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Soybean Virus Diseases in Peru

Robert M. Goodman

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International Soybean Program, INTSOY

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Trip Report/Peru

Name of Traveller: Robert M. Goodman
Associate Professor, Plant Pathology

Dates of Travel: 14 April - 28 April, 1980

Itinerary:
- 14 April - Champaign enroute to Lima
- 15 April - Arrive in Lima. Visit INTSOY/Peru offices. Visit Instituto Nacional de Investigaciones Agricolas (La Molina). View soybean breeding and experimental plots.
- 16 April - Meet with Dr. T. Fullerton at INTSOY/Peru office. Travel to Tarapoto. Visit soybean experimental plots near El Porvenir station.
- 17 April - Field trip to soybean fields in Tarapoto area and offices of Zona Agraria San Martin.
- 18 April - Visit soybean plots near El Porvenir. Travel to Lima.
- 19 April - Meet at Lima with Ing. Rodolfo Vargas Saco and Dr. Fausto Cisneros.
- 20 April - Travel to Chiclayo
- 21 April - Visit INIA Vista Florida and Universidad Pedro Ruiz Gallo plant pathologists. View soybean and bean experimental plots. Travel to Lima.
- 22 April - Meet with Dr. Loren Schulze, Dr. M. E. Irwin, and Dr. Fausto Cisneros at Universidad Nacional Agraria, La Molina. Discuss plant pathology personnel in Peru. Work on samples and teach operation of laboratory equipment at INIA/La Molina.
- 23 April - Visit and collect samples from soybean fields at INIA La Molina. Visit Departamento de Sanidad Vegetal, Universidad Nacional Agraria, La Molina.
- 24 April - Visit Sanidad Vegetal, UNA La Molina and Centro Internacional de la Papa (CIP) plant virology personnel.
- 25 April - Discuss observations and recommendations with Drs. T. Fullerton, L. Camacho at INTSOY/Peru office and Dr. L. Schulze at USAID.
- 26 April - Work on report.
- 27 April - Work on report.
- 28 April - Travel to Cali, Colombia.

Summary of accomplishments:

Institutions and locations visited. Orientation and discussion of objectives for my visit were provided by several people. I visited at the beginning and end of my trip with Drs. T. Fullerton, Luis Camacho, and Loren Schulze (USAID). I had valuable discussions with Ing. Rodolfo Vargas S., national coordinator of the Peru soybean project; Dr. Fausto Cisneros, head of Sanidad Vegetal and Dean of Graduate Studies at the Universidad Nacional Agraria (La Molina); Dr. Frederico Scheuch, CIAT bean project coordinator stationed with INIA La Molina; Ing. Manuel Llaveria, Director of INIA CIAG-Central; and Ing. Pompeyo Contreras, Director of INIA CIAG-Norte.

Unfortunately I was unable to meet with Ing. Ricardo Villamonte due to conflicting schedules caused by my delayed arrival in Peru. Dr. Al Harms was particularily generous with his time and information during my stay in Tarapoto.

Field visits were made at La Molina (INIA and Universidad Nacional Agraria), Tarapoto (INIA Station El Porvenir and growers' fields near Tarapoto), and Chiclayo (INIA Station Vista Florida and Universidad Nacional Pedro Ruiz Gallo at Lambayeque). Ings. Feliciano Avalos and Renzo Urdanivia, Dr. M. E. Irwin and I travelled together to Tarapoto and Avalos, Irwin and I traveled together to Chiclayo. Because part of the reason for my trip was to assess the present scientific capabilities and future educational needs of plant pathology personnel associated with the Peru soybean project, I visited with numerous members of the staff of the Depto. de Sanidad Vegetal, UNA La Molina. Ing. Jaime Castillo, Ing. Cesar Fribourg, and Dr. Enrique Fernandez-Northcote were very generous with their time and interest in my visit. Also very helpful was Dr. Luis Salazar, virologist at the Centro Internacional de la Papa (CIP) where I visited briefly.

The following is a list of institutions and persons involved in my visit.

Instituto Nacional de Investigaciones Agrarias
- Estacion Experimental, La Molina
  - Ing. Feliciano Avalos
  - Ing. J. Bruno
  - Ing. Oscar Bullon
  - Ing. Chila Mendosa
  - Ing. Renzo Urdanivia
  - Dr. Frederico Scheuch (CIAT)
- Estacion Experimental, El Porvenir and Zona Agraria San Martin, Tarapoto
  - Ing. Edison Cardenas
  - Dr. Al Harms
  - Ing. Faustino Hidalgo
  - Ing. Homer Tuesta
  - Ing. Antonio Sandoval
  - Biolg. Cesar Valles P.
  - Ing. Viro Yaringano
- Estacion Experimental Vista Florida, Chiclayo
  - Ing. Felix Chicoma
  - Dr. Victorio Garcia
  - Ing. Consuelo Higaonna
  - Sra. Elva Llontop
  - Ing. Flor Pizarro

Universidad Nacional Agraria, La Molina
- Dr. Fausto Cisneros
- M. Sc. Jaime Castillo
- Dr. Enrique Fernandez-Northcote (also CIP)
- M. Sc. Cesar Fribourg (also CIP)

Universidad Nacional Pedro Ruiz Gallo Lambayeque
- Dr. Carlos Panizo

Centro Internacional de la Papa
- Dr. Luis Salazar

INTSOY/Peru Lima
Dr. T. Fullerton
Dr. L. Camacho
Dr. A. Siegel

USAID/Peru Lima
Dr. L. L. Schulze

Background information on soybean viruses. Soybeans are susceptible to infection by many viruses, but fewer than 10 are of current agricultural importance. Which viruses are important depends to some degree on the geographical region under consideration. Soybean dwarf virus, for example, is very important in East Asia but unknown elsewhere in soybean production areas.

The most prevalent soybean virus seen during my visit to Peru was soybean mosaic virus. For various reasons it is likely that if this crop has virus disease problems in the future, soybean mosaic is likely to be one of them. The disease caused by soybean mosaic virus (SMV) was noted in the Western scientific literature as early as 1916 by Clinton, soon after the beginning of serious scientific work in North America to develop improved cultivars. While the world-wide spread of SMV is not documented, most of what is known about the virus and its epidemiology make it likely that SMV was brought with the crop from the soybean center of origin in north central China.

SMV belongs to the large and important potato virus Y (potyvirus) group. The virus particles are flexuous and rod-shaped. The single-stranded RNA genome of the virus is contained within a capsid having helical symmetry and made up of a single type of coat protein subunit. Molecular weights of the RNA and coat protein are 3.25×10^6 and 28,300, respectively.

The physical and chemical properties of SMV are typical of potyviruses. The virus remains infective in plant sap for 2 to 4 days, has a dilution end point titer of about 10^{-3}, and a thermal inactivation point of less than 60°C. The virus is a moderately good antigen; rabbit antiserum titers of 1:2048 to 1:4096 have been reported.

SMV has a relatively narrow host range that, with the exceptions of two species in the genus Chenopodium, is confined to the legume family. SMV is transmitted in the field and in the laboratory by aphids (Homoptera: Aphididae) in a nonpersistent manner and is also seed transmitted in soybeans.

It is seed transmissibility that accounts for the worldwide distribution of SMV. Soybean germplasm collections are repositories of virus as well as soybean germplasm. International exchange of germplasm resources, necessary for continued improvement of the crop, carries a risk of virus spread. Economic consequences of this situation have not been serious in the major soybean growing areas of the world as of the late 1970's. That the virus can do damage, however, is beyond question. Published and unpublished reports of serious epidemics and yield loss caused by SMV in such diverse areas as Korea, Indonesia, Ecuador, the Soviet Union, and Japan, document the potential importance of the disease. The disease is widespread in the southern soybean growing areas of the United States also, and in mixed infection with bean pod mottle virus can cause significant economic loss. Recent reports indicate that SMV is widespread and of concern in Brasil and in mainland China as well.

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In studies on the pathogenic variation of seedborne SMV isolates recovered from the USDA germplasm collections, we found that none of the soybean cultivars with resistance to SMV were resistant to all isolates of the virus. Severity of symptoms induced in susceptible cultivars and the virulence they displayed against SMV-resistant cultivars varied considerably among SMV isolates. Each source of SMV resistance currently in use provides useful protection to only a few of the SMV strains found in the germplasm collections. These results, together with the universal susceptibility of soybean cultivars commonly grown, suggest the obvious possibility that SMV could become a major problem in soybean production. Seed transmission is the primary source of inoculum for field spread of SMV and therefore is a major means of survival from season to season. Seed transmission is also the route by which the virus continues to be spread from one geographical region to another. Seed transmission in soybeans plays a pivotal role in the epidemiology of SMV. The virus is not reported to be seed transmitted in any of its other host plants and to our knowledge does not often occur naturally in species other than Glycine max and its close relatives.

Soybean seeds produced by SMV-infected plants exhibit a characteristic symptom termed mottling. Mottling is a discoloration of the seed coat of yellow-seeded soybeans caused by the bleeding of hilum pigment into other regions of the seed coat. While a symptom of SMV infection of the plant producing the seeds, mottling has long been recognized to be influenced also by environmental and genetic factors. Seed coat mottling is not a symptom of seed transmission, although in one report, among seeds from infected plants, the seed transmission incidence was twice as high for mottled seeds as for nonmottled seeds. There are soybean lines that show seed transmission but not mottling, others that show mottling but no or very low incidence of seed transmission, and many lines in which the incidence and severity of mottling varies significantly from one year to the next. Seed coat mottling, when it occurs, is an indication that the plant producing the seeds was probably infected, but nonmottled seeds from such plants may transmit and mottled seeds may not.

The incidence of seed transmission of SMV in soybeans is affected by two principle factors, viz., the time of infection in relation to plant development and the plant genotype. Seed transmission is reduced or eliminated when inoculation is during or after flowering. Thus, tactics that delay infection until after flowering will reduce the incidence of seed transmission. Another approach is to find genetic resistance to seed transmission. In an extensive recent study of this phenomenon, we screened nearly 900 soybean germplasm accessions from temperate and tropical maturity groups. Nineteen temperate lines and 4 tropical lines were found to have very low incidence of seed transmission. The incidence of transmission in the tropical lines ranged from 0.05 to 0.2%. Since the incidence of seed transmission of SMV in improved cultivars is typically 5 to 20% when plants are inoculated before the onset of flowering, use of germplasm with lower rates of seed transmission offers the possibility of reducing primary inoculum levels by a factor of 10 or more.

It is noteworthy that among tropical soybean accessions there are some with low incidence of seed transmission. Two are named varieties with superior agronomic qualities, Improved Pelican and UFV-1.

Mention has already been made of the mottling of soybean seed coats as a result of infection by SMV. While not strictly related to SMV seed transmission, mottling is an important aspect of the impact of SMV on soybean seed quality, as the discoloration of the seed coat reduces the value of soybeans in commercial trade. Discolored seeds of whatever cause lead to a lower value of the seeds, whether for food or planting the next crop.

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SMV infection also reduces the size of seeds produced by infected plants. Seed size was reduced 10 to 20 percent in experiments conducted at the University of Illinois.

SMV-infected seedlings arising from seeds infected by many isolates of SMV give the appearance of being less vigorous than noninfected siblings. In the field, one often finds that less vigorous infected seedlings from a seed lot with a low incidence of seed transmission lose out in the competition for canopy space and soon are overtaken and shaded out by nearby, more vigorous, healthy plants. Thus, in a season or location where early-season spread of the virus does not occur, the consequences of an occasional SMV infected plant in a seed lot may be ngeligible. One of the interesting epidemiological questions that has not yet been answered is at what level of incidence does seed transmission of SMV become significant. Because soybeans, like other legumes, can compensate when neighboring plants are removed during vegetative growth, severely infected seedlings that are eliminated during the vegatative development of the crop probably could be tolerated at quite high incidence with no loss of yield as long as SMV spread to healthy plants does not occur. Seedlings that are virus infected but are relatively vigorous may result in greater losses, both because they extend the time during which they may serve as sources of inoculum for spread by aphids and because they take up space in the canopy with less potential for seed production due to virus infection. This question is one that will have to be answered by a series of carefully controlled field studies with a variety of SMV strains and soybean cultivars and in a variety different of environments.

There are conflicting reports in the literature about the impact of SMV infection on germinability of soybean seeds. The most recent evidence shows that reduced germination of seeds from SMV-infected plants is caused by infection by Phomopsis sojae, the pod and stem blight pathogen. Some, but not all, soybean cultivars investigated showed a predisposition to P. sojae infection as a consequence of SMV infection and some cultivars ordinarily resistant to infection by P. sojae became susceptible to the fungus when the plants were SMV infected. The ability of seedborne P. sojae to reduce germinability of soybean seeds is well established, and results from controlled inoculation experiments showed that it was the seedborne fungus rather than virus infection that caused loss of germinability in seed lots from SMV infected plants. There is no evidence linking embryo infection by SMV with reduced germination.

SMV is transmitted from plant to plant within the field by members of the family Aphididae (Insecta: Homoptera). Laboratory tests confirm the nonpersistent manner by which SMV is transmitted; using clones of apterous Myzus persicae (Sulzer) maintained in the laboratory, we demonstrated optimum transmission from acquisition probes of 30-60 sec.; rates of transmission were lower with acquisition access of 15 min or longer and with acquisition access of 15 sec or less.

In Asia and parts of Africa, three species of aphids colonize soybean fields, but aphids seldom colonize soybean fields in the rest of the world. However, A. craccivora can form small temporary colonies on soybeans in the high jungles of Peru. The timing and rate of SMV spread in a soybean field is, to a large extent, a function of the activity of transient aphids that land on soybean leaves, probe, move to new plants and probe again.

Status of soybean viruses in Peru. The time of my visit coincided with a relatively minor soybean growing season and only one selva site (Tarapoto) was

included on my itinerary. The analysis I will present here is therefore not in any way comprehensive. To do a proper job of surveying soybeans in Peru for virus diseases, one would also have to visit Jaen and Bagua where large hectarages are planted after rice from August through October and the numerous locations where authorized seed is produced at various times of the year.

No evidence of virus diseases in soybeans was seen in a small planting (about 1 ha) nearing maturity at INIA Vista Florida near Chiclayo. The other coastal site visited, La Molina, had a rather high incidence of soybean mosaic virus (SMV) in some plantings. The germplasm and experimental plots nearby had a very high incidence (over 50% in some lines) and one seed increase plot of the variety National was also infected, probably by aphid inoculation, at a very high incidence. Other plantings had scattered SMV-infected plants. Of potential importance was that a few plants in each of several lines planted at La Molina originally from Brasil were SMV-infected. SMV is a major production problem in parts of Brasil and a recent report indicates that one of the SMV strains common there is quite severe.

At Tarapoto, SMV was found at low incidence in the germplasm plantings and in experimental plots near El Porvenir. It was also present, but at very low incidence, in growers' fields in the Tarapoto area.

No other soybean viruses were seen with the exception one possible case of bud blight (possibly caused by tobacco ringspot virus) found at La Molina. TRSV reportedly occurs in tobacco in the Tarapoto area and if the virus should spread to soybeans it could be serious. There was no evidence of this in the fields I visited, however, and no reports of major outbreaks came to my attention.

Scientists at Tarapoto were diagnosing a soybean disease called machismo, but, based on the symptoms seen in Peru and subsequently in Colombia and discussions with Drs. L. Camacho and M. E. Irwin who are also familiar with machismo as it occurs in Colombia, I believe this diagnosis is incorrect. Machismo is a mycoplasma-induced disease causing gross abnormalities in flowering and severe reduction in pod set. Axillary buds proliferate and small pods, which are borne erect, either fail to develop or develop abnormally with one, typically oversized, seed. In some cases, the immature seeds germinate while the pods are still green. No such symptoms were seen in the fields in Tarapoto.

Numerous cases of physiological disorders, including at least one case of herbicide injury resulting in foliar symptoms similar to those caused by SMV, were seen. I spent considerable time with the Peru soybean staff discussing how to differentiate between such disorders and the symptoms caused by viruses.

With Renzo Urdanivia, I collected more than two dozen samples for laboratory and greenhouse diagnostic work at La Molina and at Urbana. The results of these analyses will form the beginnings of one of the cooperative projects to be undertaken, that of classifying according to virulence on SMV resistant soybean differentials the strains of SMV occurring in the crop in Peru.

Evaluation of plant pathology personnel. The Peru soybean project currently has two part-time plant pathologists, Cesar Valles at Tarapoto (50% time committed) and Renzo Urdanivia at La Molina (10% time committed). Both have backgrounds in general biology. Valles has had some plant pathology training, including the short course in soybean production at INTSOY; Urdanivia has spent some time at CIAT learning virus inoculation and germplasm screening techniques for his work in the CIAT-INIA bean project. Neither of these men has any significant research experience with

viruses and neither have training or sufficient experience in plant disease diagnosi to provide the basis for the research in soybean pathology that will be necessary for a successful soybean project in Peru.

Both Valles and Urdanivia are intelligent and sincere individuals. They appear to be capable of working well together. However, as things now stand, the very limited time commitment to soybean pathology and the combination of lack of experience and lack of the necessary education to design and conduct research indicates, in my judgement, that little if any significant research progress can be expected.

Research and educational resources for plant virology in Peru. In view of the lack of experience and background of the Peru soybean staff in virology, I investigated the resources available for cooperative research and in-country higher educati The Departamento de Sanidad Vegetal, Universidad Nacional Agraria at La Molina has an outstanding research and education program in plant pathology. The faculty of the department includes three virologists, one with a Ph.D. and two with the M.Sc. All three of these individuals are active researchers, one primarily in virus epidemiology, one in virus characterization and serology and one in strain characterization and genetic resistance. The course in plant virology offered by the department is comprehensive, including both lectures and laboratory work. With the cooperation of the virologist at CIP and the use of facilities there (CIP has the only laboratory in Peru equipped to purify and characterize plant viruses - such facilities are lacking even at UNA) students get experience in all aspects of basic and applied virology. Because of its unique combination of faculty, excellent curriculum, and convenient location (the classrooms at UNA, the laboratory facilities at CIP, and the field plots and laboratories of INIA are all within a few minutes walk of each other) UNA offers without question the best choice for advancing the education of the Peru soybean pathology staff.

The courses offered by the department in other areas of plant pathology also are very good. A full listing of the course offerings and the syllabus for the M.Sc. degree for students specializing in phytopathology is in appendix A at the end of this report. In my judgement the quality of this curriculum is as high as many in the U.S. and Europe.

The research facilities in plant pathology at UNA are generally adequate. Ample laboratory space is available, with good microscopes, autoclaves, media preparation facilities, and routine equipment. There are presently no facilities for virus purification, but the virologist at CIP and the two UNA virologists who have joint appointments with CIP welcome occasional work by scientists working in other crops. The facilities at CIP are outstanding. There is an electron microscope laboratory with a JOEL JEM 100-S and a fully equipped virology research laboratory with ultracentrifuges, electrophoresis equipment, equipment and supplies for modern serological diagnosis and for making antisera in rabbits. Some work with insect vectors of viruses is done at CIP. This is mainly with aphids. At UNA, there are presently no facilities for rearing and doing experiments with insect vectors, but a new laboratory funded by CIDA for maize virus research will soon be built for this purpose.

Relationships between institutions at La Molina apparently have a history of being strained, particularily between INIA staff on the one hand and UNA and CIP on the other. At least in virology, UNA and CIP people work together. It is to be hoped that the problems between INIA and the other institutions can be overcome because that is the most sensible way, if not the only way, to strengthen the discipline in INIA.

Recommendations

1. Based on my preliminary observations, there does not seem to be an immediate threat by virus diseases to soybeans in Peru. However, soybean mosaic virus is present and is a potential problem. This virus alone justifies a research effort in cooperation with soybean breeding and other plant protection disciplines; the objective should be to prevent SMV from becoming a production problem in the future. The dangers of not doing so are illustrated by the seriousness of this virus disease in Ecuador and Brasil.

The research program should include the following elements. A complete survey of virus diseases in the principle locations and seasons is needed. Representative fields should be visited at least twice during the season (before and either during or soon after flowering ceases) and disease samples taken for diagnosis. Host range and serology should be used to identify the viruses present. In particular, SMV isolates should be collected and classified according to virulence on soybean differentials having SMV resistance. With information on the prevalent strains of the virus present in Peru, project staff will then be in a position to test advanced lines in the breeding program for reactions to these strains. Breeding material with SMV resistance from the INTSOY virology program and other sources should be included in the Peru breeding program and SMV inoculations should be part of the evaluation and selection process used to advance these lines.

Particular attention should be given to virus diseases occurring in the seed crop (i.e. the fields where soybean seeds are grown for planting in subsequent seasons). SMV and certain other soybean viruses are seed transmitted. Growers and sectoristas should be trained to recognize virus symptoms and taught to remove infected plants. The seed crop should be regularly inspected throughout the growing season (weekly if the incidence is low, twice weekly if it is high) and diseased plants removed. The incidence of seed coat mottling should be recorded for the seed lot from each field and lots with significant mottling (>1%) should not be used for seed purposes.

A good research program would also be on the lookout for new virus disease problems. Virus identification, studies on how the virus is spread, and screening of germplasm for resistance are steps that should be taken while the disease is still at very low incidence.

2. The soybean disease research program should be the responsibility of one or more scientists with education and training in plant pathology. For the virology part of this work, I recommend a M.Sc. level person with 50% time commitment to this crop. It makes sense to combine responsibility for soybean virus disease research and development with similar responsibilities for another crop such as beans or maize, two major crops in Peru in which much virology work is also needed. The type of research skills, much of the traveling needed, and the facilities required are similar for soybeans and the other crops. Thus the educational investment would have a broad impact on the agricultural future of Peru.

The necessary education is available through the UNA La Molina curriculum in plant virology. This is an excellent program and exactly fits the type of education and experience needed by INIA for its crop research programs. The education needed is disciplinary and is not specific to a particular crop. However, if the decision is to prepare someone such as R. Urdanivia who is already on the INIA staff for these responsibilities, it should be possible to plan the thesis research topic to deal with soybean viruses so that useful progress in the INIA soybean program could be made during the time away from the job that study for the M.Sc. would require.

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The personnel development called for in this recommendation could be accomplished by further education for R. Urdanivia, who has already displayed some interest in virus diseases, by assignment of a new graduate from the UNA M.Sc. program who already has the necessary education, or by arranging for part-time work on soybean viruses by one of the experienced virologists presently at UNA (Castillo, Fribourg, or Fernandez-Northcote).

In my opinion, and for the foreseeable future, no significant research progress in plant virology at INIA can be expected if the research staff at INIA continue to isolate themselves from the opportunities to learn from and cooperate with the experienced staff members of UNA and CIP and from the availability of the virology laboratory facilities at CIP. One advantage of having an INIA staff member take graduate work at UNA would be to create closer links between INIA and both UNA and CIP.

3. The soybean virologist should be located at La Molina, at least for the foreseeable future, even if the project continues its emphasis on the selva alta. There are several reasons for this recommendation. The work to be done requires good screen houses and laboratory facilities, both of which are available at La Molina. It will also be necessary for the scientist to make more than infrequent use of the virology laboratory facilities at CIP to prepare virus antisera and to examine samples of new or unknown diseases in the electron microscope. Also, the continued professional interchange that I hope will develop between the soybean virologist and virologists working at La Molina in other crops will be very beneficial to the soybean program.

On the other hand, the soybean virologist must have the support to travel to the selva several times a year to conduct surveys and to train growers and sectoristas. He or she must also be able to participate in the inoculations and evaluation/ selection process in cooperation with the breeding program at its various locations.

4. The work needed in applied virology for soybeans over the next few years does not require expensive or sophisticated equipment or facilities. A good screenhouse that is insect proof, some home-made insect cages, incubators, one for indexing and another for rearing insect vectors, and some routine laboratory facilities which are already available at INIA La Molina are sufficient. Cooperative arrangements for occasional virus purification and preparations of antisera can be made with CIP. Technical advice and assistance, if needed, in serology, insect vector rearing and other more demanding techniques are available from UNA and CIP staff members. What is most important is careful and intelligent decisions about objectives and some practical, well-designed experiments to positively identify viruses, judge their potential impact, determine their mode of spread, and identify cultural or genetic approaches for their control. The research planning should be coordianted with pathologists working on other diseases of soybeans as well as with soybean breeding, entomology and weed science personnel. In particular, entomologists and virologists should work cooperatively to understand virus spread and the role of insect vectors, and breeders and the virologist should work together to identify and exploit genetic resistance.

5. All new soybean accessions brought to Peru, especially from germplasm collections or from other production areas where SMV is a problem (notably Ecuador and Brasil) should be first planted in an isolated area at least 200 m from other soybeans, and monitored throughout the season for seedborne virus infection. Any and all infected plants should be removed and destroyed as soon as they are found to prevent introduction of new viruses or new strains of known viruses into Peru.

PROGRAMA ACADEMICO DD GRADUADOS
UNIVERSIDAD NACIONAL AGRARIA

ESPECIALIDAD DE FITOPATOLOGIA

La Fitopatología es una ciencia dedicada al estudio de las enfermedades de las plantas, su causa, proceso y control. Su propósito es desarrollar nuevos conocimientos a través de la investigación básica sobre las enfermedades de las plantas y aplicar estos conocimientos con el objeto de ayudar a satisfacer las siempre crecientes necesidades del hombre muy especialmente en alimentos de fibra. Es una ciencia multifacética que ofrece una gran diversidad de oportunidades científicas y profesionales cualquiera que sea la inclinación del estudiante ya sea a la botánica, micología, bacteriología, virología, fisiología vegetal, taxonomía, ecología, mejoramiento genético o entomología.

Es estudiante en esta especialidad recibe una preparación teórica y práctica en materias seleccionadas por el Comité Consejero, según su propia inclinación, sin embargo al término de sus estudios de Magister Scientiae, deberá poseer un profundo conocimiento de conceptos fundamentales para poder desarrollarse con eficiencia en programas de enseñanza, investigacón y extensión ya sea en Universidades, Instituciones Públicas o privadas del país o del extranjero.

Los postulantes deberán poseer una preparación adecuada en ciencias básicas y aplicadas a nivel universitario por lo que se exigen ciertos requisitos de cursos para la admisión. Asimismo, en casos necesarios los alumnos graduados se inscribirán en aquellos cursos no graduados que sean básicos para su formación integral.

El alumno graduado tiene la oportunidad de participar en la enseñanza de los diferentes cursos que ofrece la Esppecialidad, así como de realizar su investigación sobre problemas relacionados con los diferentes proyectos que se llevan a cabo, o en los Programas de Investigación en que participa la Especialidad.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE FITOPATOLOGIA

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION

Biología General
Bioquímica General
Botánica General
Estadística General
Fitopatología General
Física General
Fisiología Vegetal
Genética General
Química General e Inorgánica

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Botánica Sistemática
Ecología Agrícola
Entomología General
Fitopatología Agrícola
Meteorología y Climatología
Nematología
Química Orgánica
Métodos Estadísticos I

3. CURSOS GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
SV-661	Micología	Biología General	2-2-3
SV-761	Técnicas y Métodos de Fitopatología	Fitopatología General	3-2-4
SV-762	Hongos Fitopatógenos	Micología Fitopatología Agrícola	3-2-4
SV-763	Fitopatología Avanzada	Fitopatología Agrícola	3-2-4
SV-793	Seminario de Fitopatología I	-	1
SV-794	Seminario de Fitopatología II	-	1
SV-799	Investigación	-	1-6

4. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Código	Cursos	Pre-requisitos	T-P-C
SV-662	Control de las Enfermedades de las Plantas	Química Orgánica Fitopatología Agrícola	2-2-3
SV-764	Bacterias Fitopatógenas	Técnicas y Métodos de Fitopatología	2-2-3
SV-765	Virus Fitopatógenos	Técnicas y Métodos de Fitopatología Fitopatología Agrícola	2-2-3
SV-766	Fisiología del Parasitismo	Técnicas y Métodos de Laboratorio Bioquímica General	2-2-3
SV-796	Problemas Especiales de Fitopatología		1-3
SV-741	Nemátodes Parasitos de Plantas	Nematología	2-2-3

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas recomendables:

Entomología
Estadística
Mejoramiento Genético de Plantas
Biología
Producción Agrícola

Significado de las abreviaturas:

T - Horas de teoría por semana
P - Horas de práctica por semana
C - Número de Créditos

SYLLABI DE LOS CURSOS OFRECIDOS EN LA ESPECIALIDAD DE FITOPATOLOGIA

SV-661 MICOLOGIA (2-2)3
Pre-requisito: Biología General
Introducción al conocimiento de las características morfológicas y fisiológicas más importantes de los hongos poniendo especial énfasis en los grupos más generales que puedan servir de base para estudios especializados.

SV-761 TECNICAS Y METODOS DE FITOPATOLOGIA (3-2) 4
Pre-requisito: Fitopatología General
Estudio de los principios de investigación fitopatológicas incluyendo la aplicación del método científico. Las prácticas incluirán la apreciación de problemas fitopatológicos, revisión de literatura, experimentos y técnicas de laboratorio e invernadero y la evaluación y presentación de datos.

SV-762 HONGOS FITOPATOGENOS (3-2) 4
Pre-requisitos: Micología, Fitopatología Económica
Morfología y Taxonomía de los Hongos Fitopatógenos. Técnicas utilizadas para su identificación. Diagnosis de las enfermedades que producen.

SV-763 FITOPATOLOGIA AVANZADA (3-2) 4
Pre-requisitos: Fitopatología Económica
Un estudio en profundidad de los conceptos básicos de etiología, sintomatología, patogénesis, epifitiología y control de las enfermedades de las plantas.

SV-662 CONTROL DE ENFERMEDADES DE LAS PLANTAS
Pre-requisittos: Química Orgánica, Fitopatología Económica
Evaluación de pérdidas. Control por exclusión, erradicación, terapia y protección. Clases de fungicidas y bactericidas: su aplicación, características deposicionales, fitoxicidad, regulación, métodos de ensayo y mecanismos de acción.

SV-764 BACTERIAS FITOPATOGENAS (2-2) 3
Pre-requisitos: Técnicas y Métodos de Fitopatología, Fitopatología Económica
Morfología, Biología y Taxonomía de las Bacterias fitopatógenas. Diagnosis de las enfermedades que producen.

SV-765 VIRUS FITOPATOGENOS (2-2) 3
Pre-requisitos: Fitopatología Económica, Técnicas y Métodos de Fitopatología
Estudio de los virus de las plantas incluyendo los efectos sobre sus huéspedes. Estudio de transmisión, clarificación, métodos de purificación, determinación de sus propiedades, naturaleza química, estructura y multiplicación. Diagnosis de las enfermedades que producen.

SV-766 FISIOLOGIA DEL PARASITISMO (2-2) 3
Pre-requisitos: Técnicas y Métodos de Fitopatología, Bioquímica General
Estudio de los conceptos fundamentales e información reciente sobre la fisiología del parasitismo

SV-741 NEMATODOS PARASITOS DE PLANTAS (2-2) 3
Pre-requisitos: Fitopatología Agrícola y Nematología
Estudio detallado de los nemátodos que atacan a las plantas cultivadas.