phytopathologist working at La Selva, so there is relatively little phytopathological work.

Bogota - Jorge Velandia monitors pea diseases in growers' fields so is aware of major problems. He has screened lines for Ascochyta resistance and found 10-15 lines which appear promising. Some are local varieties. These need further evaluation and testing on a broader scale to ascertain their level of field resistance.

Fusarium is another problem in pea production. Jorge would like sufficient seed of pea lines with known genes for resistance, and samples of known races of the fungus, for further study and characterization of the races present in Colombia.

PRODUCTION AREAS:

Pea production is mostly in the Departments of Cundinamarca, Boyaca, Narino and Los Santanderes. These are the areas of Pasto, Merino, Bogota to Tunja, and the Rionegro area near Medellin. The best altitude for pea production seems to be between 2000 and 2800 m.

PRODUCTION PERIODS:

Rains start in February and continue until mid-June (first semester). These are the lightest rains of the year. Little if any rain falls from mid-June until September. From September until mid-December or January (second semester) the rains are heavier than during the first semester.

Rainfall varies by locality with approximately 850 mm per year at Bogota to 1600-2000 mm/year at lower elevations.

Frost may occur above 2400 m, normally toward the end of December and during January. Occasionally frost may occur in August.

Most growers wait to plant peas until near the end of the rainy periods, in order to avoid pea problems associated with wet soils. Thus, one common sowing time is about May-June and a second period with even more peas planted starts in December.

PRODUCTION PRACTICES:

Many growers save their own seed but some buy from seed brokers or at the local market.

Lime is available at reasonable cost for correcting low pH. Phosphorous is the main nutrient added through commercial fertilizer. Weed control, when practiced, is usually by hand or sometimes a glyphosate treatment before planting. Occasionally a grower will use a pre-emergence herbicide.

Seeds are not treated with fungicide or insecticide and are not inoculated with rhizobia before planting.

Time of planting is determined more by the rains than by the calendar. Because peas don't do well in wet soils and tend to have more foliage diseases in wet weather, the bulk of the plantings are made as the rains begin to taper off. Some growers, however, such as those with irrigation, grow peas at other times of the year to take advantage of the higher prices brought about by scarcity of the product.

There does not appear to be a common or standard rotation involving peas. Peas may be planted following a sod or forage crop. They often follow a maize or potato crop which received applications of fertilizer, with the peas expected to benefit from carryover.

It is not unusual to see peas intercropped with other species. Such crops as potatoes, maize, beans and carrots may be planted in the same row with the peas.

Most pea varieties grow 120-200 cm tall so are supported by strings tied to the vines and to overhead wires, Figure 1.

Plant populations vary tremendously. Rows are spaced far enough apart for workers to move between them, perhaps 1 m, with 4-8 cm between plants within the row fairly common. Other times, 3-4 seeds are planted per hill, with hills approximately 15 cm apart. Plants are grown on ridges.

Fungicide sprays are applied frequently to the growing plants, with the interval between applications influenced by the amount of rain. It is common to spray from once to two or even three times per week.

Harvest is by hand picking of the pods, Figure 2. Usually, there will be three to five pickings from a field, with a few days to a week between pickings. Pods are often picked one day for transport and sale in a village market the next day.

One visit near Bogota was to a grower producing edible podded peas which are also referred to as Chinese peas or snow peas. The variety being grown here was Mammoth Melting Sugar. The pods are shipped to the United States, London and Paris. A very high level of management was exercised with production carried on throughout the year. The plants are sprayed with benlate and other pesticides frequently. Three crops of peas are grown in succession on a field and then it is rotated to grass. Fertilizer, 10 30 10, is

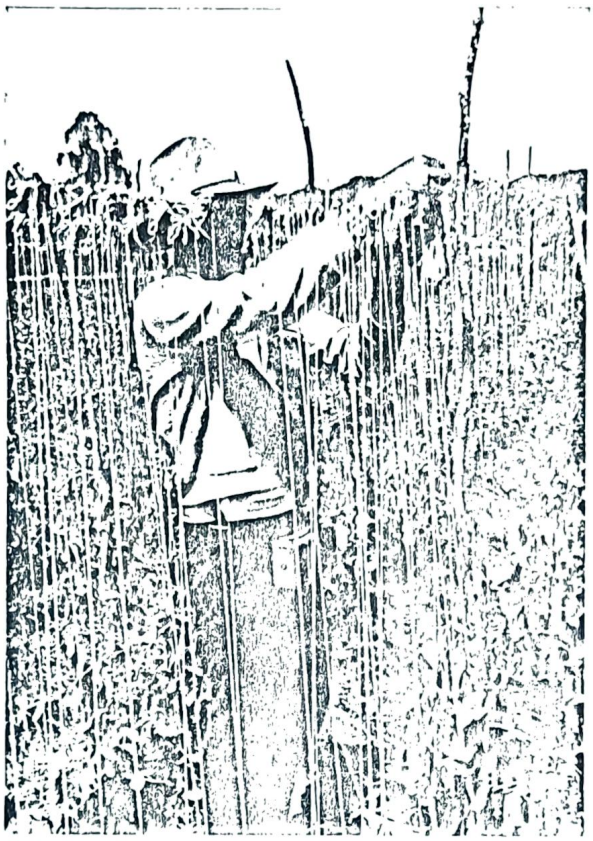

Figure 1. In Colombia, pea plants in many fields are held upright by tying them to strings supported by overhead wires.

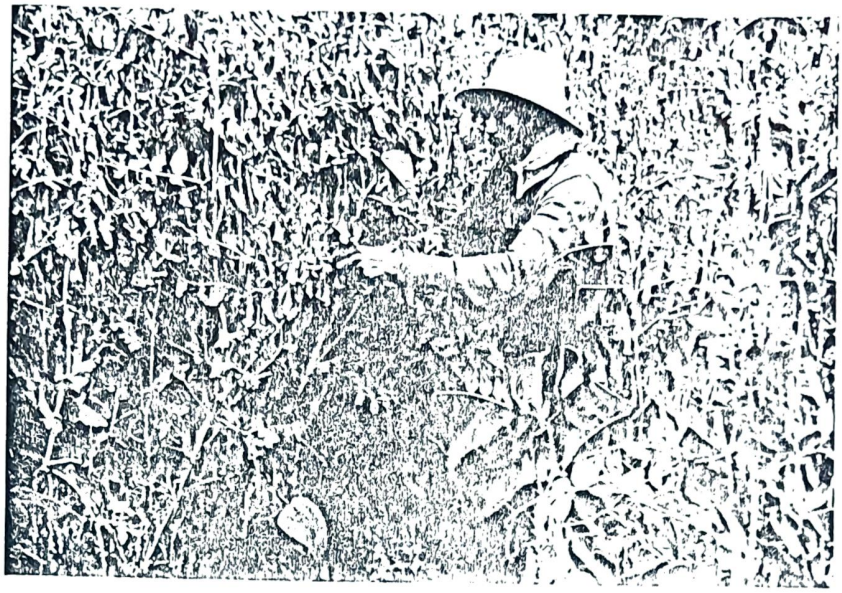

Figure 2. Several harvests are possible from pea plants with long vines which produce pods at many nodes. Colombia.

applied at the rate of 500 kg/ha, plus 50 kg/ha of minor elements. Additionally, urea is applied 2-3 times during the growing season to help develop the desirable dark green pod color. Dolomitic limestone is applied to maintain a soil pH of 6.0 or higher. Plants bloom 60 days after planting and pod harvest occurs 26 days after bloom. The fields which produce the highest quality are located at 2200-2600 m altitude.

VARIETIES:

Some pea seed is imported from the states of Idaho, Washington and Oregon in the United States to be used mainly by the canning industry for rehydration. This is mostly Alaska-type seed which has green cotyledons and is smooth.

Early Sweet, Charger and Mikado are three varieties that have been used for some time by companies that can peas in the green succulent stage. These varieties are being replaced by newer releases. Seed is obtained from foreign seed companies such as those in the Netherlands and the United States.

In growers' fields we saw varieties that produced yellow cotyledon seeds, with yellow hilums, and were smooth. First flowers were borne at about node 15. There were two flowers per node. Flowers were white except for a low proportion of purple-flowered plants. The first pods are picked 105 days after sowing, with 3-4 more pickings at weekly intervals. The lowest pods bear 6-8 seeds per pod.

Another field had plants with yellow cotyledons, black hilums and smooth seeds. Flowering started at node 17. Pods were borne double, and there were about 6 peas per pod. Pods were borne on 7 nodes and the plants were still developing.

In still other fields, plants started blooming at node 17, but bore only one pod per node. There were pods at 12 nodes and the plants were still developing. There were 8-9 ovules per pod with 6 of them developing into peas, on average. Seeds were yellow with black hilums and were smooth.

In a field near Bogota we saw a very dwarf variety with short internodes being grown. Although it was late in maturity, starting flowering at node 17, it was only about 100 cm tall. It bore single and double pods. Seeds were yellow with black hilum and smooth.

All of the varieties I saw in farmers' fields had a light green pea (berry) at the fresh succulent stage. This would be considered a canning color betty in the United States as contrasted to a dark green berry which is considered a freezing pea type.

DISEASES:

The most common foliage diseases are caused by Ascochyta spp. These diseases were present in all fields we visited and spraying programs are usually aimed at their control. Not only do they reduce production, the infected pods are less desirable and bring a lower price in the marketplace than pods not showing symptoms.

Fusarium root rots and wilts are also common, but the races have not been identified.

Powdery mildew is often present on plants at the pod-picking stage but it is considered of little or no significance.

Bacterial diseases do not appear to be serious problems.

Although some virus-infected plants are seen, viruses do not appear to be a significant problem.

INSECTS:

The two most troublesome insects of peas in Colombia are the root and stem borers. The root borer damages the pea root system and probably provides an easy infection site for Fusarium. The stem borer, at least one of which appears to be a Hapellates sp., causes severe loss due to damage of the stem. Aphids are seldom a problem to peas.

RHIZOBIA:

Seeds are not inoculated before planting but in some fields nodules develop profusely on the roots and have a deep pink to red internal coloration. In other fields, little if any nodulation occurs.

RECOMMENDATIONS:

1. I encourage the soil testing of growers' fields to determine the pH and fertility status. Then as resources permit, the grower can apply lime and fertilizer for the greatest economic benefit in growing peas.

2. It is desirable to continue obtaining new varieties and lines of peas. However, the evaluation and maintenance of a large collection can be very time consuming. Therefore, judgement should be exercised in acquiring more material. Successful cultivars from other countries are well worth evaluating in Colombia. Other lines can be observed for their reaction to prevalent diseases and insects, but unless they demonstrate these desirable qualities it is doubtful that much effort can be justified in working with them. The advantage of evaluating released cultivars is that desirable ones can rapidly be put into production.

3. Hybridization of local or successful cultivars with other lines possessing desirable attributes is necessary to develop lines best suited to production and utilization in Colombia and other Andean countries. As I understand the present plan, these progeny will be carried to the F_4-F_5 at La Selva and then made available for evaluation at other locations. Personnel at those locations are to choose plants which appear most promising under their conditions. If those doing the evaluation and selection have the time and expertise to do this, the system can work. It may be necessary, however, for Emile to select the most promising lines in F_5-F_6 at La Selva, and then provide nearly homozygous, homogeneous lines for testing at other locations.

   A hybridization program takes years to develop and identify superior material so this is a long-range approach. The single seed descent breeding procedure might be the most effective scheme where the parents are well adapted productive cultivars. If one or more lines of the cross are not of cultivar status, then it may be more effective to utilize regular pedigree breeding where only the most promising plants from each generation are advanced to the next.

4. Continued work with nodulation is justified. Certainly that is the most economically efficient means of supplying nitrogen to the plant. Rhizobia strains need to be evaluated with promising cultivars. As Colombian farmers are already accustomed to providing inputs to the pea crop, it is likely they would invest in inoculation of the seeds if this were shown to be economically beneficial. Brasil has conducted research on pea rhizobia and it is possible they could provide some effective strains. Also, the Soils department at FONIAP, Santa Catalina, Quito, Ecuador has investigated pea rhizobia and could provide information and possibly rhizobia strains.

5. Efforts need to be intensified to identify the races of Fusarium responsible for root rot and wilt. This will require pea lines with known genes for resistance and it would also be helpful to have cultures of known races of the fungus. Some additional equipment for the plant pathology labs, such as microscopes, may be needed for this work.

6. Because Ascochyta spp. are a problem in almost all production fields, are very destructive, and are difficult and expensive to try to control with chemicals, a very strong research effort is justified in studying these diseases and their control.

   The specific organisms involved need to be identified. Fungicides need to be evaluated for their effectiveness and most efficient use.

   Genetic resistance is the most desirable means of control but high levels of resistance to these species are not generally available. The most tolerant lines available should be brought into the pea improvement program and evaluated for their resistance (tolerance) under local pressures. Then the best lines should be combined and a recurrent selection breeding scheme followed to try to accumulate genes for resistance. This will require several cycles of selection and recombination but offers the greatest possiblity for improvement. Lines can be pulled off and taken to homozygosity during the recurrent selection process, and each cycle should see a higher level of tolerance in the lines.

7. Further study of the root borers and stem borers is needed. They can be extremely destructive and seem to be widely distributed. Chemical control as by treating the seed or soil with insecticide offers the greatest hope for immediate control. The expense and problems associated with chemical applications, plus the sometimes limited effectiveness, encourages the search for plant resistance. Lines should be carefully evaluated under controlled conditions, as in a greenhouse, to try to identify sources of resistance. If differences are found, then a breeding effort, probably recurrent selection, is in order.

8. Selection and breeding efforts need to recognize the different market demands. For those peas to be canned in the fresh, succulent stage, the demand appears to be for a small sieve pea and probably one with green cotyledons. It seems that varieties with wrinkled seeds are acceptable and in some cases may be preferred. Thus, it is important to establish and maintain close contact with canning companies to provide lines for this limited but important market.

A very large market exists for fresh peas sold in the pod. For this market it is desirable to have a large pod containing many peas. Sieve size is generally large as large peas contribute to the weight. Pods free of defects such as those caused by diseases and insects sell at a higher price so control of pests is important. Most local cultivars appear to have a light green berry color although where dark green berries are available, they appear to sell at a premium. Thus, breeding for darker shelled peas may be desirable.

Most local varieties appear to have yellow cotyledons and this may be the color of choice for peas sold as dry grain. Again, it is not clear that this is a consumer preference and so green cotyledon peas should be evaluated for market acceptance. Peas with green cotyledons are likely to have a more desirable color at the fresh stage than are those with yellow cotyledons.

9. Some effort should be devoted to development and evaluation of new or novel types. The afila foliage type, where the leaves are composed primarily of tendrils, may offer advantages in plant support, in coverage of plants and pods with pesticides, and in uniformity of color development of pods and shelled peas.

There is evidently an export market for the edible podded snow pea type. It is desirable to exploit this market. Additional varieties should be evaluated for possible use but breeding efforts can not now be justified to develop new varieties. Growers should be encouraged to explore this market where the possibility exists.

A large proportion of peas are sold in the pod as fresh market peas. Then the berries are shelled out for consumption and the pods are discarded. This means that approximately one-half of the purchased product is not utilized. I believe it is worthwhile to evaluate the acceptance of the sugar snap type of pea where the pod can be consumed along with the berries. The berries can be shelled out and eaten separately as is done with the peas now grown, but the pods provide additional food if they are consumed. One should not expect immediate acceptance but demand might grow.

10. Plant type and maturity need to be modified and these efforts should continue. Crosses should be made to develop shorter plants and ones of earlier maturity. Earlier maturity plants will reach the harvest stage sooner and mature before frosts where that is a problem.

PERU

PERSONNEL:

Personnel associated with pea research in Peru are listed in Table 2.

Table 2. Personnel associated with pea research in Peru.

1. Israel Tineo, Director
   IICA (Instituto Interamericano de Cooperacion para La Agricultura)
   Lima, Peru
   Telfs: 229623

2. Richardo Fort, Research Director
   INIPA (Instituto Nacional de Investigacion y Promocion Agropecuaria)
   Lima, Peru
   Telfs: 248776

3. Dr. Dale Bandy, Head
   North Carolina Mission/INIPA
   Lima, Peru
   Telfs: 244657

4. Dr. Juan Risi Carbone
   National Food Legume Advisor
   Nicaragua 2761
   Lince
   Lima, Peru
   Telfs: 403309

5. Jesus Hipolito de la Cruz Rojas
   Director of Experimental Station and Mejorador
   Estacion Experimental Agropecuaria.
   Baños del Inca
   Apartado 169
   Cajamarca, Peru

6. Segundo Torrones Cotrina. Fitopatologia
   Estacion Experimental Agropecuaria
   Banos del Inca
   Apartado 169
   Cajamarca, Peru

Peru (cont'd)

7. Luis A. Sanchez Mendoza. Mejorador
Estacion Experimental Agropecuaria
Baños del Luca
Apartado 169
Cajamarca, Peru

8. Ing. Aurelio Marlos Diaz. Fitopatologia
Universidad Nacional de Cajamarca
Facultad Ciencias Agricolas y Forestales
Apartado 16
Cajamarca, Peru

9. Ing. Roberto Horqqie Ferro
Estacion Experimental Cusco, Andenes.
Ave. Los Incas - 1032
Cusco, Peru

10. Ing. Cesar Apolitano
Director of Food Legumes
Chincha, Peru

11. Elmer Rojas
Head of legume section and agronomist
Estacion Experimental Agropecuaria
Banos del Luca
Apartado 169
Cajamarca, Peru

12. Edwin Pariona Meza. Especialista
Proy. Leguminosas
Estacion Experimental Sta. Ana. Huancayo
Real 503
El Tambo, Huancayo
Apartado 417
Huancayo, Peru

13. Dr. Tommy E. Fairlie.
Director INIPA National Programs of Crops and Animals
Ave. Guzman Blanco 309
Lima 1, Peru

14. Romulo Loayza
Huaraz, Peru

15. Ing. Luis Chiappe, Head
Department of Plant Technology
Universidad Nacional Agraria
La Molina, Peru

Peru, cont'd

16. Ing. Francisco Delgado de la Flor.
Head of Horticulture Program
Universidad Nacional Agraria
La Molina, Peru

17. Dr. Alfonso Cerrate, Vice Chancellor
Universidad Nacional Agraria
La Molina, Peru

18. Ing. Marino Romero
Dean of Agriculture
Universidad Nacional Agraria
La Molina, Peru

Dr. Juan Risi Carbone is located in Lima and is advisor to the Peru food legume program. He will be involved in collecting and disseminating information and germ plasm to the researchers. He will coordinate research. His responsibilities also include providing training within and outside the country for food legume researchers.

Cesar Apolitano is head of the food legume program and is located at Chincha. I did not have the opportunity to visit with him regarding his involvement in peas.

Jesus Hipolito de la Cruz is Director of the Los Banos Agricultural Research Station at Cajamarca and is a plant breeder. He will be involved with research on pea production and evaluation of lines.

Segundo Terrones Cotrina is a plant pathologist stationed at Cajamarca. It is anticipated that he will be able to devote some time and effort to pea disease research.

Elmer Rojas is agronomist and head of the food legume section at Cajamarca.

Louis Alberto Sanchez is an assistant plant breeder at Cajamarca.

Edwin Pariona Meza is a plant breeder stationed at Huancayo. He will have responsibility for pea hybridization and evaluation at that station and will assemble stocks of germ plasm.

Romulo Loayza is an agronomist at Huaraz who has had some involvement in pea research. His main emphasis in peas now will be the assessment of lines provided to him.

Roberto Horqque Ferro has worked at the Andean Experiment Station at Cusco for 14 years. He has been involved in pea research for the last several years.

Francisco Delgade de la Flor is head of the Horticulture program at the Universidad Nacional Agraria, La Molina (Lima). He has been involved with research with several lines of peas including processing, dry seed and sugar snap types.

Luis Chiappe is Head of the Department of Plant Technology at La Molina. He has been directing graduate student research on production practices for snow peas.

Alfonso Cerrate is Vice Chancellor at La Molina. About three years ago he began research efforts on grain legumes. His efforts are primarily in guiding the research efforts of graduate students.

Marino Romero is a small grains breeder but is interested in peas and other legumes as a source of nitrogen in crop rotation.

Aurelio Martos Diaz is Dean of Agriculture at the Universidad Nacional de Cajamarca. He is also a plant pathologist and is interested in pea diseases.

RESEARCH FACILITIES:

Lima - There is no station at Lima for pea research, other than through the Universidad Nacional Agraria at La Molina. The University, however, has laboratories and field research plots so has good facilities for research.

Cajamarca - The Los Banos experiment station has 3 ha available for field plot research plus 30 ha at Sullusischa. It is primarily a field research station and has no wet lab facilities. It has only limited dry lab and seed handling facilities available for pea research.

The National University at Cajamarca has a plant pathology laboratory and facilities for research in plant diseases.

Essentially no facilities at Huancayo are presently devoted to peas. There are glass and screen houses and facilities for entomology and plant pathology but these are used only for potato research. The station has 12 ha of land.

There is a University at Huancayo which has laboratories and a 60 ha experimental station. It may be possible to enter into cooperative pea research with them.

Cajabamba - The research station here is composed of 32 ha, 18 ha of which are cultivated. Twelve ha are irrigated. Several very adequate buildings are on the station and several more are planned. This is a field research station so does not have wet lab facilities. Limited research equipment is available for food legume research.

Cusco - I believe most of the research at Cusco has been conducted on cooperating farmers' fields. There is essentially no equipment for handling pea trials but the cereal program has cooperated by making their balance available, and other work has been accomplished through improvisation.

RESEARCH EFFORTS:

Lima - Luis Chiappe is advising a graduate student who is studying production practices for snow peas.

Francisco Delgado de la Flor has been evaluating several lines of fresh processing type, dry seed type and sugar snap types.

Alfonso Cerrate serves as advisor to graduate students. I believe he has not yet guided a student in pea research.

Marino Romero is a small grains breeder who stated that his only interest in peas is as a legume crop to return nitrogen to the soil when grown in rotation with small grains. Work to date indicates that peas are effective in supplying nitrogen to the succeeding crop.

Cajamarca - Little pea research has been conducted on the experiment station to date, but it is anticipated that line evaluation and production practices will be studied. Growers' fields have been visited and observed with regard to varieties, production practices and disease problems.

No phytopathology work on peas has been carried out at the University, but there is interest, particularly regarding the races of Fusarium and resistance to them.

Cajabamba - There have been evaluations of pea varieties on the station and more are planned.

Huancayo - Essentially no pea research has been conducted here to date. Hybridization and evaluation of lines is planned for the future.

Huaraz - Small evaluation plots of peas have been grown. Evaluation of lines provided to this station will be emphasized in the future.

Cusco - Lines and germ plasm have been collected from this area and evaluated. Two selections have been especially promising and will be put in further trials. In 1986 and 1987, there were trials of peas planted alone, maize planted alone, alternate rows of peas and maize, and alternate hills of peas and maize. Peas supported by maize were most successful.

Lines originating in other areas of Peru or other countries have not performed as well as local varieties.

Peas have been studied at 15 different areas near Cusco.

PRODUCTION AREAS:

Production of peas in Peru is centered in the Departments of Piura, Lambayeque, Cajamarca, La Libertad, Anoash, Huanuco, Junin, Huancavelica, Ayacucho, Apurimac, Cuzco, Arequipa, and Puno, Figure 3 (Hernandez-Bravo, et al. 1987).

The Mantaro valley near Lima is a large pea producing area. The crop is rainfed. Tractors and other such technology are widely used in this area.

A second important pea producing area is Churcampa, which is south of the Mantaro valley. Ninety percent of the peas here are harvested fresh and supplied to Lima. Approximately 10% are harvested as dry seed.

A third area important in pea production is Comas, which is east of the Mantaro valley. This area has fairly high humidity which comes from the Amazon.

A fourth area in which peas are important is Tarma. This is a small valley surrounded by high mountains. Because irrigation is available, crops can be produced throughout the year. Much of the production goes to Lima.

Pazos is a fifth area growing many peas. Slopes are higher than at Huancayo, and are very steep so that all production is by hand labor. Animals and tractors can not operate in this terrain.

Figure 3. The primary pea producing departments of Peru are named on this map. (From Hernandez-Bravo, et al., 1987).

Huancayo is at 3200 m and peas are cultivated up to 3600 m without danger of frost. The Cusco station is at 3339 m altitude with a minimum temperature of 6° C., maximum of 18° C., and average of 10-12° C. Precipitation averages 800 mm per year.

The San Pablo region has a cool climate with lots of fog from the coast.

PRODUCTION PERIODS:

The main plantings of rainfed peas are in January and February, with some continuing into March.

Where irrigation is available, peas can be planted from July to October.

In the areas of Chota, Santa Cruz and Cutervo peas are sown with the last rains of March.

Near Cajabamba, peas planted in January and February are grown for dry seed. For fresh consumption, some peas with irrigation are sown in September - October. In some areas of Chota and San Pablo, some late sowings made in March are for harvest fresh.

PRODUCTION PRACTICES:

Seed for planting comes primarily from seed saved by the grower, but some is purchased from brokers and some is obtained in village markets.

Seeds are not treated with insecticides or fungicides nor inoculated before planting.

A common rotation where peas are grown and moisture is adequate will be potatoes, followed by maize, with peas following the maize. The potatoes may be well fertilized with commercial fertilizer and/or animal manure, the maize may receive a small amount of fertilizer or none at all, and the peas usually receive no fertilizer. Soils are not usually tested for nutrient levels. On upper, dryer soils the main crop will be mostly wheat and barley, with some peas grown now and then to break the small grain cycle. In the south the cycle may be potatoes, small grains, a food legume such as peas or faba beans, and then fallow for one year.

Soils are usually scratched lightly with ox-drawn equipment and pea seeds spread on the surface, though sometimes seeds are dropped in an open furrow which is then closed with the next pass of the ox-plow, Figure 4. Peas are generally not grown on ridges.

Herbicides are not used. Peas are broadcast or may be planted in rows perhaps 20 cm apart. They are not supported by strings or trellises. Plant populations vary greatly. Fungicides are not applied to the plants.

Some peas are grown in association with wheat or barley or maize as well as with Vicia faba. There is a feeling the grains or faba support the pea plants and keep the pods from rotting or being stained as can happen when they lie on the soil surface. Sloping fields are preferred for pea production since they are better drained than flat fields.

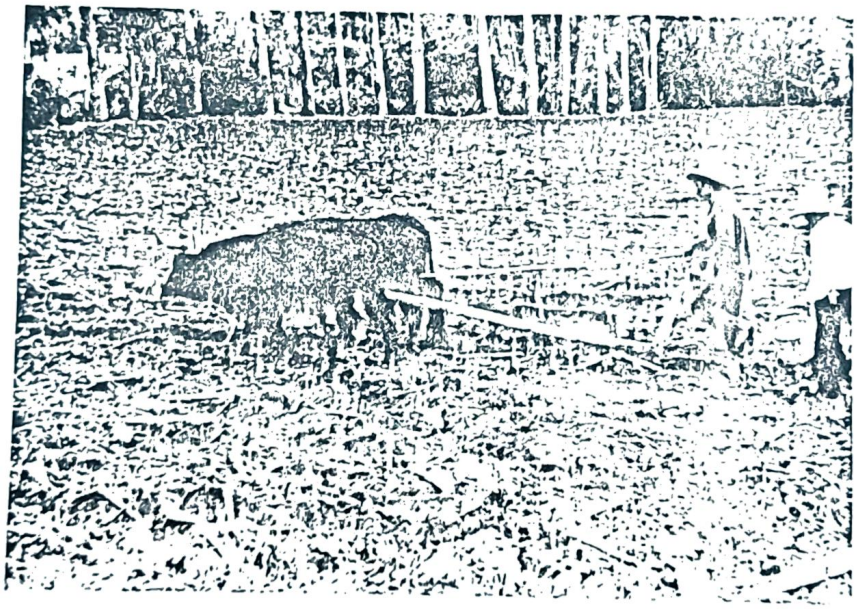

Figure 4. Peas are sometimes grown in rows by dropping seeds into furrows opened by ox plow, and then covering them with soil from the next furrow opened. Peru.

VARIETIES:

It was not always possible to learn the variety name of peas being grown. Many times the grower did not have the name of the peas he was growing.

In visits to growers' fields, or discussions with researchers, the following types of peas were observed or were reported to be grown:

--Flowering started at 15th node. A total of 22 nodes per plant. Double podded. Some plants with colored leaf axils (which could indicate colored flowers and possibly purple spots or other colors on the seed) among predominantly white-flowered plants. Light green berries with colorless hilum. Five to six peas per pod. The seed type here is a mixture of small yellow and large green, with all dry seed smooth and round. Pods will be picked fresh for the local market. Those seeds which go to maturity will be saved for consumption or planting. Animals will be pastured on the vines after all peas are harvested.

--Dwarf-type vine with 60-100 cm length. Double podded. Most plants have green leaf axils but a small proportion are colored.

--Plants flower at 15th node. Approximately 10% of the plants are purple flowered, the rest white. Pods borne single and double. Seven peas per pod. Vines 70-100 cm long. Mixture of pod and berry sizes from small to large. Light colored berry.

--Plants blossom at nodes 20-22. Mixture of plant types. About 7 seeds per pod. This field will be harvested at the dry seed stage and part of the harvest consumed by the farmer and part saved for seed. Seeds will be threshed by driving horses over plants on a threshing floor.

--Plants with very long internodes and long vines of about 150-170 cm. Growing on area near buildings where animals had been tethered.

--Blooms at 15th node. Almost all plants white flowered.

In the San Pablo region, many fresh peas are produced and varieties suitable for canning are used because of the canning factory at Trujillo. Alderman (wrinkled green seeds) has been used for a long time, but because of susceptibility to root rot, growers would like a replacement.

In the areas of Chota, Santa Cruz and Cutervo, peas are sown with the last rains of March. If the peas then suffer drought, they produce many empty pods. Late maturing varieties suffer the most. Some early maturing types obtained from the United States had filled pods at 60 days after sowing, but plants did not grow very large nor yield especially well.

In the area of Churcampa, a local variety known as Blanca Criolla de Churcampa is widely grown. The seed type is round and seeds are large. Vines grow to about 3 m length. Plants are late, taking about seven months to mature.

In the Mantaro, Tarma and Comas regions, varieties with many colored flowers are grown and some of the dry seeds have purple spots. Dwarf Alderman is also grown to some extent as it is considered a very good fresh pea.

At the market in Cajabamba, peas were for sale fresh in the pod, and as dry seed. Fresh peas were of light green berry color. Dry seeds were of many types and often the types were not separated. Most seeds were round and many were yellow. There were, however, green cotyledon seeds. Some seeds had purple spots.

DISEASES:

Peas are attacked by many diseases in Peru. Some of the most widespread and destructive diseases appear to be caused by Ascochyta spp., though species identification has usually not been made. Anthracnose is prevalent. Bacterial blight is common. Sclerotinia can be a problem during rainy periods. Root rot is a problem with Fusarium probably the most frequent cause. Rhizoctonia may also be involved. Fusarium wilts cause losses but the races of Fusarium present have not been identified. Powdery mildew can usually be found and sometimes completely covers the plant but it is felt to cause little if any yield or quality loss. Viruses appear to be of minor or insignificant importance.

INSECTS:

Insects appeared not to be a serious problem in Peru.

RHIZOBIA:

Seeds are not inoculated before planting so any nodulation is from rhizobia already present in the soil. The amount of nodulation varied from few if any on the roots of peas from some fields, to profuse nodulation on the roots of plants from other fields. Nodule size varied from barely perceptable swellings to nice large ones of approximately 10 mm diameter. Nodule internal coloration ranged from white or green (suggesting inefficient nitrogen fixation) to pink and deep red (suggesting efficient nitrogen fixation).

RECOMMENDATIONS:

1. Insofar as possible, it would be desirable to test the soil of farmers' fields so as to know the pH and fertility status. Though little is usually invested in the pea crop in Peru, knowing the soil needs could result in the most efficient use of lime and fertilizer. Even if these are applied to other crops in the rotation, peas might benefit from carryover.

2. It is desirable to collect and evaluate local varieties. They may possess some degree of resistance to local diseases and must have adaptation to the environment if they persist. Provision should be made for long-term maintenance of these collections so they are not lost.

3. Promising introduced varieties should be evaluated. An effort should be made to secure those most likely to succeed, so as not to waste valuable time and resources on unadapted or unacceptable material.

4. With the limited resources available for pea research, only one hybridization program might be supported. Material from this program could be evaluated at the other stations to identify the best material for each locality.

5. Experiments should be conducted to measure the effectiveness of local strains of rhizobia. It would be desirable to secure effective rhizobia

Recommendations, cont'd

strains from local soils, from the Santa Catalina station at Quito, Ecuador, and perhaps from Brasil, for these studies. It is likely that inoculation could significantly improve pea performance. Nitrogen fixation through the symbiotic process is the cheapest and most efficient means of promoting pea growth and contributing nitrogen to the soil.

6. Positive identification of pea diseases and the relative importance of them needs to be established. Because universities appear to have the best facilities for this purpose, it would be desirable to establish cooperative work with plant pathologists at these universities. The species of Ascochyta and the races of Fusarium, especially, need to be determined.

7. Varieties most tolerant to local diseases should be identified through evaluation in each of the growing areas, and seed of the best ones increased for distribution to growers.

8. The market demand with regard to type of pea should be identified. Much of this can be done simply by having researchers visit with buyers and sellers at village markets and with the few processing factories that can peas.

9. Studies are needed to ascertain desirable plant populations. While this will vary with fertility, moisture, variety and other factors, information can be collected so that recommendations can be made to growers.

10. Additional training of pea researchers is needed and in fact is being carried out. This should be encouraged.

BOLIVIA

PERSONNEL:

Personnel associated with pea research in Bolivia are listed in Table 3.

Table 3. Personnel associated with pea research in Bolivia.

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2. Dr. Alberto Franco, Director
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3. Ing. Raul Rios Enríquez
   Coordinador Nacional de Leguminosas
   Centro Fitotecnico Pairumani
   Casilla 3861
   Cochabamba, Bolivia
   Telfs: 60083

4. Dr. Rainer H. Rothe
   Irrigation Agronomist
   Proyecto de Riego
   Altiplano/Valles
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   Cochabamba, Bolivia

5. Raul Tastaca
   Extension Agent
   Project Area Tiraque
   Proyecto de Riego
   Altiplano/Valles
   Cassilla 1503
   Cochabamba, Bolivia

6. Edith Ruiz
   Extension Agent
   Project Area Tiraque
   Proyecto de Riego
   Altiplano/Valles
   Cassilla 1503
   Cochabamba, Bolivia

Table 3, cont'd

7. Jorge Zuna Rico
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Dr. Rainer H. Rothe is an irrigation agronomist with the Proyecto de Riego at Cochabamba. His project has several extension agents associated with it, and some of their work involves pea research. Two of them are Raul Tastaca and Edith Ruiz.

It is reported that some observation plots of pea lines were put out by the faculty of agriculture at Santa Cruz. I was not able to learn the names of those responsible or any other information about this work.

Raul Rios Enriquez is National Food Legume Coordinator stationed at Cochabamba, Bolivia. He has not conducted any research with peas but is the person likely to be involved in any work instituted through IBTA (Instituto Boliviano de Tecnologia Agropecuaria).

RESEARCH FACILITIES:

Cochabamba - There is a small research farm with limited buildings at the Programa de Riego "Altoplano/ Valles," Proyecto IBTA-GTZ at Cochabamba. The work under Dr. Rothe with peas is being carried out as research/demonstration plots on farmers' fields.

Raul Rios works at the Centro de Investigaciones Fitoecogeneticas de Pairumani near Cochabamba. There are research plot areas and some dry lab facilities for seed and plant work here. Limited wet lab space is present but lacking in equipment. Very good temperature and humidity controlled seed storage is present but no pea lines are in storage.

La Paz - The altiplano experiment station at Belen, some kilometers from La Paz, possesses extensive fields and buildings. However, it is now hardly functioning.

RESEARCH EFFORTS:

There is no history of pea research in Bolivia. The only research being conducted now appears to be that under Dr. Rothe's direction near Cochabamba. This is really more of an extension effort to utilize legumes in the rotation as a source of nitrogen to the succeeding crop. Factors being considered in the pea demonstration plots are irrigation, variety, fertilization, and weed control.

Future research might be conducted with Dr.Rothe if it fits into the objectives of that program. Raul Rios, also at Cochabamba, is interested in conducting pea research but does not presently have the financial support to do so.

PRODUCTION AREAS:

Most peas are grown in the Departments of La Paz, Cochabamba, Potosi, Tarija, Chuquisaca, Santa Cruz and Oruro, Figure 5 and Table 4 (Hernandez-Bravo, et al. 1987). The altitude in the La Paz area is around 4000 m and at Cochabamba is around 3000-3200 m.

Table 4. Production of peas in Bolivia. 1985.

Department	Area (ha)	Production (t)	Yields (t/ha)
La Paz	4804	3287	0.7
Cochabamba	3888	8231	2.1
Potosi	3013	3232	1.1
Tarija	1959	1914	1.0
Chuquisaca	1445	2865	2.0
Santa Cruz	115	359	2.9
Oruro	90	130	1.4

Source: Hernandez-Bravo, et al. 1987.

PRODUCTION PERIODS:

Peas in the La Paz altiplano area are planted during the second semester of the year, July to December, and harvested during the first semester of the following year. Frosts are possible in the altiplano during January and February; even as early as December or as late as March.

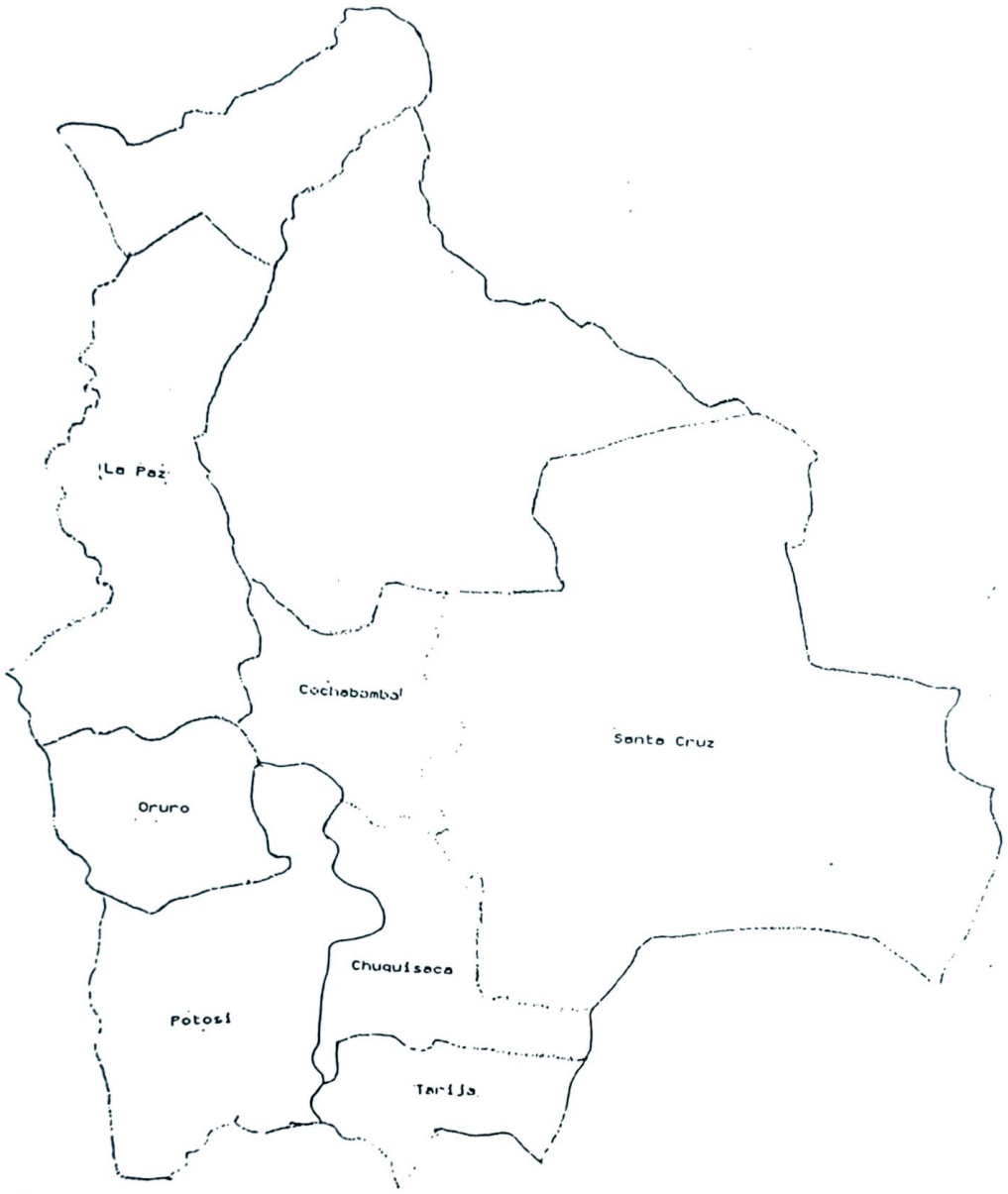

Figure 5. The primary pea producing Departments in Bolivia are named on this map. (From Hernandex-Bravo, et al., 1987).

In the Cochabamba area, peas may be planted at three main times - July to August, September, and November to December. For the last sowing date an early maturity variety is used because of a lack of rain during its growing period and also to escape frost which could injure a variety which took too long to reach the harvest stage.

In one area we visited near Cochabamba, the grower considers April to July the best period for planting peas.

PRODUCTION PRACTICES:

In the flood plain valley below La Paz, it appears that peas are grown in very small patches for harvest and sale at both the green pod and dry seed stages. We saw few peas here, but those were sole cropped and were broadcast.

Near Lake Titicaca in the altiplano above La Paz, we saw peas grown in association with Vicia faba. Peas constituted from 1 to 5% of the population of plants. Plants were in rows on ridges. These were primarily for consumption as fresh peas for the growers' families, and were not being grown for sale. Peas are also interplanted with maize but never with potatoes.

Rotation in the altiplano may be potatoes, which receive chemical fertilizer and/or manure; legumes, which may be V. faba and/or peas; followed by wheat or barley. Peas in the altiplano are harvested primarily in the fresh succulent stage. Because the altiplano is cold and subject to hail and frost, most peas are grown in the valleys.

Just outside Cochabamba, we saw peas about 10 cm tall. The seeds had been planted at a spacing of about 30 cm half way up the soil ridges which were spaced approximately 60 cm apart. These fields were irrigated. The farmer grows peas here only for consumption. He grows peas to produce seed under the less intensive rainfed conditions up in the hills.

Seeds are not treated with fungicide or insecticides nor inoculated before planting. No herbicides are used. Usually no fertilizer is applied to the pea crop, but we saw in Dr. Rothe's demonstration plots that peas responded very favorably to fertilizer.

Peas in the Cochabamba area may be broadcast and incorporated into the soil by oxen if they are being grown for seed. If they are to be picked green, they are more likely to be planted in hills about 30 cm apart, with rows separated about 50 cm. Practices vary greatly, however.

An extension agent here noted that plant growth is better, there is more tillering, and higher yields are obtained, from rows than broadcast plants.

A rotation involving peas in the Cochabamba area may be potatoes, which receive fertilizer and/or manure; followed by maize, which might receive a small amount of fertilizer; and then followed by V. faba and/or peas. We visited a grower where onions are substituted for maize in the rotation.

One farmer near Cochabamba planted peas in July to take advantage of higher prices due to the scarcity of peas at harvest time. Most growers here would start planting in August. She will continue planting into November, with the last planting used for seed production.

Some peas will be sold fresh in the local market but many will be purchased by truckers as fresh peas in the pod and transported to the cities for resale. Most peas are consumed green, few as dry grain. Sometimes the first and second pickings of peas will be harvested and sold as fresh peas, Figure 6, the third picking will be delayed for dry seed harvest. Peas for seed are often saved by growers, but may also be purchased from vendors or in the village market.

VARIETIES:

The peas we observed in the altiplano were of dwarf stature, about 80 cm tall. They bore white flowers, two per node. Flowering started at the 12th node which means they are early maturing.

In the Cochabamba area, we saw dwarf varieties of peas. One of these is referred to as the Petit Pois variety, which was introduced by seed merchants more than 30 years ago. The actual variety name is not known. It is white flowered with two flowers per node. Seeds are round with yellow cotyledons. First flower is at node 16. Berry is light green in color, of medium size. It is reported that because of its better appearance and taste it sells at a higher price than local varieties.

Another field here had plants reported to be of the Petit Pois variety. They started flowering at node 17. About 2% of the plants had colored flowers rather than white. Plants had vines about 100 cm long.

Last year some trials compared the introduced Petit Pois variety to local varieties. The Petit Pois was more resistant to diseases and was more productive than the local

Figure 6. Picking fresh peas from a broadcast planting. Bolivia.

varieties. The Alaska variety, which is an early maturing pea that starts flowering at about the 11th node and has medium sized smooth seeds with green cotyledons, was rated second to the Petit Pois in last year's trials.

Another very productive looking field of Petit Pois had vines about 120 cm long.

A field planted to a local variety had about 25% colored flowered plants among the white flowered ones. Shelled peas from the purple flowered plants have an undesirable dark color which results in a lower price for these peas.

Another field of nice plants was starting to flower at nodes 12-14. The variety was not known.

There is a canning factory in Cochabamba which processes peas, among other crops. The varieties and production practices used for these peas is not known.

The Criolla variety was also observed. This variety seemed to produce vines about 60 cm long. Internodes were very short and there appeared to be about 20 nodes in total. It was difficult to ascertain the nodes to flower as this field had already been harvested and vines were senescent.

Still another field had plants which started blooming at the 12th node. Both white and colored flowers made up this planting. A very tall vigorous variety which flowers at the 18th node was observed. This variety produced double white flowers. Both size of berry and maturity were highly variable. There was much tillering of the plants.

One grower reported that he uses a variety that takes three months from planting to reach the green succulent stage. For use as dry seed, he grows a second variety which requires 5 months to reach the dry seed stage.

Another grower says he uses a green seeded variety that takes only two months to reach the green harvest stage.

DISEASES:

Some pea fields were very free of diseases. These were producing nice crops of pods that were free of defects. Since fresh peas are sold in the pod, any disease lesions or damage to the pod lowers the market value. Of course, diseases can also greatly reduce the yields.

Root rot was reported to be a common problem. Some of this can be attributed to the wet soil in which peas are frequently grown. Fusarium appears to be one cause of the root rot though Pythium and Rhizoctonia are probably also involved.

Fusarium discoloration was observed in the stems of some unthrifty plants. The races of Fusarium present are not known.

Bacterial blight and Ascochyta spp. appear to cause significant damage, especially during the rainy periods.

Powdery mildew was observed in several fields but was not severe. It is not considered to be a problem by growers or researchers.

A limited number of pea plants showing virus symptoms was observed, though the virus responsible was not ascertained. Growers and researchers felt viruses were not a significant problem. Large numbers of aphids were observed on faba plants, and volunteer faba plants are frequently found in pea fields, if in fact they are not interplanted. Aphids can disseminate the viruses.

INSECTS:

Aphids were observed on faba plants and on some peas. Chemical sprays had been applied to some pea fields for control. It seems that aphids are not usually a serious problem.

Stem and root borers did not appear to be a problem.

A cutworm was causing very serious stand reductions and plant damage in peas as well as other crops in the Cochabamba area. It was not difficult to dig up from one to three cutworms from the base of a single pea plant. Growers and researchers said the problem is more severe this year than it has been in the past. Some had used a soil insecticide but it was not clear how effective such treatment had been. No control measures had been used by most growers.

One field we visited had an infestation of what appeared to be an armyworm-type insect. This larvae was feeding on the foliage and had nearly stripped some plants of their leaves. Some larvae had bored through the pods and were in the berries inside. This appeared to be an unusual occurrence and was not causing any great alarm.

RHIZOBIA:

Seeds are not inoculated before planting. Most pea plants examined had some nodules though none were nodulated profusely. Even some plants with excellent growth were evidently benefitting from soil nitrogen as they were not well nodulated. Many nodules examined were small with white or greenish interiors.

RECOMMENDATIONS:

1. As in the other countries, it would be desirable to obtain soil test results so as to know the pH and nutrient status of the fields. Even if this could be done for only a few fields, it would provide a base point.

   It might be that some relatively inexpensive lime or fertilizer applications would result in significantly improved productivity.

2. A collection should be made of presently grown pea cultivars. No such collection has ever been made. Some of the seed of lines collected should be placed in long-term storage. Perhaps a portion of each sample could be kept in the excellent storage room at Pairumani, and another portion sent to storage outside the country such as Geneva, New York or the Nordic Gene Bank in Norway. These lines should be evaluated for their disease resistance, yielding ability and quality characteristics. If superior lines are identified, seed supplies of them should be increased and distributed to growers.

3. Promising cultivars should be introduced and evaluated. Care should be taken to select only those lines for trial that have the greatest changes for success. Preliminary trials at La Selva, Colombia, may suggest the best lines to try.

4. It does not appear that resources are available to conduct a breeding or hybridization program.

5. It would be desirable to obtain rhizobia cultures from other countries and measure the benefit, if any, from inoculating seeds prior to planting. If inoculation is proven to be beneficial, it might be possible for growers to use a little soil from fields where the peas were effectively nodulated, to coat seeds being planted into other fields. Transfer of soil has been used in the past to introduce the proper rhizobia.

6. Pea diseases appeared to be less of a problem in Bolivia than some of the other countries visited, but then my visit was not during the main pea growing period. Arrangements should be made with a plant pathologist to identify the most prevalent diseases and the races of organisms present during the main pea growing season.

7. The market demand for peas should be studied. The canning companies can be contacted to learn their needs. Village markets can be visited to see which types are most in demand, and to learn to what extent different types are acceptable.

8. Cultural practices should receive attention. There are essentially no research results to show the best plant populations, plant spacings, soil preparation, pest control, dates of planting, etc.

9. Personnel need to receive training in pea production and research. Since peas have not received research attention in the country in the past, this training will need to be received in another country.

It would be beneficial to visit the pea research programs at La Selva, Colombia. An active program has been in place at Brasilia, Brasil. Chile has a history of pea research. Europe and the United States have many places where pea research is carried out.

ECUADOR

PERSONNEL:

Personnel associated with pea research in Ecuador are listed in Table 5.

Table 5. Personnel associated with pea research in Ecuador.

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10. Dr. B. Ramakrishna, Especialista
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Dr. Guillermo Hernandez-Bravo is International Coordinator for Food Legumes with PROCIANDINO (Programa Cooperativo De Investigacion Agricola Para La Subregion Andina), based in Quito, Ecuador. He is securing seed-stocks, publications, arranging for visits and facilitating the exchange of information and material among the five Andean countries.

Cristobal Villasis is National Coordinator of Food Legumes located at the Santa Catalina Research Station, Quito, Ecuador.

Edmundo Cevallos N. is a breeder with the legume program at Santa Catalina.

Victor Vasquez Almeida is Chief of the Department of Entomology at Santa Catalina, and as such will be involved with any pea insect work.

Julio Cardenas Granja is Chief of the Department of Weed Control. His work includes weed control in peas.

Dr. Jose Espinosa is Chief of the Soils Department at Santa Catalina. A person on his staff in soil microbiology, Consuelo Estinez, has been involved with phytopathology and rhizobia work.

RESEARCH FACILITIES:

The Santa Catalina station is the primary station in Ecuador for grain legume research. It has about 75 professional and 200 support staff. There are 900 ha in the station which includes excellent plot land. It covers a range of altitude from 2300 to 3600 m. Good buildings, laboratories, glasshouses and a seed conditioning facility exist here. Research is also conducted on growers' fields.

There is not a temperature-humidity controlled facility for seed storage so the only way to maintain viability of pea seed is to regrow the stocks every 5-6 years.

The University in Quito and other faculties of agriculture usually have some students working on their thesis research with Santa Catalina staff.

RESEARCH EFFORTS:

The food legume breeders have about 44 local varieties and about 150 introductions in their pea collection. They have been evaluating these varieties. One local variety has looked very good in comparison with other lines so seed is being increased for release. One line from Colombia has also performed well in trials. However, germination of seed stocks of this line is poor so release will be delayed until sufficient good germinating seed is available. Selections are made in segregating material received from other pea improvement programs. Material from the Colombia program has been especially promising.

Pea herbicide trials have been conducted for two years. Good herbicides are available. However, herbicides are not generally used for weed control in peas.

Both stem and root borers as well as aphids have been identified in peas.

Several diseases have been identified in peas. No pea disease work is currently in progress.

About 40 local strains of rhizobia were compared for their effectiveness to 10 strains obtained from Brasil.

Five local strains were judged superior. These strains have produced a four-fold yield increase in field experiments. The best rhizobia strains produced higher pea yields than the fully fertilized control.

PRODUCTION AREAS:

The Sierra area of Ecuador accounts for 99% of the peas produced in the country, (Hernandez-Bravo, et al. 1987). According to the above authors, Table 6, the leading provinces in hectarage are Bolivar and Chimborazo, with Loja having about one-third as much area in pea production as either of these. Lesser amounts are grown in Pichincha, Cotopaxi, Tungurahua, Carchi, Imbabura, Carar, and Azuay.

Most peas are grown between 2000 and 3000 m altitude.

PRODUCTION PERIODS:

The primary pea planting period is March, April and May, coinciding with the end of the rainy period. A few growers may plant a few peas in February. Some plantings may be made in October or November if sufficient rainfall permits.

PRODUCTION PRACTICES:

It is estimated that 95% of the seed used in planting is purchased in the market, with only about 5% of the seed saved by the farmer for his use the next season.

Seeds are not treated with fungicides or insecticides nor inoculated before planting. Herbicides are not used by growers for weed control in peas. There is an effective systemic insecticide for control of the stem borer but it is not widely used. Fungicides are rarely used on peas.

Fertilizer is used for maize and potatoes but not for peas.

A common rotation involving peas is maize, peas, potatoes, cereals.

About 80% of the peas are consumed in the green succulent stage. Of the other 20%, some are used for consumption from the dry grain, a small amount is ground into flour before consumption, and the rest is used as seed. There is no pea canning industry.

Table 6. Area of peas harvested in Ecuador (1976-1985). (From Hernandez-Bravo, et al. 1987).

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985*	$\bar{x}$	%
Total República	16030	10300	8609	13129	13967	14000	12476	8558	8597	6791	11246	100
Sierra	15850	10067	8609	13119	13949	13975	12443	8502	8530	6737	11178	99.3
Carchi	1500	280	319	488	316	351	350	261	400	300	457	4.1
Imbabura	1200	565	231	318	350	406	426	350	510	250	460	4.1
Pichincha	1600	2570	484	388	696	582	530	372	761	850	883	7.9
Cotopaxi	550	345	161	649	1087	714	690	602	723	708	623	5.5
Tungurahua	400	319	936	241	700	494	720	773	506	188	528	4.7
Chimborazo	3300	1500	1483	5375	5560	4970	3500	2500	1600	1947	3174	28.2
Bolívar	3900	2635	3833	4107	3800	4942	4500	2000	2240	1700	3366	29.9
Cañar	300	166	220	168	230	351	500	600	650	107	329	2.9
Azuay	500	375	160	185	200	286	197	244	240	37	242	2.2
Loja	2600	1310	780	1200	1010	879	1030	800	900	650	1115	9.9
LITORAL	120	233	1	10	12	18	18	43	32	15	55	0.5
ORIENTE	60	-	-	-	6	7	15	13	35	39	25	0.2
GALAPAGOS	-	-	-	-	-	-	-	-	-	-	-	-

* Se reportan para este año, 4094 ha. dedicadas a la producción en tierno.

Most peas are sole cropped but some are interplanted with maize, faba or cereals. Planting patterns vary. Many are hill dropped with 3 seeds per hill, hills spaced 45 cm apart.

VARIETIES:

Growers like to plant tall varieties that will permit several harvests over a period of time. They prefer varieties with large berries and pods. Round seeds are preferred over wrinkled, with the feeling that round seeds weigh more and that wrinkle-seeded varieties are more susceptible to diseases and insects. Most varieties have yellow cotyledons.

A company here is growing the sugar snap pea for export.

Some of the pea varieties observed in the field were as follows:

--Plants blooming at 15-17 nodes. Mostly double podded with 5-6 peas per pod. Most plants white flowered but a few plants with colored flowers scattered throughout the field. Vines about 80 cm but were limited by lack of moisture. Berry color light green. Variety name not known by grower.

--Plants flowering at nodes 8-13. Single and double flowered. White flowers.

--Plants first flower at 13-15 nodes. Double podded with 6 peas per pod. Primarily white flowered but some plants colored. Light green berry color. Vines 100-120 cm long in most productive area of field. Variety name not known by grower.

Some local varieties grown are Alverjon, Crema, Rosada and Verde. Alderman, an introduced variety, has been grown for about the last seven years for fresh consumption but Dark Skin Perfection is beginning to replace it. Fresh peas of these two varieties, both of which have wrinkled seed with green cotyledons, sell at a premium because of their dark green berry color and sweeter taste. They may sell for 14,000 suchres per 45 kg while local varieties are bringing only 6,000 suchres. However, the wrinkled dry seed of these varieties sells at a lower price in the market place than round seeds.

A new variety from the Ecuador selection program is being released. A second variety selected from progeny originating in the breeding program in Colombia will be released as soon as seed supplies permit.

The food legume program has about 150 lines in its collection and is evaluating this material. A few of the named varieties are listed in Appendix Item 3.

DISEASES:

There were few pea plants in the field during my visit, but from those observations I did make, plus discussions with researchers, I understand these to be the main diseases.

Ascochyta, Rhizoctonia, Fusarium oxysporum, and Fusarium solani are all serious problems. The races of Fusarium have not been identified.

Anthracnose is also a problem but of lesser importance than the above.

Powdery mildew is usually present but does not generally result in severe yield or quality loss.

Viruses do not appear to be a problem.

INSECTS:

The stem borer is a very serious problem. Aphids are sometimes a problem.

RHIZOBIA:

Seeds are not inoculated. Plants in some fields appear to be well nodulated with effective bacteria. Plants in other fields do not appear to be effectively nodulated. Studies by the Soils Department indicate great differences in the effectiveness of local rhizobia.

RECOMMENDATIONS:

1. Soil tests can be run at the Santa Catalina station so it would be feasible and desirable to test some representative fields.

2. Evaluation of varieties should continue. If resources permit, it is desirable to select among segregating progeny under local conditions. If this becomes prohibitive, then resources should be allocated to evaluation of only varieties or pure lines.

3. A hybridization program does not now exist and I concur with the researchers that one cannot now be justified.

4. Identification of superior rhizobia strains has been made. Efforts should be pursued to have inoculum prepared by the Nitta project of INIAP and to further evaluate and probably disseminate this inoculum.

5. Lines of peas should be evaluated for their disease reactions. Except for the determination of races, diseases appear to have been identified.

6. Losses due to the stem borer should be quantified. If the information collected shows that chemical control is economically feasible, then this should be encouraged.

7. The best cultural practices such as plant populations, spacings, soil preparation, etc., should be studied and recommendations provided to growers.

8. Additional training of pea researchers should continue.

VENEZUELA

PERSONNEL:

Personnel associated with pea research in Venezuela are listed in Table 7.

Table 7. Personnel associated with pea research in Venezuela.

1. Mariano Segura, Director
   IICA (Instituto Interamericano de Cooperacion para La Agricultura)
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2. Santiago Rodriguez, General Director
   FONAIAP (Fondo Nacional de Investigaciones Agropecuarias)
   Maracay, Venezuela
   Telfs: 833311

3. Simon Ortega
   National Food Legume Coordinator
   FONAIAP
   Maracay, Venezuela

4. Ing. Ranulfo Manchego, Director
   Estacion Experimental Merida
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Table 7, cont'd

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7. Luis Ramon Lacruz Linares. Tecnico
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8. Ing. Manuel Salas N.
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Simon Ortega is National Food Legume Coordinator and is located at Maracay.

Ranulfo Manchego is director of the experiment station at Merida and is a food legume breeder.

Pedro A. Salazar is a legume breeder at Valera near Trujillo.

Luiz Ramon Lacruz Linares is associated with the food legume project at Valera (Trujillo).

Manuel Salas N. was located at Yaritagua, Yaracuy in 1985. At that time he had some work with peas.

RESEARCH FACILITIES:

Maracay - There appear to be good field and laboratory facilities at Maracay. However, it is my understanding that no pea research is planned for this station.

Merida - A limited amount of plot land is located outside the city. Wet and dry lab space is very limited and overcrowded at the FONAIAP offices building in Merida. Some good experiment stations with plot land and dry lab facilities are located within driving distance of Merida.

Valera (Trujillo) - Some plot land is available and limited space is available in buildings for dry lab work.

RESEARCH EFFORTS:

No pea research has been carried out at Maracay and because of the warm climate, this may not be a good place to work with peas.

Peas have not been studied at Merida but are widely grown in the area. The research director is enthusiastic about initiating pea research and is already establishing linkages with growers.

The Trujillo station staff have not been engaged in pea research. However, many peas are grown in the higher elevations near the station.

In 1985 I was contacted by Manuel Salas H. of FONAIAP, Yaritagua, Yaracuy regarding a small research effort at that station on peas. I did not visit that location and have no recent information on any research effort that may be taking place there.

PRODUCTION AREAS:

The primary pea producing areas are the states of Tachira, Merida, Trujillo, and Lara, Figure 7 (Hernandez-Bravo, et al., 1987). Peas are planted on gently sloping to very steep slopes, Figure 8, and at altitudes between 1500 and 2600 m. Some growers are trying to grow them at 1000 m altitude.

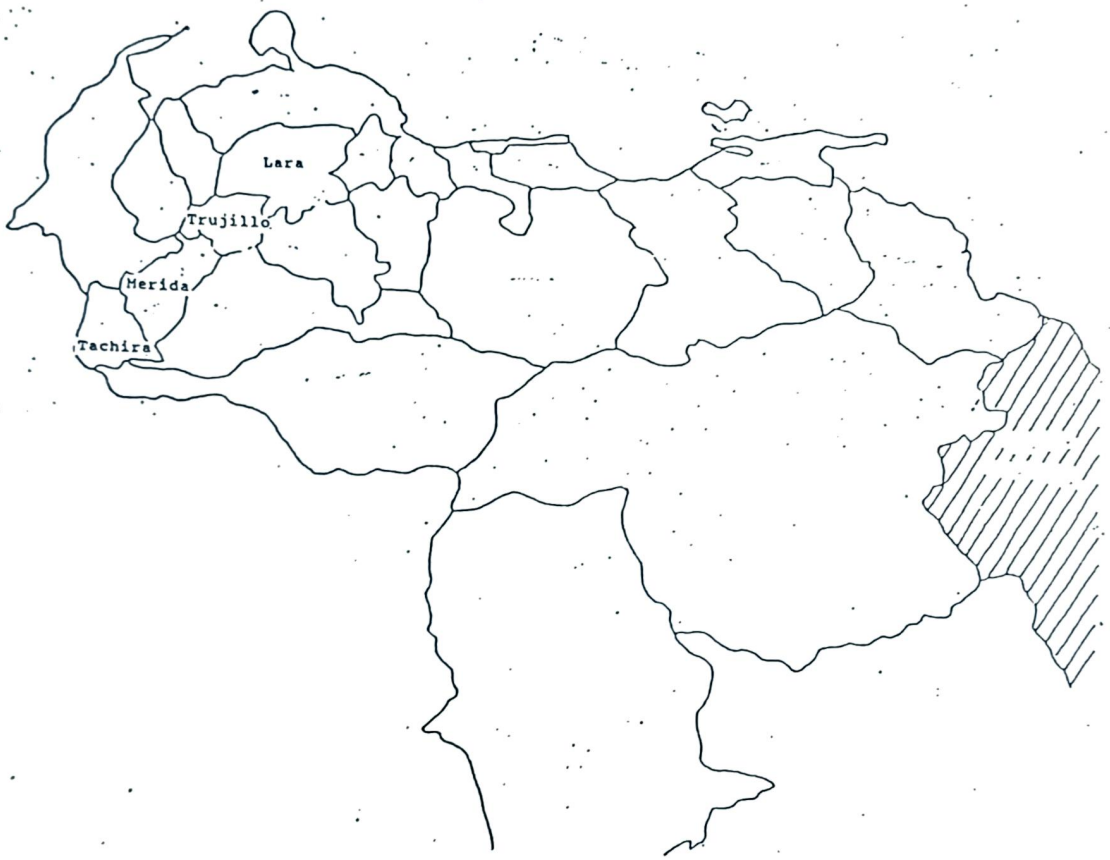

Figure 7. The primary pea-producing states of Venezuela are named on this map. (From Hernandez-Bravo, et al. 1987).

Figure 8. Peas in the Andes are often grown on very steep slopes. Some slopes are too steep even for animal traction. Venezuela.

PRODUCTION PERIODS:

Rainfall, topography and altitude can vary greatly within short distances, so growing conditions and optimum production periods likewise are variable.

October, November and the first part of December are the preferred time to plant peas near Jaji. The soil is too wet earlier and the peas suffer from root rot.

In the vicinity of El Morro, peas are usually planted in April and May because there is insufficient moisture earlier. For those few growers who have access to irrigation, they can plant in December and January.

Near Bailadores and Tovar, peas are planted in February, March and April.

In the mountains above Trujillo, some peas are planted in September and October to provide a little production and income during the time other crops are not normally produced. The growers state that in most cases, the best time to plant peas in this area is February, March and April, when there is more adequate rainfall.

PRODUCTION PRACTICES:

Seed for planting comes primarily from that saved by a grower. It frequently is of poor viability. Farmers would like a source of good quality seed for planting and feel it may have to be imported. Seeds are not treated with fungicide or insecticide nor inoculated with rhizobia before planting.

Pea farmers are apt to grow a range of other crops such as potatoes, maize, wheat, barley, onions, garlic, black beans and carrots. There does not appear to be a common rotation.

Seeds are usually broadcast on soil that has been tilled by oxen or hand to prepare a seedbed. No fertilizer is applied to peas though potatoes, maize and some other crops usually do receive fertilizer. One grower commented that when he did fertilize peas, he did not get his money back.

Peas are usually sole cropped rather than being grown in association with another crop.

Usually some peas are harvested in the green succulent state for home consumption, but most are harvested as dry seed. There is no preservation of green peas by canning. Some varieties reach the green pea harvest stage in two months after planting, and the dry seed stage in three. Others require three months to the succulent stage and four to five months to reach the dry seed stage.

Some farmers reported that hard dry seeds that fail to absorb moisture in cooking can occur in some growing environments. The same seed source planted in two different areas may produce hard seeds in one environment and not in another.

VARIETIES:

Several growers reported that they grow the Criolla variety which requires a long period to reach maturity. This is an old variety and it appears that not all fields considered Criolla have the same characteristics. The Arvejon variety is also grown to some extent and this variety has brown tinted seed coats. In one area, farmers were growing a green cotyledon smooth seeded variety that they thought originated in the United States or Canada. They like it.

One enterprising grower is experimenting with introduced varieties that he obtained through Ranulfo Manchego. During two years of trials, he feels that Alderman is looking most promising.

The characteristics of some varieties observed are:

--Considered to be Criolla variety. Four months required to reach dry seed stage. White flowers. Seeds are reported to have clear seed coats, are smooth and round, and were a mixture of green and yellow. Seed was sold at the market for eating and he planted it.

--Dry seed available for sale. Medium to small size of seed. Smooth and round with yellow cotyledons. A few seeds with dark seed coats and purple spots mixed with the others. The grower was aware that they would produce plants with purple flowers and identified them as arvense (Pisum arvense), often called field pea).

--Plants blooming at node 17. Dwarf vine type. Double white flowers, with a low proportion of plants producing purple flowers.

--Variety identified as Criolla. Most seeds round but with some wrinkled ones mixed in. All with yellow cotyledons. He is aware he has a mixture and would prefer only the round seeds.

--Peas packaged for sale in small village store were available as smooth green or smooth yellow.

--Criolla variety. Mostly white flowers but some colored. Flowering starts at node 18.

--Mixture of plants with white and purple flowers. Node of flowering variable but mostly starts at 20th node. Vines 75 to 100 cm long, several plants with double stems.

Many growers expressed the desire for varieties that would mature in less time than those presently available.

The United States varieties which Ranulfo Manchego passed on to the grower are Little Marvel, Alaska, Dark Skin Perfection, and Alderman.

Other lines available for evaluation are listed in Appendix Item 5.

DISEASES:

The fields of peas we visited were relatively free of diseases. The unthrifty growth of some plants was due more to lack of moisture, low soil fertility and competition from weeds.

Ascochyta is one of the most serious pea diseases. Alternaria is sometimes more severe than Ascochyta in individual fields. Anthracnose is occasionally serious. Some plants were observed with water congestion but this is not a serious problem. Root rots are a problem when the soil is too wet. The causal organism is not known. No powdery mildew was observed and it is not considered a problem. Viruses were not observed, either.

INSECTS:

A leaf miner was observed in some pea fields and is reported to be fairly common and to cause some losses. Another insect identified as Lyriomiza scavies is said to eat holes in the leaves and to burrow within the stem. One grower reported a problem with cutworms.

RHIZOBIA:

Nodulation of plants varied from those essentially free of nodules, or with small white or greenish tinged interiors, to some plants with well developed nodules that had a deep pink to reddish interior coloration.

RECOMMENDATIONS:

1. Soil tests should be taken of a sample of soils to learn the pH and nutrient level status. Sometimes a very small investment in lime or in correcting a nutrient imbalance can return large dividends.

2. Samples of local varieties should be collected and evaluated. It is likely that there are differences in productivity, resistance to pests and maturity.

3. Cultivars obtained from other countries should be evaluated. It will be most efficient if only those most likely to be adapted and accepted are evaluated. These may come from the Colombian evaluation program, other Andean countries, other South American countries, or in some cases from the United States or Europe.

4. No hybridization program is planned and none can be justified at this time.

5. Effective rhizobia should be identified and disseminated to growers. It is likely that effective strains can be maintained in the soil through periodic crops of peas, once they become established.

6. Diseases do not appear to be too serious but it would be desirable to have a plant pathologist take a survey of the most prevalent diseases during the growing season for peas.

7. High levels of resistance to Ascochyta, Anthracnose, Alternaria and root rots are not generally available in cultivars nor germ plasm. Because of the importance of these diseases throughout the Andean region, evaluation of resistance should be a part of all pea evaluation programs.

8. The market demand for type of pea should receive attention. Many cultivars imported from other countries will have wrinkled green seeds. If these will not be acceptable, then a tremendous number of cultivars can be eliminated from evaluation programs. On the other hand, it appears there is flexibility on the part of consumers.

9. Cultural studies looking at plant population, plant spacing (especially broadcast versus row), fertility, pesticide use, weed control, variety, and time of planting should be conducted to provide research results which can be extended to growers.

10. Additional training of researchers in pea production and evaluation is needed.

GENERAL OBSERVATIONS

Peas are widely grown and consumed in the Andean region of Bolivia, Colombia, Ecuador, Peru and Venezuela. Growers in Colombia are accustomed to investing in their production through the application of lime, fertilizer, fungicides and the poles, wires and strings used to support the plants. In the other countries, the primary investment in pea culture is the seed used in planting and the animal and/or human effort expended in the planting operation. In all these countries, potatoes and maize are considered more important and profitable and occupy the best fields. Peas and other grain legumes are often relegated to the poorer fields.

During the last few years there appears to be an increased interest in the grain legumes. The price received by growers for their pea crop has improved over past years and it has again become a profitable crop. There is, in fact, a feeling of enthusiasm for pea research, development and production. Many growers were eager for information on production practices, concerned about pests and expressed a need and desire to see extension and research workers involved with them in pea production. Many growers felt they needed new pea varieties that would be more productive, of a maturity better suited to the area of production, and would possess greater disease resistance. Several felt it would require government help to secure strong viable seed of improved varieties. They thought such seed might have to be imported.

The fields where most peas are grown is not tested for pH or nutrient status. These fields are usually low in fertility and would be more productive if limed and fertilized.

It appears to be relatively common to grow peas in soils that are very wet. Peas are not able to tolerate waterlogged conditions and frequently develop root rot under such circumstances.

Many fields do not contain efficient nitrogen-fixing rhizobia for peas.

Weeds are well controlled in some fields but little or no control is practiced in others. Where weeds are present, they can result in significant yield reduction. Weeds are easier to control in plots that have been planted in rows than when the seed have been broadcast. Herbicides are not generally used in peas.

The most widespread and destructive disease is caused by Ascochyta. The disease causes reduced yield and quality. Control is difficult even with fungicides, and fungicides add to the cost and problems of production. Root rots are common and especially under wet conditions cause stand reductions and unthrifty plants. Fusarium solani is one organism causing root rot but Pythium and Rhizoctonia also are involved. Races of Fusarium oxysporum cause wilt of the plants, and this is a significant problem. The races have not been identified. Powdery mildew is usually present in pea fields, especially as they reach the harvest stage. Generally, there is little loss due to the fungus. Viruses have not been a problem.

Losses are being experienced from stem borers, root borers, leaf miners and cutworms. It appears that effective insecticides are known.

Where the dry grain is sold, the preferred product seems to be round yellow peas of medium to large size. However, peas with green cotyledons are selling well in some localities. Almost all peas consumed fresh produce a light green berry, of the canner type compared to the darker green of varieties developed for freezing.

Most of these five countries have not had very active pea research programs in the past. Recently there is increased interest in peas.

GENERAL RECOMMENDATIONS

1. Soil tests to determine pH and nutrient status should be taken on a sample of soils used in growing peas. These results can be used as a guide to liming and fertilization, where such are economically feasible.

2. There should be more studies with rhizobia. Because nitrogen fixation by rhizobia is the cheapest way of supplying nitrogen to peas, this area deserves more attention. Where effective strains are identified, they should be disseminated to growers.

3. The importance of effective weed control should be emphasized to growers. Weed control would be facilitated with row planting.

4. The effect of plant population needs to be established for the various levels of input and management.

5. Local cultivars should be evaluated and seed supplies of the best increased for dissemination to growers.

6. Promising cultivars from other countries should be evaluated. Where superior, seed supplies should be increased and disseminated.

   CAUTION! Seeds can carry the pea seed borne mosaic virus. This is an extremely dangerous potential. Many seed stocks in the Geneva, New York Plant Introduction Station collection are known to be infected. Efforts are underway to eliminate the virus but this will take time. It is advisable to grow introduced seed stocks in isolation from the resident material, and to watch them very carefully for the presence of the virus. If detected, all plants from this lot and the entire seed lot should be destroyed.

7. The detrimental effects of wet soil on pea production should be emphasized. Growers should be encouraged to select well-drained fields, follow tillage practices that improve drainage and aeration, and be aware of the effect of planting date on soil moisture.

8. Great effort should be expended in arriving at control measures for Ascochyta. This includes the use of fungicides and selection and breeding for genetic resistance.

9. Races of Fusarium should be identified and resistance incorporated into adapted cultivars through breeding. A backcross breeding procedure is appropriate for the transfer of single genes for resistance.

10. A plant pathologist should survey pea fields of each country during the main pea growing season to assess diseases present and the relative importance of each disease.

11. More research should be conducted on pea stem borers, root borers, leaf miners and cutworms. Control measures such as insecticides and management practices need to be devised and applied.

12. A strong breeding and genetics effort should continue at La Selva, Colombia. The level of training, experience, facilities and support at this location exceeds that of the other countries. This has already been designated the lead institution for pea improvement in the Andean countries.

13. Additional training of pea researchers should continue. Training should take place at a number of locations so as to sample a range of knowledge and approaches. Advantage should be taken of the research knowledge available in South American countries, but some visits should also be made to programs or meetings in Europe and/or the United States where there is a long history of pea production and research.

14. As soon as possible, the pea researchers from the five countries should be brought together to get acquainted. Most do not know the other researchers and effective communication and interaction require familiarity.

    I would propose this meeting be held at La Selva, Colombia, since that has been designated the lead institution. This would provide everyone the chance to see the institution and its facilities. The program should include the status of pea research in each country and plans for the next year.

REFERENCE

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A P P E N D I X

INSTITUTO INTERAMERICANO DE COOPERACION PARA LA AGRICULTURA