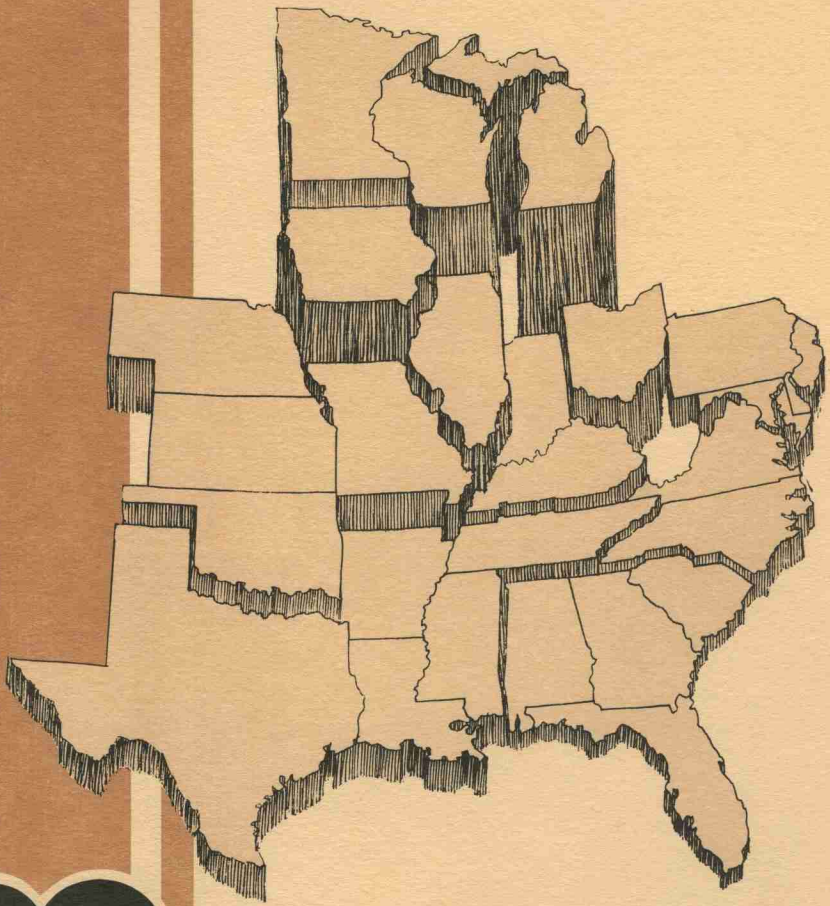


80 Soybean Research

Supported by Soybean Growers

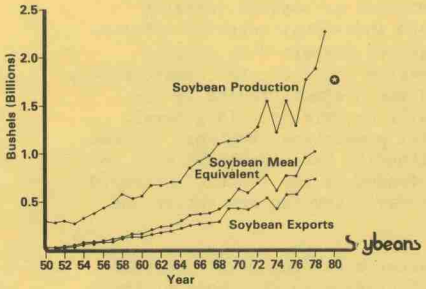
American Soybean Association

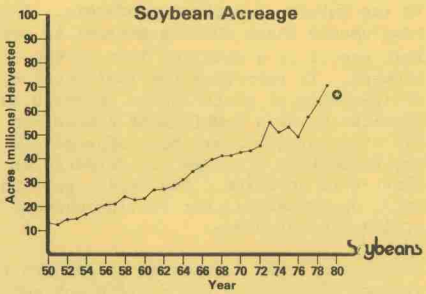
Fall 1980

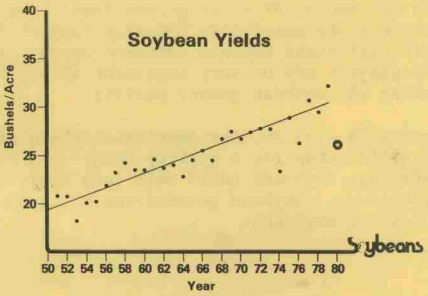
This report summarizes the research supported by soybean growers in 1980. The financial support of soybean research is critically important in times of tight budgets and expanding research needs.

Soybean production, like agriculture, is at a crossroads; do we continue our expansion or will there be a leveling off in production? The three charts tell an impressive story: Soybean production has risen significantly in the past 30 years. This increased production has been due to two factors: (a) increased soybean acreage and (b) increased soybean yields.

Many economists now think cropland for soybean production may have reached a point where expansion will be less dramatic than in previous years. The same economists also predict that demand for soybeans will continue to increase. As the opportunity to increase acreage decreases, future production increases must come from increased soybean yields. Developing the resources to increase yields will take a real funding commitment.







There are several factors working against yield increases:

Weather We must learn more about the soybean to better engineer a plant which can perform under stress environments.

Energy Costs New cultural practices must be developed which will allow for improved yields and be less dependent on fossil fuel.

Decreasing Acreage Base Reduction Research must keep soybeans profitable in order to compete for available land.

Soil Erosion Research must bridge the gap between conservation tillage and soybean yields -- we must find ways to reduce soil erosion losses and, at the same time, improve yields.

Management We must put to practice innovative cultural systems which maximize yields.

Inflation Not only are the soybean inputs becoming more expensive, but inflation is having a devastating effect upon research -- research costs are escalating while research administrators are cutting budgets.

Public Apathy Many persons do not recognize the need to increase yields and the yield influence on production costs and profits.

Because of these challenges, grower investment boards can look with pride and confidence that their investment in soybean research is vital to the future of soybean producers. Investment in soybean research complements state funding sources to expand individual research efforts. This report is a detailed list of the research supported by soybean growers. In reviewing the individual research projects, the complementary relationship of state-funded research and the projects funded by the American Soybean Development Foundation will be evident. In general, the state projects are more appropriate for production problems, whereas, the Foundation programs are directed at studying basic problems with no short-term solution. The basic research funded by the Foundation should offer opportunities for solving many of today's soybean production and utilization problems.

Please avoid the temptation to compare research funding levels between states. Each state has a different set of circumstances. Some of these variables may include the amount of state grower funds available for research, differences in state university research support from non-grower funds and individual state soybean research needs. In some states, even a single project may be very important if the research is successful in increasing the soybean grower profits.

With an aggressive research program, the American soybean grower can continue to meet the world needs for a quality edible oil and protein. Without aggressive funding, soybeans could well lose their dominant role in this nation's agriculture. Soybean growers can be proud of their investment in the future of soybeans.

Keith J. Smith
Director of Research
American Soybean Association

ALABAMA SOYBEAN PRODUCERS — 1980

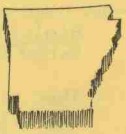
Competitiveness and control of weeds in soybeans
R. H. Walker and E. R. Jolley (Auburn University)

Primary objectives are as follows: Determine the most effective control system(s) with present herbicides and cultural practices for control of broadleaf weeds such as sicklepod, cocklebur, annual morning glories, balloon vine, hemp sesbania, coffee senna and prickley sida; evaluate experimental herbicides for their control potential of grasses and broadleaf weeds in Alabama and feasibility for use; determine biological characteristics and competitiveness of hemp sesbania, balloon vine, wooly croton, tropic croton and jimsonweed, as well as specie and ecotype shift in pigweeds; determine the validity of weed threshold levels as used in integrated pest management systems; and evaluate experimental growth regulators for soybean yield enhancement. ($25,000)

The effect of pesticide combinations and their interactions on yields and non-target pests of soybeans
B. A. Backman, (Auburn University)

The primary objectives are to determine the effects of soybean foliar fungicides on target and non-target soybean diseases, insect populations and yield; study the interaction of soybean varieties with the performance and yield benefits from applications of fungicides, nematicides and herbicides; develop an integrated pest control program which will optimize yield with minimal pesticide use; evaluate control measures for cyst and root knot nematodes; evaluate fungicides for control of soybean diseases and determine which diseases cause significant disease losses; and evaluate airplane application techniques with an aim of improving disease control with a minimum of spray volume. ($20,000)

Research Funded in State	$45,000
ASA Research Foundation	5,000
Total Research Investment	50,000



ARKANSAS SOYBEAN PROMOTION BOARD — 1980

Developing of higher yielding soybeans through breeding
C. E. Caviness, H. J. Walters, R. D. Riggs and A. J. Mueller (University of Arkansas)

Search for strains with high yield potential, disease, nematode and insect resistance in population from crosses between parents that are genetically diverse using single seed descent, intermating techniques and other contemporary breeding procedures. Develop, through breeding, new strains with different combinations of narrow leaves, upright leaves, semideterminate growth habit, large number of seeds per pod and large seeds in an attempt to increase seed and forage yields. ($31,678)

-- new complementary projects--

Soybean variety development for narrow rows

K. D. Beatty (Northeast Research & Extension Center) and C. E. Caviness (University of Arkansas)

The objectives are to develop superior soybean varieties specifically adapted to narrow row culture (20" or less); determine plant (phenotypic) characters of specific genotypes that contribute to greater productivity when planted in narrow rows; and determine the inheritance of plant characters which control favorable yield response in genotype adapted to narrow rows. ($20,680)

Improved precision for state soybean variety testing program

D. E. Laonger (University of Arkansas) and A. M. Simpson, Jr. (Northeast Research & Extension Center)

The objectives of this project are to enlarge the existing soybean variety testing program to incorporate a larger number of entries as necessitated by the presently large number of public and private varieties. This needs to be accomplished without sacrificing accuracy and statistical precision; and to develop the proper methodology in experimental design and handling of harvested material so that experimental error will be minimized and suspected block X treatment interactions detected. ($12,603)

Control technology for diseases, nematodes and insects of soybeans

H. J. Walters, R. D. Riggs and A. J. Mueller (University of Arkansas)

Determine parameters for the use of fungicides to control foliar diseases, develop techniques for testing resistance to diseases, search for disease resistance and evaluate other disease control methods. Examine effects of new chemicals in reducing populations of nematodes and increasing yields, study effect of rotation and other practices on nematode populations and determine economic interaction and initiate studies to determine threshold levels for certain nematodes. Refine existing demand thresholds for the major insect pests and determine injury levels for species where thresholds are lacking with special emphasis on the beet army worm and the three cornered alfalfa hopper. ($65,350)

--new complementary projects--

Biological organisms controlling root rots, etc.

Walter K. Slabaugh (Southeast Research & Extension Center)

This research will isolate, identify and characterize biological agents present in the soybean rhizosphere which will control organisms causing rots in Arkansas soybean production areas, survey soils for the presence of Phytophthora races not previously reported to occur in Arkansas soybean production areas. ($13,200)

Establishment of microplots for nematode threshold level studies

R. T. Robbins (University of Arkansas)

The objective of this research project is to estimate the number of microplots needed and then introduce nematodes at different population densities. The highest priority will be placed on solving the most economically important nematode problems which, at present, is

the soybean cyst nematode. The importance of these nematodes to the production of soybeans needs to be established. ($14,080)

Evaluation of water and microclimate conditions limiting soybean yields

D. A. Brown, H. D. Scott, J. A. Ferguson and C. A. Stutte (University of Arkansas)

Determine the variations in water and energy flows and the microenvironment induced by variable soil moisture levels in the field. Evaluate yeilds through use of selected plant growth regulator chemicals. Determine the extent to which nutrient and water stress conditions after the efficiency of nitrogen fixation and losses. ($71,670)

--new complementary projects--

Evaluation of the influence of tillage pans on soybean yields and in-the-row subsoiling

T. C. Keisling (Southeast Research & Extension Center)

The objective of this project is to evaluate the influence of tillage pans on soybean yields and investigate the value of in-the-row subsoiling as a tillage practice on several Arkansas soils. ($6424)

Enhancement of soybean yield potential by improving production systems

D. Oliver, F. Collins, C. Stutte, R. Talbert, B. Frans and E. Matthews (University of Arkansas)

Develop soybean production systems that would lead to yield enhancement through integration of new research data into alternate cultural practices. Determine effect of weed populations and duration on competition on soybean growth systems for specific weeds. Improve herbicide practices by determining how herbicide performance and selectivity is affected by soil type, application procedure, weed species and growth stage, etc. Evaluate "wide bed" planting. Develop herbicide recommendations for doublecropped soybeans using no-tillage and conventional methods. Develop strategies for ameliorating plant responses to environmental conditions which are adverse to optimum yields. To develop and evaluate new application equipment and methods. ($68,900)

-- new complementary project --

Applied soybean management: pest management, rotations, agronomic factors

R. H. Crowley, T. C. Keisling, W. R. Seabuagh (Southeast Research & Extension Center), G. J. Musick and R. D. May (University of Arkansas)

The objectives of this project are to evaluate the influence of soybean cropping rotational systems on pest management requirements and pest population dynamics; evaluate the influence of tillage practices on pest management requirements and pest populations in soybean production; evaluate the economic returns associated with alternative cropping systems, pest management levels and reduced tillage in soybean production; characterize changes in soil productivity factors such as organic matter content, infiltration rates, pore size distribution and water stable aggregates resulting from

various cropping rotation systems in combination with reduced tillage practices; and to investigate the use of the computer to improve timeliness of application pesticide and agronomic practices, effectiveness of pest control, and reduce pesticide cost. ($36,388)

Breeding soybeans especially adapted to high soil salt content, low fertility and extremes in pH
(University of Arkansas)

This research will develop soybean varieties adaptable to stress soils. ($41,232)

Improving the quality of soy oil by alternative processing
H. E. Snyder (University of Arkansas)

The objectives of this project are to overcome flavor defects in soy oil and thereby to improve the marketing position of soybeans; to maintain the nutritive value of soy meal; and to minimize energy expenditure in processing. ($35,795)

Plot combine

Supplemental appropriation for the purchase of a plot combine. ($22,000)

Irrigation system - Pine Tree Station
H. J. Walters (University of Arkansas)

The objective is to install an overhead irrigation system at the Pine Tree Station to develop disease control methods. ($10,000)

Research Funded in State	$450,000
ASA Research Foundation	25,750
Total Research Investment	475,750

FLORIDA SOYBEAN ADVISORY COUNCIL — 1980

Extension soybean thrust program
Dr. J. L. App, (University of Florida)

Purchase of 8 CO_2 backpack sprayers for demonstration purposes. Used by County Extension service specialists. ($8,300)

Supplemental funds from soybean breeding line demonstrations and cultural management projects. ($1,600)

Interactions of defoliating insects and soybean plants
Dr. C. S. Barfield (University of Florida)

Dr. Barfield's research is a part of a large program in IFAS to develop IPM procedures for soybeans. In particular, he is measuring lead consumption rates by fall armyworm and velvet bean caterpillar across a broad range of temperatures. ($2,000)

Utilization of soybeans in animal feeding systems
Dr. R. P. Bates and Dr. R. H. Schmidt (University of Florida)

This is an ongoing project to determine better methods for using soybeans in the diets of domesticated cattle, especially dairy cattle. Attention is given to improved flavor of soybean products. ($2,800)

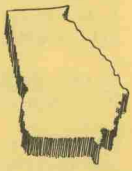
Evaluation of soybean varieties and breeding lines
Dr. H. A. Peacock and Dr. R. A. Kinloch (University of Florida)

Varieties and breeding lines of soybeans are evaluated under northwest Florida conditions. Special attention is given to the development of nematode (root-knot and cyst) resistance. ($2,500)

Integrated pest management and breeding program for soybeans
Dr. I. D. Teare (University of Florida)

This research is a part of the large national program to develop IPM procedures and better varieties of soybeans. Attention is devoted to insect resistance, biological control of insects, disease build-up, fertility and irrigation practices. ($2,900)

Research Funded in State	$20,100
ASA Research Foundation	1,500
Total Research Investment	21,600



GEORGIA AGRICULTURAL COMMODITY COMMISSION FOR SOYBEANS — 1980

Water stress effects on soybeans and its alleviation through use of surface residue mulches
J. E. Hammell (University of Georgia)

Investigate the effects of a surface residue mulch on stored soil water under a soybean crop. Determine the effectiveness of surface residue mulches in alleviating water stress in soybeans during short periods of drought. Investigate the effects of water stress on crop photosynthesis. ($5,000)

Control of the soybean cyst nematode in Georgia
R. S. Hussey, H. R. Boerma (University of Georgia)

Develop maturity group VII & VIII soybean cultivars with resistance to SCN, Races 3 & 4 and root knot nematodes (Meloidogyne incognita & M. Arenaria). Determine the influence of temperature on SCN activity and infertility under greenhouse and field conditions. Develop soybean genotypes tolerant to SCN and race independent. Determine the efficacy of fumigant (EDB) and nonfumigant (Nemacur, Furadan, Temik) nematicides on controlling SCN. ($10,400)

Weed control in soybeans
P. A. Banks (University of Georgia)

The objectives of research are to reduce the loss of yield and quality of soybeans associated with weed infestations. This will be accomplished by evaluating new herbicides, application methods and soybean production practices. ($5,600)

Soybean weed control research
W. S. Hardcastle (University of Georgia)

Requested equipment for research projects already underway. ($11,303)

Multiple-cropped, minimum-tilled soybeans
J. T. Touchton (University of Georgia)

Research is designed to evaluate the relationship between soil fertility levels and nodule growth and production; nitrogen placement on growth and production of late planted soybeans; and the use of winter legumes as a no-tillage mulch. ($5,000)

Nitrogen fixation of soybeans
J. Giddens (University of Georgia)

Nitrogen fixation of soybeans with superior photosynthesis will be studied to obtain more information on selection of higher yielding varieties. Study the effect of various crops (10) following soybeans on persistence of soybean nodule bacteria. Study high inoculant application of an effective Rhizobium, strain to form nodules rather than an ineffective strain. Study acid resistant strains of Rhizobium and their interaction with soybean cultivar. ($6,200)

Water requirements and physiology of soybean projects
D. A. Ashley (University of Georgia)

Research objectives are to determine how late soybeans can be planted and receive reasonable yields and determine yield response from irrigated and non-irrigated beans planted in late season. The research will identify plants with high photosynthesis and high yield potential and to determine why plants with high photosynthesis have high yields. ($8,800)

Breeding soybeans for Georgia
H. R. Boerma (University of Georgia)

This research will make crosses among domestic and exotic strains with desired characteristics. Use the single seed descent breeding procedure to obtain a rapid generation advance. Make plant selections in the F_4 and F_5 generation and grow the progency rows at Athens, Georgia. Evaluate elite progency under full season conditions at Athens, Midville and Calhoun, Georgia. Advance the elite selections to the State and Regional Testing Program. Repeat the above procedure except to evaluate lines under a doublecropping situation. ($20,000)

Management practices for soybeans planted extremely late
M. B. Parker (University of Georgia)

Objectives of this project are to evaluate soybean varieties at early and mid-July and early August planting dates to determine the effects of row spacing, irrigation, seeding rates and nitrogen rates on soybeans in mid-July. ($6,000)

Weed science in soybean production on southeastern coastal plain soils

C. C. Dowler (University of Georgia)

The research objectives are to continue studying and measuring the effect of selected integrated pest management programs in intensive cropping system utilizing soybeans with other agronomic and horticultural crops; study the effect of selected weed control systems in a doublecropping corn-soybean sequence on crop production and weed population; to study the effect of tillage practices and integrated pest management on soybeans and other crops grown in rotation under irrigation; to measure the effect of specific herbicides on production in a long-term corn-soybean rotation on soybean growth characteristics, nutrition and production, soil chemical residues and oil microbiological dynamics and conduct primary, secondary and terminal evaluation of selected herbicides or herbicide combinations on soybeans with emphasis on developing economical and effective weed control systems for controlling the broad weed spectrum. ($5,000)

Root development of soybeans as affected by water management in the vegetative stage

J. E. Hook (University of Georgia)

The purpose of this research is to examine rooting depth and densities in response to soil and water conditions under various management practices and to compare root development in the vegetative state with above ground growth and with yield. ($5,500)

Breeding soybeans for nematode and insect resistance

S. H. Baker (University of Georgia)

This research is to develop superior varieties, breeding strains and genetic stock which are resistant to certain nematodes and insects and study the inheritance of resistance which has not been previously determined. ($4,700)

Nematode control on soybeans

N. A. Minton (University of Georgia)

This research will study the interaction of corn hybrid, soybean varieties, and nematicide. Also will evaluate candidate nematicides and study the effects of nematode populations and soybean yields of different nematicides applied under different soil tillage systems. ($6,500)

Trap crop principle as a management tool for control of stink bugs in soybeans

J. W. Todd (University of Georgia)

Research objectives are to determine most suitable variety to use as trap crop component, determine planting dates, planting rates and whether or not main crop and trap crop can be planted at the same time with no loss of trap crop effectiveness; determine optimum time to treat an infestation in the trap crop in order to prevent infestations of main crop; evaluate short maturity varieties which offer potential for use in trap crop situations; study the maturing and dispersal behavior of stink bugs, to find ways of interfering with host finding behavior in stink bugs. ($6,750)

Soybean diseases and seed quality research
D. V. Phillips (University of Georgia)

To develop a standard procedure to determine germination and vigor of the seed lot than can readily correlated with actual field performance. ($5,200)

Recalibration of soil testing and leaf analysis norms for soybeans
M. E. Sumner, C. O. Plant, R. Isaac (University of Georgia)

Research objectives are to generate a data bank of soil and leaf analyses for soybeans together with crop yield and quality and environmental parameters which can be used as a basis for developing diagnostic norms; to develop a set of leaf and soil norms which are capable of diagnosing insufficiencies, excesses and imbalances among major and minor essential elements and are calibrated in terms of soybean yield; to develop a set of remedial norms which are calibrated in terms of the quantities of nutrients which must be applied in order to correct diagnosed insufficiences, excesses and imbalances on a particular soil; to establish fertilizer field experiments which can be used to test the validity and applicability of the leaf and soil norms developed above and to study the interaction of nutrients and seasonal and environmental effects. ($8,000)

Research Funded in State	$119,953
ASA Research Foundation	15,000
Total Research Investment	134,953

ILLINOIS SOYBEAN PROGRAM OPERATING BOARD — 1980

Genetic control of the soybean cyst nematode
O. Myers Jr. (Southern Illinois University)

Study the environmental and soybean production practices which affect the amount of damage caused by nematodes. Objective is to develop nematode damage resistant soybean cultivars. ($48,510)

Technician in plant breeding
O. Myers Jr. (Southern Illinois University)

Funds to provide support of a technician to assist Dr. Oval Myers. ($6,000)

Genetic, chemical and cultural control of races 3 and 4 of the soybean cyst nematode
D. I. Edwards (SEA/USDA, University of Illinois)

Study to evaluate soybean varieties, cultural practices, chemical nematicides, etc., in minimizing nematode damage. ($14,740)

Soybean breeder program
C. Nickell (University of Illinois)

Funds to provide support for professional plant breeding, technical assistance and operating funds. ($75,788)

A regional program of applied research and demonstration for Western Illinois and research-demonstration technician for Roskamp, Gardner and Palmer
(Western Illinois University)

Funds to support the research-demonstration program at Western Illinois University including experimental tests or demonstrations on soybean herbicides, commercial and public cultivators, growth regulators, planting systems to improve canopy architecture, hail damage and fertilizers. ($22,000)

An analysis of alternative physical and chemical soil amendments to improve soybean emergence in crusting-type soils
R. L. Wolff (Southern Illinois University)

Study to determine the relationship between crust hardness and soybean seedling emergence and subsequently determine under what conditions and the benefits of amending the soil by mechanical, chemical and biological means. ($7,607)

Support of chemist to assist with research on soybean breeding and genetics program
H. H. Hadley and T. Hymowitz (University of Illinois)

Develop techniques for rapidly screening soybean germplasm collections for various economic traits. ($26,288)

Genetics of plasmids in rhizobium japonicum
M. A. Cole (University of Illinois)

Characterize a genetic exchange in Rhizobium japonicum which can be used to increase the nodulation and nitrogen-fixing potential of this organism. ($12,925)

Soybean production research
(University of Illinois)

Evaluate new management practices or management systems specifically oriented toward maximizing grain yield or economic return; and conduct field studies to determine how genetic variation within the soybean species can be used to improve productivity. ($15,400)

Extension agronomist -- soybean extension program
G. Pepper (University of Illinois)

Soybean production, marketing and utilization specialist to assist County Extension Advisors. ($44,260)

Breeding soybeans for virus resistance and seed quality
R. L. Bernard (University of Illinois)

Identify genes controlling the known sources of soybean resistance to soybean mosaic virus and transfer this resistance to soybean varieties adapted to Illinois; develop selection techniques for the non-seed-transmitting type of resistance to soybean mosaic and for resistance to bean pod mottle virus and to use them to select for improved resistant soybeans; and to evaluate this resistant material for possible improved yield, seed quality, or other agronomic improvement. ($23,485)

Soybean germination: The effects of environmental stress on energy production and the expression of vigor by storage and embryonic tissue

D. E. Koeppe (University of Illinois)

Determine the role of the energy inefficient alternate oxidase in the expression of soybean vigor. ($22,749)

Characterization of organic compounds in the soybean rhizosphere

W. L. Banwart, J. J. Hassett and J. D. Paxton (University of Illinois)

Classify organic compounds in the rhizosphere of the soybean plant; identify compounds that are potentially biologically active; and analyze the rhizosphere of the soybean plant for phytoalexins that have been shown to regulate disease resistance. ($24,853)

A critical study of the effects of water stress on nitrogen metabolism and growth during key stages in the life cycle of selected soybean cultivars

J. H. Yopp and J. K. Leasure (Southern Illinois University)

Determine, by means of a new system of inducing controlled water stress, the stages in the life cycle of the soybean that are most sensitive to drought conditions; critically study the effect of water stress on the phases of establishment of a functional nitrogen-fixing symbiosis between the soybean and the Rhizobium bacterium; monitor the changes in nitrogen fixation and metabolism, key physiological drought responses and overall growth following induction of water stress during specific stages in the soybean life cycle; and compare the responses to water stress as given above in selected cultivars of soybean. ($17,064)

Pheromone-regulated reproduction in the soybean cyst nematode Heterodera glycines Race 3

L. W. Bone (Southern Illinois University)

Examine the natural reproductive process in the soybean cyst nematode Heterodera glycines; investigate the role of pheromones in the reproductive and population biology of this pest worm; study the regulation of pheromone communication to host plant, nematode and environmental factors; extract, isolate, purify and identify the chemical nature of the pheromone(s) of H. glycines; and design experiments to determine the feasibility of disrupting cyst nematode reproduction through manipulation or blocking of pheromone-based reproduction. ($21,175)

An investigation of the feasibility of using soybean oil as a diesel fuel substitute

R. L. Wolff, J. Chen and L. Solverson (Southern Illinois University)

Investigate the feasibility of using soybean oil as a diesel fuel substitute and determine the economic implications. ($13,332)

Nonpetroleum fuels for diesel engines
C. E. Goering (University of Illinois)

Screen nonpetroleum blends of vegetable oils and agriculturally derived solvents as to suitability as fuel for diesel engines; and further evaluate the most promising blends in preliminary engine tests. ($16,000)

Grant to Western Illinois University

Support ongoing soybean research being carried on at Western Illinois University. ($15,000)

Grant to the University of Illinois Department of Plant Pathology
R. E. Ford

Support an ongoing program of soybean research in plant pathology. ($20,000)

Grant to the University of Illinois

Support a plant pathologist for the AES-AR/SEA field research on corn-soybean methods. ($20,000)

Grant to the University of Illinois Plant Clinic
($3,000)

Grant to the University of Illinois Department of Foods and Nutrition
B. Klein

Support ongoing soybean utilization research. ($15,000)

Grant to the University of Illinois

Support exploration for wild relatives of the soybean which would have real potential for future soybean research. ($5,000)

Grant to the University of Illinois Department of Food Science
M. Steinberg and L. S. Wei

Support ongoing soy foods research. ($10,000)

Grant to the University of Illinois
J. Widholm and M. Cole

Support ongoing soybean research. ($10,000)

Grant to the University of Illinois
M. Kogan and D. Kuhlman

Provide funding for the publication of "A Manual on Integrated Pest Management for Soybean Insects in Illinois." ($25,000)

Grant to Southern Illinois University

Support ongoing DNA research. ($20,000)

Grant to Southern Illinois University

Support ongoing soybean research at Southern Illinois University. ($10,000)

Grant to the University of Illinois
G. Pepper

Provide funding for the publication of a "Soybean Production Manual." ($35,000)

Grant to Organizational Committee for the Establishment of an International Soybean Institute

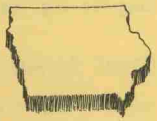
Support a feasibility study for a proposed International Soybean Institute. ($15,000)

Grant to Food Protein Council

Provide funding for production and distribution of a filmstrip for a Junior High School Soy Protein Educational Program. ($12,500)

Research Funded in State	$627,676
ASA Research Foundation	47,500
Total Research Investment	675,176

IOWA SOYBEAN PROMOTION BOARD — 1980



The relationships among lengths of developmental periods, degrees of photoperiodic sensitivity and seed yield in soybeans
D. E. Green and R. M. Shibles (Iowa State University)

The objective of this project is to assess the range of lengths of vegetative and reproductive periods of photoperiodically sensitive and insensitive soybean lines to determine the effects on vegetative and seed yield. ($15,000)

Characterizing and modifying the location of soybean roots within the soil profile
H. M. Taylor and D. K. Whigham (Iowa State University)

The objective of this research is to locate soybean genotypes that will extract more water from the soil profile each year. ($12,108)

A comprehensive soybean breeding program for Iowa
W. R. Fehr (Iowa State University)

The overall objective is to develop improved soybean varieties to include yield improvement genetic diversity, phytophthora rot resistance, brown stem rot resistance, iron chlorosis resistance and protein improvement. ($87,795)

Selective evaluation of soybean germplasm
R. G. Palmer (Iowa State University)

The objective of this project is to evaluate "land races" of soybeans from foreign countries as possible sources of germplasm for breeding programs and mutants to use in chromosome mapping.

Improving oil quality by plant breeding
E. G. Hammond (Iowa State University)

The objectives of this research are to reduce the amount of linolenic acid in soybean oil by plant breeding so that an oil of greater stability will result and to investigate the effect of glyceride structure on the stability of soybean oil.

Increasing soybean yield by delaying leaf and nodule senescence
J. Imsande (Iowa State University)

The objectives of this research are to establish and compare the temporal (seasonal) profile for nitrogen fixation as exhibited by wild type soybeans and by isogenic lines for both male sterility and determinent growth; determine the cause for the apparent rapid increase and subsequent rapid decrease in the rate of nitrogen fixation in soybeans; use hydroponically grown soybeans and our newly devised non-distruct assay for nitrogen fixation to establish the total amount of nitrogen fixed by an average soybean plant of each of seven different genotypes; and, calculate in terms of photosynthate and plant growth the cost to the plant of fixing its own nitrogen. ($20,275)

Determining feasibility of continuing cropping of brown stem rot (BSR) and soybean for BSR control and higher yields
A. H. Epstein and H. Tachibana (Iowa State University)

The objectives are to determine the effectiveness and feasibility of continuous cropping of BSR resistant soybeans for disease control and higher yields and determine the relationship between moisture stress, BSR and yield. ($35,700)

Control of seed diseases of soybeans in Iowa
D. C. McGee (Iowa State University)

The objectives are to determine the time of infection of soybean seed with Phomopsis and the cultural and environmental factors which favor seed infection; determine relationships between the degree of soybean pod infection with Phomopsis and the subsequent degree of seed infection with the view to using pod infection as a means of predicting the need for fungicide application; determine the relationships between the species of Phompsis which cause stem symptoms and those which cause pod and seed symptoms; and, determine the non-pathogenic fungi, prevalent on soybean seeds which have potential in controlling pathogenic fungi on soybean seeds. ($18,509)

Improvement of physical seed quality in soybeans
J. S. Burris (Iowa State University)

The objectives of this project will be the characterization of the agronomic and physiological parameters involved in the increased presence of soybean seed etching and the determination the role etching may have in increased susceptibility of mechanical damage. ($5,000)

Certification of soybean seed for soybean mosaic virus
J. H. Hill and D. P. Durant (Iowa State University)

The objectives are to establish the sensitivity level of the SPRIA for detection of SMV in seed and establish the maximum tolerance level for seed infected with SMV in seed lots which will not result in significant yield reductions. ($15,481)

Nematodes attacking soybeans in Iowa
D. C. Norton (Iowa State University)

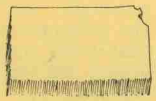
The objectives are to identify the race(s) of soybean cyst nematode in Iowa and evaluate the occurance and damage of the lesion nematodes (Pratylenchus hexincisus and P. scribenri) to soybeans in Iowa. ($20,000)

Biochemical basis of differences among soybean varieties for iron deficiency chlorosis on calcareous soils
C. L. Tipton, J. J. Hanway and W. R. Fehr (Iowa State University)

The objective of this research is to determine the biochemical basis of differences among soybean varieties for iron deficiency chlorosis on calcareous soils. ($15,132)

Research Funded in State	$245,000
ASA Research Foundation	82,000
Total Research Investment	327,000

KANSAS SOYBEAN COMMISSION — 1980



Development of Kansas-adapted disease resistant soybean cultivars
W. T. Schapaugh, Jr. and F. W. Schwenk (Kansas State University)

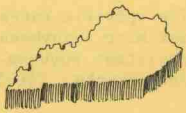
This research will expedite the development of new soybean varieties especially adapted to Kansas soil and growing conditions through the use of winter nurseries, increased technical assistance and the use of new techniques in disease screening. ($29,695)

Evaluation of the breeding strategy used to develop tall indeterminate, short indeterminate and determinate soybean varieties adapted to Kansas
W. T. Schapaugh, Jr. (Kansas State University)

This research will determine if present evaluation techniques effectively evaluate breeding lines which may be useful in narrow row production, or doublecropped after wheat. This research will also evaluate the ability of indeterminate and determinate varieties to endure environmental stress. ($3,700)

Research Funded in State	$33,395
ASA Research Foundation	8,000
Total Research Investment	41,395

KENTUCKY FUND UTILIZATION COMMITTEE — 1980



Weed control systems in soybeans
W. W. Witt (University of Kentucky)

Objectives are to determine the most effective control systems with presently available and experimental herbicides for the control of the most troublesome weeds in Kentucky and evaluate new control measures and improved agronomic practices as to their effect on weed control and to determine their feasibility for use by Kentucky soybean producers. ($17,500)

Soybean seed quality as influenced by variety and environmental stress
D. M. TeKrony and D. B. Egli (University of Kentucky)

Studies are designed to determine the role of soybean variety and environmental stress on the quality of the soybean seed. ($12,500)

Identification and genetic transmission of resistance to manganese stress in soybeans
D. E. Peaslee and J. Orf (University of Kentucky)

This research will evaluate soybean cultivars and pertinent genetic lines that are adapted to Kentucky for differentials in absorption of soil manganese. ($10,000)

Evaluation of currently available insecticides for soybean insect control
K. V. Yeargan (University of Kentucky)

This research will thoroughly evaluate and compare the insecticides which are currently labeled for use against insects attacking Kentucky soybeans. ($7,750)

Quality of soybean inoculants and methods for their application
M. S. Smith and J. L. Sims (University of Kentucky)

This research effort will survey the quality of soybean inoculants and develop new and practical information on inoculants which improve nitrogen fixation. ($10,000)

Germplasm screening for the length of the grain filling period
J. Orf and D. B. Egli (University of Kentucky)

This research will screen soybean breeding materials to assess whether differences in the length of grain filling are available in materials suitable for Kentucky ($11,000)

Identification of races of the soybean cyst nematode in Kentucky
R. A. Chapman (University of Kentucky)

The specific races of cyst nematode infecting crop land must be known to maximize a soybean breeding program effectiveness in developing nematode resistant soybean lines. This research will determine the races present in Kentucky. ($6,500)

Serological detection of soybean mosaic virus in large scale screening of soybean seed
S. A. Chabrial (University of Kentucky)

Methods will be developed to screen soybean seed for the presence of mosaic virus. This research will assist in assuring the Kentucky soybean grower a better quality planting seed. ($10,000)

Varieties and production practices for narrow row and solid seeded soybeans
J. Orf, M. J. Bitzer and J. H. Herbek (University of Kentucky)

Solid seeded soybeans will increase yields in midwest states. Kentucky environmental conditions are different. This research is to investigate varieties, weed control and management practices for soybeans planted in narrow rows. ($9,000)

Effects of soil-borne plant pathogens on seedling stand and vigor in soybeans
Ferriss and R. E. Stuckey (University of Kentucky)

This research will investigate the effects of soil-borne plant pathogens on seedling stand and vigor in soybeans. ($9,302)

Research Funded in State	$103,552
ASA Research Foundation	16,600
Total Research Investment	120,152

LOUISIANA SOYBEAN PROMOTION BOARD — 1980

Identification and evaluation of soil chemical and physical properties limiting root development in Louisiana soils
Louisiana State University

Objectives of this study are to identify physical and chemical properties of Louisiana soils that contribute to reduced plant root development and

to establish critical levels for root penetration in the soils and what corrective measures can be taken. ($20,000)

Development of control measures for red rice by breaking seed dormancy
Louisiana State University

Objectives of this study are to determine the nature of seed dormancy in red rice and specifically the effect on red rice seed dormancy by relative humidity as regards to germination and the effect of substances that break dormancy in rice on red rice dormancy. From the above results, hopefully a program will be formulated to effectively control red rice in the field. ($10,000)

Soybean breeding
Louisiana State University

The soybean breeding project endeavors to develop improved soybean varieties which are adapted to Louisiana and are resistant to disease, insects and nematode pests. ($38,000)

Increasing nitrogen fixation in soybeans
Louisiana State University

The purpose of the project is to test any new soybean inoculants which appear on the market or are being developed by the inoculant industry, as well as outfield testing to determine if Louisiana farmers are deriving benefit from their present inoculation program. ($10,000)

Control of insect pests in soybeans
Louisiana State University

Specifically, this project deals with studies of the southern green stinkbug and its predators and analyzing stinkbug damaged soybeans for aflatoxin. ($50,000)

Soybean diseases and their control
Louisiana State University

This project will look at new fungicides for control of pod, stem and leaf diseases. Particularly, Benlate and Mertect are being closely compared as to their effect on these diseases. ($57,000)

Development of weed management systems

Objectives of this study are to develop weed control programs for narrow row soybeans. Also, several new overtop pest emergent herbicides are being studied as to their effectiveness at various rates and stages of growth. Several new herbicides have been registered, including a federal registration for Blazer and Vista. ($80,000)

Development of a system for recording, processing and storing regional soybean research data
Louisiana State University

The objectives of this project are to develop a standardized regional data card format for recording, processing and storing data on soybeans and procedures for the dissemination of this data. ($20,000)

Research Funded in State	$285,000
ASA Research Foundation	25,000
Total Research Investment	310,000

MICHIGAN SOYBEAN COMMITTEE — 1980

Cultural practices for increased soybean yields in Michigan

J. T. Johnston and Z. R. Helsel (Michigan State University)

The overall objectives of this study are to identify as many of the management factors limiting soybean yields as possible. The primary research objectives are to determine the effects of early and late planting of recommended varieties of soybeans in Michigan as reflected in yield, disease and other agronomic characteristics; evaluate the effects of row spacing on the yields of varieties of several maturity groups; and determine the optimum plant populations for maximum soybean yields. ($4,000)

Chemical and cultural practices for effective weed control in soybean production

W. F. Meggitt and J. Dekker (Michigan State University)

This research will determine the effect of various velvetleaf populations and competition on soybean yields; evaluate several herbicide combinations; preplant incorporated, pre-emergence and preplant incorporated plus pre-emergence to obtain maximum velvetleaf control; establish the depth from which velvetleaf emerges and its effect on the ultimate weed control obtained; establish the exact numbers of velvetleaf that emerge in the field and when in the growing season they emerge for determining more effective timely herbicide practices; and determine physiological and metabolic aspects of herbicide application to achieve better use of chemicals in and on the weed. ($9,500)

Study of seedling vigor and development in soybeans

L. O. Copeland (Michigan State University)

This research will explore and establish the relationship between laboratory indexes of seed and seedling vigor and field performance in terms of emergence, stand establishment and yield and develop recommended vigor tests or vigor test combinations which can be used to identify soybean seed lots with high field performance capability. ($2,200)

Irrigation management for high yields of soybeans

M. L. Vitosh (Michigan State University)

The objective of this study is to determine the optimum method for irrigating soybeans and improve irrigation efficiency. ($2,000)

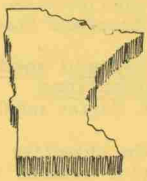
Effects of irrigation on yields of soybeans

Drs. T. J. Johnston, Z. R. Helsel and M. L. Vitosh (Michigan State University)

This research will evaluate the effects of irrigation on the yields of soybeans; compare different plant population and row spacing effects on

yields of soybeans under irrigated and non-irrigated conditions; and determine the responses of soybean varieties of different plant types and different maturities to irrigation. ($13,700)

Research Funded in State	$31,400
ASA Research Foundation	5,000
Total Research Investment	36,400



MINNESOTA SOYBEAN RESEARCH AND PROMOTION COUNCIL — 1980

Soybean breeding project
J. W. Lambert (University of Minnesota)

The objectives of this soybean breeding project are to develop soybean varieties having the highest yield of harvestable, high-quality seed consistent with the maturity needs of the various growing areas of Minnesota; to incorporate disease resistance, etc., in new varieties; evaluate commercial soybean varieites being marked in Minnesota; develop improved methodologies for breeding soybeans; and evaluate new germplasm. ($40,000)

Nitrogen fixation and fertility
G. E. Ham (University of Minnesota)

The objective of this project is to increase nitrogen fixation of soybean nodules by matching rhizobia strains with soybean genotypes and screening for soybean genotypes which will select more vigorous strains of rhizobia. ($8,000)

Research on soybean diseases in Minnesota
B. Kennedy (University of Minnesota)

Research is directed at assessing the importance of soybean diseases in Minnesota. The project involves screening of cultivars resistance to the major disease organisms: use of control measures to minimize disease damage; and evaluation of factors affecting seed quality. ($8,000)

Effect of physiological sinks on leaf photosynthesis in soybeans
W. A. Brun (University of Minnesota)

The objective of this project is to increase the understanding of the mechanism for internal control of soybean physiological processes. Research will be initiated to determine if the stimulation of leaf photosynthesis rate the presence of filling pods is related to the presence of either abscisic acid or a metabolic product. The research is also directed at determining where the decrease in photosynthesis rate with time (leaf senescence is due to a decrease cytokinin signal from the root system). ($7,000)

Operating funds for Waseca, Lamberton and Morris, Minnesota

Continuing operating funds are the greatest need in most soybean research because of the great increases in the cost of doing research in recent years. Waseca, Lamberton and Morris are the major soybean research stations in the state and additional operating funds for these stations contribute to all soybean research done by the Minnesota Agricultural Experiment Station. ($13,000)

Soybean seed yields and N_2 fixation as influenced by tillage practices

E. Carter and G. W. Randall (University of Minnesota)

The objective is to evaluate the influence of "conventional" and potential reduced tillage treatments on soybean seedling emergence, early plant growth, nodulation, N_2 fixation, dry matter, nutrient accumulation, lodging, maturity and seed yield. ($9,500)

Role of endogenous plant hormones in regulation of soybean yield

M. Brenner (University of Minnesota)

The objectives are to determine the traffic pattern of endogenous hormones in soybean plants and to relate such hormonal signals to the coordination of physiological processes relevant to soybean yield; to investigate the role played by hormonal signals in soybean plant development (such as the onset of flowering, the setting of pods, and the processes of senescence); and to further develop improved plant hormones analysis procedures to be used for the above objectives. ($4,600)

Establishment of loss figures for bacterial blight disease of soybean in Minnesota

B. Kennedy (University of Minnesota)

The objective is to devise and establish field plots that will reveal how much damage is caused by bacterial blight of soybean in Minnesota. ($4,000)

The identification, biology, control and detection of the soybean cyst nematode in Minnesota

D. MacDonald (University of Minnesota)

The objectives are to identify the races of the soybean cyst nematode that are present in Minnesota; to cooperate with soybean breeders in the evaluation of sources of resistance and the development of resistant cultivars; to determine how long resistant cultivars are likely to be resistant to the various Minnesota isolates of the soybean cyst nematode; to determine the economic significance of the race or races of the soybean cyst nematode that are present in Minnesota; to determine how the environment, especially temperature, affects the buildup and survival of the soybean cyst nematode; to determine the value of rotation, fertilization and chemical control as components of an integrated control program that also includes resistant cultivars; and to develop sampling procedures and assay techniques that will permit accurate preplanting evaluation of infested or potentially infested fields. ($16,600)

Soil-plant relationships in iron chlorosis of soybeans on high lime soils

P. Bloom, J. Lambert and G. Malzer (University of Minnesota)

The objectives are to determine the physical, mineralogical and chemical soil conditions that result in chlorosis in representative soybean varieties on high lime soils; to determine the differences in chemical composition and grain quality between chlorotic and non chlorotic soybeans; and to determine if high phosphorus fertilization contributes to iron chlorosis in representative genotypes of soybeans grown under field conditions. ($14,500)

Measuring and projecting soybean export market growth

J. Houck (University of Minnesota)

The objectives of this project are to evaluate the growth and change in export market shares of various users of soybeans and soybean products; project the evolution of market shares by nations into the 1980s; and assess the implications of this analysis for market development and promotion programs. ($10,600)

Weed control using reduced amount of chemicals

D. W. Wyse (University of Minnesota)

The objective is to develop safe and practical methods for the control of perennial weeds in soybeans by integrated use of agronomic practices, herbicides and life cycle information. ($7,000)

Identification and utilization of highly efficient combinations of soybean varieties and thizobium strains

J. W. Lambert (University of Minnesota)

Preliminary studies indicate that soybean varieties vary greatly in their ability to form nodules with superior introduced strains of bacteria. The repeatability of such results needs to be verified, and the way in which this selective ability is inherited should be investigated. Genetic material for such studies has been identified and pertinent crosses have been made. However, present sources of financial support will expire before the studies can be completed. The objectives of the present proposal would be (1) to establish the heritability and mode of inheritance of the selective ability of the host plant and (2) to utilize this knowledge in the development of high-yielding soybean cultivars which support large numbers of nodules filled with highly efficient strains of bacteria. ($20,200)

Reduced tillage studies emphasizing energy, soil and water conservation in soybean production

R. Schuller and J. Bauder (University of Minnesota)

The objective is to compare reduced tillage systems to conventional tillage practices in soybean production with respect to yield, energy requirements, erosion control, moisture conservation and crop residue on the soil surface. ($4,600)

Equipment purchases

Grain Moisture Meter (Computer Model) (2) ($6,000)
Electric Seed Counter (2) ($10,000)

Nitrogen assimilation and distribution in soybeans and alfalfa
G. Heichel (University of Minnesota)

The objectives are to investigate limitations to nitrogen assimilation and distribution in soybeans and alfalfa by determining the contribution of soil nitrogen and biologically fixed nitrogen to the nitrogen economy of soybean and alfalfa at successive stages of growth in the field. This objective will make use of nodulating and non-nodulating soybeans and alfalfa; use stable isotope tracers to determine the partitioning of biologically fixed nitrogen and soil nitrogen to seeds, pod walls, leaves, stems, roots, and nodules throughout crop development (the isotope tracer technique is the only available method for pursuing this objective); and determine the relative sink strengths of the organs and tissues in the above for biologically fixed and soil nitrogen. Again, the isotope tracer technique is the only available method for pursuing this objective. ($15,570)

Research Funded in State	$199,170
Research Foundation	50,000
Total Research Investment	249,170

MISSISSIPPI SOYBEAN PROMOTION BOARD — 1980

The interaction of insect population, cultural practices and soybean cultivars in developing pest management systems
H. N. Pitre, H. F. Hodges and D. W. Parvin (Mississippi Agricultural and Forestry Experiment Station)

This research will determine the effects of varieties, planting dates and location on crop phenology and on populations of insect pest on soybeans. Crop production budgets, cost-returns and relative profitability of each cropping practice will be determined. ($21,000)

Affects of various potash levels on cyst nematode infested soil on soybean disease and yield
N. W. Buehring, F. W. Jones, K. W. Roy and J. M. Epps (Mississippi Agricultural and Forestry Experiment Station)

A study will be conducted on a leeper silty clay loam soil infested with soybean cyst nematodes (Race 3) and low in available potash. Four levels (0, 40, 80 and 160 lb. of K_2O/acre) of potash will be applied and incorporated with a breaking disk. Tracy (susceptible) and centennial (resistant) soybean varieties will be grown. Soil samples will be obtained to determine the changes in cyst-nematode populations and potassium. Yields and other agronomic measurements will also be obtained. ($13,450)

Evaluation of tillage methods for soybeans planted after wintergrazed ryegrass pasture

(Mississippi Agricultural and Forestry Experiment Station)

To slow soil erosion and reduce labor, it would be desirable to utilize minimum tillage practices for soybean planting. Studies need to compare strip tillage, no-tillage with colter only, no-tillage with a colter and digging tyne and no-tillage subsoiled in the row to conventionally disced and chisel disced. ($1,500)

The development of soybean irrigation systems for the Mississippi Delta on silt loam and silty clay soils

G. R. Tupper, J. G. Hamill, H. F. Hodges, W. I. Spurgeon, R. A. Wesley, F. D. Whisler and J. R. Williford (Mississippi Agricultural and Forestry Experiment Station)

A combination of field experiments are proposed to provide information on silt loam and silty clay soils in the following areas: (1) Variety response to irrigation timing. (2) Yield response as affected by water quantity and method and timing of irrigation. (3) Effect of ultra-low flow rate furrow irrigation and basin tillage in alternate middles on yield and yield stability. (4) Basin tillage as a cultural method for water management without supplemental irrigation. (5) Water infiltration, usage and rooting depth in the different management systems. (6) The hydraulic properties of these soils and other soybean producing soils. (7) An analysis of costs of irrigation will provide necessary information for decision making by the individual producer. ($62,900)

Evaluation of foliar fungicides in Mississippi

G. L. Sciumbato, K. W. Roy, N. C. Edwards, N. Buehring, C. H. Hovermale and B. L. Arnold (Mississippi Agricultural and Forestry Experiment Station)

This research will expand and coordinate statewide foliar fungicide trials at the following MAFES locations: (1) Brown Loam Branch (2) Central Location (3) Delta Branch (4) North Mississippi Branch and (5) South Mississippi Branch. Foliar fungicides will be evaluated for efficacy as disease control agents; effects on seed quality and vigor; return-on-investment from their use will be determined. ($40,000)

Development of Blazer for controlling morning glory, crotalaria, hemp sesbania and other resistant weeds in soybeans

C. G. McWhorter and G. D. Wills (Delta Branch Experiment Station)

Research to develop Blazer for control of crotalaria in soybeans led to three important discoveries. These are: (a) use of an oil-surfactant concentrate-type adjuvant in the spray mixture with Blazer greatly increased the toxicity of the herbicide to crotalaria as compared to using conventional surfactants; (b) another new type additive (Herbex) did not increase the activity of Blazer on crotalaria; and (c) the use of several herbicides such as dinoseb (dinitro) and Dyanap/Ancrack in tank mixture with Blazer greatly decreased the activity of Blazer in controlling crotalaria. These findings have important use implications on the best manner in which to use Blazer for weed control in soybeans. Funding is requested to: (a) reconfirm these findings in another year's field research; (b) test additional surfactants with Blazer to determine which should and which should not be used with the herbicide; and (c) test additional herbicides in tank mixtures with Blazer to see which are

compatible for use with this herbicide. The research will continue using crotalaria, but the research would also be expanded to include hemp sesbania, cocklebur, morning glory, purple moonflower and other "hard to control weeds" in soybeans. ($30,000)

Competitiveness of Tracy, Tracy M and centennial cultivars with prickly sida

W. L. Barrentine (Mississippi Agricultural and Forestry Experiment Station)

The competitive ability of Tracy, Tracy M (the metribuzin tolerant strain) and centennial cultivars with prickly sida will be compared. ($20,000)

An analysis of soybean production/marketing alternatives for improving decisions

(Mississippi Agricultural and Forestry Experiment Station)

Within the past few years, field experiments by MAFES scientists have examined specific production practices for soybeans such as variety evaluation, planting dates, herbicide use and tillage practices. A data base of price information has been assembled to aid in evaluating marketing decisions. Most of these evaluations of production and marketing alternatives have been, in essence, isolated and have not fully accounted for the interrelated aspects of soybean production/marketing. The individual evaluations will be meshed into a form that will make possible the generation of complete systems for soybean production/marketing. ($23,280)

Improving efficiency of rope wick applicator for controlling weeds in soybeans

J. E. Dale, C. G. McWhorter (Delta Branch Experiment Station)

Research will be conducted to improve the rope wick applicator by: (a) using previously untested types of rope that will transport herbicides more rapidly; (b) using shorter sections of rope on the applicator to obtain more rapid transfer of herbicides; (c) constructing new "v-type" applicators that will have a greater surface area than present rope wick applicators that should have the effect of "squeezing" herbicide onto the weed; and (d) a new "loose-end" applicator will be designed that should provide better coverage on the weed than the present model. We estimate that we could construct six to eight new types of rope wick applicators in 1980 that would be tested in field research to evaluate Roundup and other herbicides for weed control in soybeans. A portion of the research would be an attempt to use Blazer, 2,4-D, 2,4-DB or other herbicides to control weeds in soybeans with these devices. ($15,000)

Research to evaluate the technique of applying herbicides as a coating to planting seed for weed control in soybeans

F. E. Fulgham and C. G. McWhorter (Delta Branch Experiment Station)

The Soybean Promotion Board supported research in 1979 to begin research on the new technique of applying herbicides in the seed furrow. This new and innovative technique is simple and inexpensive, yet it permits precise herbicide placement and incorporation. We found that this technique does have promise but its successful usage is dependent on using the proper formulation of individual herbicides. This new method worked sufficiently well with two of the herbicides studied to justify

additional research. We propose additional funding so that we can evaluate about six different herbicides on two different soybean varieties in a series of six to eight field experiments on both clay and sandy loam soil at Stoneville. ($15,000)

Soybean inoculation and inoculant quality
H. L. Peterson (Mississippi Agricultural and Forestry Experiment Station)

The study will continue to evaluate the effect of inoculation with an oil based, lyophilized inoculant on soybean seed yield in selected Mississippi soils. ($20,000)

Weed control and seedbed preparation for improved root environment in double cropped soybeans
G. L. Baker, N. W. Buehring and D. W. Whisler (Mississippi Agricultural and Forestry Experiment Station)

Proposed research will evaluate methods and forms (liquid and granular) of soybean herbicide application in double cropped (wheat-soybean) soybean system (control will be evaluated and soil looseness and water content properties will be measured throughout the growing season in these tests); and compare the maxi-merge, hipper-ripper and super-seeder planting methods for stand establishment, fuel comsuption and yield. All three planting methods will be compared in single cropped soybean systems. The maxi-merge and super-seeder will be compared in double-cropped systems. Soil looseness, water content and rooting depth will also be measured in these tests. ($9,000)

Methods of planting soybeans following small grain ryegrass winter pasture
N. C. Edwards, Jr. and E. G. Morrison (Mississippi Agricultural and Forestry Experiment Station)

This research will evaluate four different planters for planting soybeans following winter pasture in three preplant-date of planting treatments. ($3,500)

Evaluation of grass control in late planted soybeans
W. L. Barrentine (Delta Experiment Station)

This is the first year of a two-year study. We have shown that annual grasses and rhizome johnsongrass can be controlled with two new herbicides, LAS-9052 and KK-80, when applied over-the-top as postemergence sprays to soybeans and weeds. This research effort will compare the preplanting incorporated herbicides with the new postemergence herbicides LAS-9052 and KK-80 in early and late planted soybeans on close-row and regular row spacings. ($20,000)

Lay-by herbicides in soybeans
W. L. Barrentine (Delta Branch Experiment Station)

Weeds left in the field until harvest can reduce the soybean grade and combine efficiency even though the weed populations may or may not reduce soybean yields. Differences in weed infestations at harvest time with different varieties are expected. Research will evaluate lay-by treatments in early, mid, and late maturing varieties of soybeans to determine their efficiency in reducing weed populations at harvest time. ($15,000)

Sicklepod control in soybeans
(Delta Branch Experiment Station)

This research will initiate study on sicklepod control, a major weed specie in Mississippi. ($24,000)

Research Funded in State	$333,630
Research Foundation	41,000
Total Research Investment	374,630

MISSOURI SOYBEAN MERCHANDISING COUNCIL — 1980

Development of genetic stocks for resistance to soybean cyst nematodes
S. C. Anand and C. H. Baldwin (University of Missouri)

The objectives of this research are to screen all the resistant strains to various races of the cyst nematodes, find out the number of genes involved for resistance and combine sources of resistance and develop stocks which would be used for the development of cyst nematode resistant varieties in both determinate and indeterminate soybeans in different maturity groups. ($18,000)

Mid-Missouri extension field trials
M. Gentry and E. Musselman (Callaway County Extension Council)

The objective of this project is to provide on-the-farm comparisons of narrow row versus conventional planted soybeans and incorporating studies of varieties, herbicides and fertility. ($11,699)

Soybean varieties for drilled planting
H. C. Minor, M. R. Gebhardt and S. C. Anand (University of Missouri)

The objectives of this research are to quantify the average yield response which can be expected for drilled seeding in the major soybean producing areas of the state; to identify those soybean varieties which respond best to drilled seeding as compared to 30-inch rows; and to promote commercial and public interest in the development of soybean varieties specifically adapted to drilled seeding. ($26,650)

Reduction of soybean cyst nematode (SCN) populations through induction of suicidal hatches
C. H. Baldwin (University of Missouri)

The objectives of this research are to determine the sublethal concentrations of the nematicides Temik, Furadan, Vydate and Nemacur (technical grade materials) required to stimulate the hatching of SCN eggs; evaluate the efficacy of sublethal rates of these nematicides (commercial grade) on stimulating SCN hatch and larval emergence from cysts in naturally infested soil under greenhouse conditions; and to measure the efficacy of a combination of sublethal nematicide dosages and a non-host crop on

increasing the rate of SCN population decline in a crop rotation system under field cultivation. ($8,300)

Losses of pesticides, sediments and nutrients from farmland producing soybeans
G. E. Smith, L. B. Hughes, H. D. Kerr and R. E. Burwell (University of Missouri)

The objectives of this research are to determine the rate of reaction, strength of absorption, persistance and fate of pesticides applied to major soils of the state producing soybeans; measure the quantity of

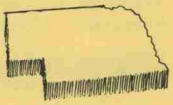
nitrogen and phosphorus lost from claypan soil growing soybeans with various field production practices; and to study erosion and runoff under different soil and crop management systems for producing soybeans. ($8,200)

Grant to purchase an eight-row planter and equipment for the Portageville Delta Center
S. C. Anand (University of Missouri)

The objective of this grant was to convert the soybean breeding program from 38 inch to 30 inch row spacing. ($19,000)

Research Funded in State	$ 91,849
ASA Research Foundation	45,000
Total Research Investment	136,849

NEBRASKA SOYBEAN DEVELOPMENT UTILIZATION AND MARKETING BOARD — 1980



Development of improved soybean varieties for Nebraska
J. H. Williams and J. E. Specht (University of Nebraska)

Development of soybean varieties for Nebraska conditions. Improve performance for agronomic traits other than yield, such as maturity, composition of the seed and disease tolerance are breeding objectives. Also, tolerance to heat and water stress will receive attention. ($8,000)

Evaluation of rate and placement of plant nutrients for irrigated soybean production in Northeast Nebraska
G. W. Rehm, R. C. Sorensen and R. A. Wiese (University of Nebraska)

Relate the response of irrigated soybeans to fertilizer phosphorus to the level of available phosphorus in the soil. Study the relationship of phosphorus concentration in the plant tissue to the rate of fertilizer phosphorus applied to define a critical level for this nutrient in the leaf tissue. Evaluate the effectiveness of fertilizer phosphorus and sulfur for production of soybeans on irrigated sandy soils. Compare row and broadcast placements for the application of plant nutrients to irrigated soybeans. ($2,500)

Field comparisons and demonstrations of broadcast type recirculating sprayers, herbicide rollers and rope-wick applicators for the control of volunteer corn, shattercane and other weed escapes in soybeans
J. D. Furrer, A. R. Martin (University of Nebraska)

The objectives are to continue comparisons of herbicide rollers, spray sickle type applicators and at least three types of rope-wick applicators for the control of weed escapes in soybeans in field trials at selected locations. ($9,400)

Evaluation of rhizobium japonicum strains derived from alkaline Nebraskan soils as soybean inoculants
A. K. Vidaver (University of Nebraska)

This project will continue in its second year testing suitable R. Japonicum strains as inoculants in controlled environments with different varieties at different pH levels and also test genetically marked strains in greenhouse trials with different varieties in alkaline soils. Then apply the results to field tests with different varieties in alkaline soils. ($6,400)

Evapotranspiration and water use efficiency in soybeans as related to humidity and irrigation levels
J. E. Specht and J. D. Eastin (University of Nebraska)

Develop an experimental system which will permit soybean genotypes to be subjected to various soil water levels in low and moderately humid environments and to evaluate the transpiration rates, yields and water-use efficiencies. The system would provide a useful screening tool to identify and develop cultivars adapted to the more semi-arid areas of Nebraska. ($5,500)

Enzymes and metabolic pathways during nodual senescence
R. V. Klucas and F. W. Wagner (University of Nebraska)

The objective of the research is to study changes in carbohydrate and protein metabolism in soybean nodules as a function of their age. The immediate goal is elucidating dynamic changes in metabolic events in nodules which occur during senescence. The long-term goal is increasing the active life of nodules and thus increase the level of nitrogen fixed. ($9,800)

Soybean oil as an alternate energy source
M. A. Hanna (University of Nebraska)

This project is working to determine if on-farm expression of soybean oil as an alternate energy source is feasible. This is to be accomplished by the determination of the effects of pre-processing on the mechanical expression of soybean oil by compression and by the design, development and testing of an on-farm machine for expression of soybean oil. ($8,920)

Seasonal histories and population dynamics of insects common to Nebraska soybeans
J. F. Witkowski (University of Nebraska)

Conduct an intensive survey of Eastern Nebraska soybean fields to identify and catalog all pest species associated with Nebraska soybeans; to

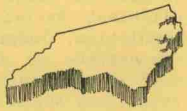
determine the extent of the problem and seasonal occurrence of the green leaf beetle and green cloverworm; to identify population regulating factors associated with the two pests with particular emphasis on the parasite complex; and to determine treatment thresholds for green leaf beetles and green cloverworms. ($9,400)

Improving soybean quality
(Nebraska Grain Improvement Association)

Improve the quality and thereby the market acceptance of Nebraska soybeans according to their intended use by supervising activities in maintaining soybean quality in storage, conducting grain grading schools, monitoring soybean quality with members and sponsoring youth activities. ($1,200)

Research Funded in State	$61,120
ASA Research Foundation	16,150
Total Research Investment	77,270

NORTH CAROLINA SOYBEAN PRODUCERS ASSOCIATION — 1980



Incorporation of phomopsis seed-rot resistance into agronomically acceptable soybeans
J. P. Ross (North Carolina State University)

Objective is to transfer the genetical characters imparting resistance to phomopsis seed-rot (identified in certain plant introductions) to agronomically acceptable soybean lines of early maturity. It is hoped that lines will be developed that will maintain good seed quality during unfavorable harvest seasons. ($1,250)

Evaluation of pathogenicity of ectoparasitic nematodes on soybeans
D. P. Schmitt (North Carolina State University)

Objectives are to determine the effects of ectoparasitic nematodes, primarily stubby-root and dogger nematodes, on 20-30 soybean cultivars, and to determine the effect of 20-30 cultivars grown in North Carolina on the population dynamics of plant parasitic nematodes. ($2,000)

On-farm tests of integrated weed management programs on soybeans
L. Thompson, Jr. (North Carolina State University)

Objectives are to determine the utility of various herbicides for control of specific weeds in soybeans; to evaluate integrated weed management programs in soybeans; and to demonstrate integrated weed management programs in an education program for county extension personnel, agribusiness people and growers. ($2,500)

Genetic control of linolenic acid content in soybeans
P. J. Buescher, R. F. Wilson and C. A. Brim (North Carolina State University)

Objective is to utilize the variation in linolenic acid content observed in existing soybean germplasm to study its control. ($2,000)

Differences in rates of assimilate transport among soybean genotypes as a factor limiting productivity
W. D. Hanson (North Carolina State University)

Objectives are to establish rates of sucrose translocation in petiole and stem along soybean genotypes; to associate rates of translocation with source-sink linkages; and to determine whether rate of translocation could be a limiting factor for production of soybeans. ($500)

Soybean variety and row width interactions
E. J. Dunphy (North Carolina State University)

Objectives are to support the overall Extention Soybean On-Farm Test Program at North Carolina State University; to evaluate seed yield of different varieties at various row widths, for evaluation of plant population, lodging, planting date and weather variables on yields; to demonstrate in several locations across the state the performance of soybean varieties when planted in various row widths; to demonstrate objectives above to county extension agents and to begin to characterize the complex interactions in the Southeast of soybean varieties, row widths, planting dates, plant populations, lodging, weather, irrigation and weed pressure. ($1,250)

Support of laboratory development and program initiation for seed research
R. D. Keys (Research-Crop Science, North Carolina State University)

Objective is to support the funding of a laboratory and program development for the purpose of investigating the physiological processes and the effects of environment and nutrition on seed development and maturation, the influence of seed treatments and storage conditions on maintenance of seed quality during storage and the effects of environment, nutrition, imposed chemical treatments and harvesting procedures on germination and uniform seed development on soybeans. ($2,800)

Publish color illustrated field guide of soybean insect pests
J. Van Duyn and T. Hunt (Extension-Entomology, North Carolina State University)

Objective is to publish a color-illustrated, pocket-size booklet for distribution to farmers, extension personnel and others as a tool for soybean insect scouting and identification purposes. Farmers and others sometimes have difficulty in differentiating between good and bad insects and oftentimes take improper and uneconomical steps to treat (or fail to treat) when timely. The color-guide describes the major insect pests found on soybeans in North Carolina. ($2,000)

Biological control of weeds

C. G. VanDuyke (Research-Plant Pathology, North Carolina State University)

Objectives are to identify and determine the distribution of fungi infecting weeds in North Carolina, with particular emphasis on cocklebur (Xanthium strumarium L.); to determine the life cycle patterns of these fungi; to evaluate the potential of fungal pathogens as bio-control agents for reducing cocklebur problems; and to cooperate with weed scientists and pathologists in North Carolina and other states in bio-control of other weeds such as morning glory, etc. ($500)

Soybean variety demonstrations

E. J. Dunphy (Extension-Crop Science, North Carolina State University)

Objectives are to support the overall Extension Soybean On-Farm Test and Demonstration Program at North Carolina State University; to demonstrate in many areas of the state the new and established soybean varieties currently available to growers in the state; to make variety and location signs available for these soybean variety demonstrations to effectively advertise their presence and insure their usefulness to interested growers who stop to compare the varieties available; and to train county extension agents and agribusiness personnel in soybean production, to include specifically how soybean varieties differ and fit into local soybean production. ($2,000)

The effect of soil factors on the infection and pathogenicity of the soybean cyst nematode races 1 and 2

D. P. Schmitt (Research-Plant Pathology, North Carolina State University)

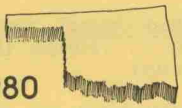
Objectives are to determine the influence of soil types on the damage caused by soybean cyst nematode races 1 and 2 and to develop a reliable method for predicting the economic threshold of the soybean cyst nematode. ($3,200)

Diagnosis and corrections of manganese deficiency

F. R. Cox (Research-Soil Science, North Carolina State University)

Objectives are to determine both soil and plant critical Mn levels; to calibrate the Mn soil test for broad spectrum of soil and climatic conditions; to evaluate methods of application of Mn fertilizer for various soil conditions; and to determine the residual effect of Mn fertilization. ($3,000)

Research Funded in State	$23,000
ASA Research Foundation	9,750
Total Research Investment	32,750



OKLAHOMA SOYBEAN COMMISSION — 1980

Development of improved soybean varieties for Oklahoma
L. H. Edwards (Oklahoma Agricultural Experiment Station)

The primary objectives of this research are to evaluate soybean genotypes under the relatively harsh dry climatic conditions characteristic of Oklahoma and to develop soybean varieties adapted to Oklahoma growing conditions and which contain resistance to our major soybean pests. Studies are also being conducted on plant populations, row spacings and planting dates in order to aid in selection of the most productive genotypes. ($7,500)

Development of soybean management systems
R. J. Crabtree (Oklahoma Agricultural Experiment Station)

This research is concerned with the doublecropping of soybeans and wheat under rainfed conditions in eastern Oklahoma and with the most effective usage of supplemental irrigation of soybeans in central Oklahoma. ($5,700)

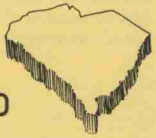
Development of effective soybean weed control systems
D. S. Murray (Oklahoma Agricultural Experiment Station)

Weed control research in soybeans including the preliminary evaluation of new candidate soybean herbicides, the development of multiple herbicide treatments for use in soybean cropping systems, the development of weed control practices for no-till doublecropping of soybeans and studies of soybean weed biology and life histories. ($6,200)

Soybean soil fertility research
R. L. Westerman (Oklahoma Agricultural Experiment Station)

This involves continued efforts to calibrate and refine the soil test indices for predicting soybean fertilizer requirements in Oklahoma and developing the means of handling iron chlorosis problems in selected soybean varieties. ($600)

Research Funded in State	$20,000
ASA Research Foundation	3,500
Total Research Investment	23,500



SOUTH CAROLINA SOYBEAN BOARD — 1980

Establishment of a winter breeding nursery in Puerto Rico
E. R. Shipe (Clemson University)

The objective is to advance experimental material an extra generation to enable researchers to utilize the normally unproductive winter months. ($5,000)

Developing management strategies for the Mexican bean beetle using a computer simulation model
B. M. Shepard (Clemson University)

The objectives are to simulate populations of the Mexican bean beetle on soybeans using the computer and provide information to growers for establishing reliable management of the Mexican bean beetle. ($5,000)

Selection of varieties for late planting in South Carolina
E. R. Shipe and H. L. Musen (Clemson University)

The objective is to select varieties adapted to South Carolina environmental conditions which can be planted after July 15. ($4,000)

Nature and extent of variation in root-knot nematodes found in soybean fields
S. A. Lewis (Clemson University)

The objectives are to collect root knot nematodes from soybean producing areas in South Carolina; screen populations against differentiating host plants and soybean varieties to determine species and race of root knot nematode; determine effect of host plant and temperature on nematode morphology; and determine the effect of host plant on the use of taxonomic means of separating species. ($5,000)

Development of chemical and genetic control of the lance nematode on soybeans
C. W. Blackmon, H. L. Musen and E. R. Shipe (Clemson University)

The objectives are to test efficiency of and methods of application for granular nematicides for control of the lance nematode on soybeans; test progeny of crosses made from tolerant soybean lines for resistance to lance nematodes; and screen soybean breeding lines for resistance to lance nematode. ($4,000)

Viability of soybeans in storage
J. M. Bunn (Clemson University)

The objectives are to measure the magnitude and direction of moisture migration within bins of soybeans during on-the-farm drying and storage; determine the allowable drying time for soybeans in a deep bed drier; establish how the viability of soybeans relates to initial moisture content, storage environment, and storage time; and develop a computer model to predict the viability of soybeans in storage. ($5,500)

Interaction of irrigation, date of planting and row spacing of soybeans with pest development under different levels of pest management
S. G. Turnipseed and H. L. Musen (Clemson University)

The objectives are to obtain basic data on development of all major pests under irrigation vs. no irrigation, early vs. late planting, early (19" rows) vs. normal (38" rows) canopy development within various pest control regimes; and relate pest development and yields to costs of various control options and adapt for grower usage. ($9,000)

Cowpea control in soybeans
B. J. Gossett (Clemson University)

The objectives are to determine the response of soybean and cowpea plants to single and multiple applications of acifluorfen (Blazer) at various growth stages; and compare seed dormancy between the various types of wild cowpeas and determine when dormancy develops during seed formation. ($8,000)

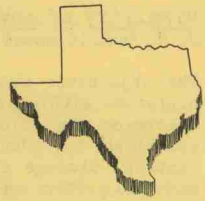
Research Funded in State	$45,000
ASA Research Foundation	5,000
Total Research Investment	50,000

TENNESSEE SOYBEAN PROMOTION BOARD — 1980

The use of plant growth regulators to enhance soybean production efficiency and reduce flower and pod abortion
W. A. Krueger and F. L. Allen (University of Tennessee)

The objectives of this study are to enhance the yield of soybeans through the application of plant growth regulators; increase the production efficiency of soybean varieties by altering plant size and shape with plant growth regulators and decrease the number of flowers and pods aborted through the use of plant growth regulators. ($7,500)

Research Funded in State	$7,500
ASA Research Foundation	-0-
Total Research Investment	7,500



TEXAS SOYBEAN PRODUCERS BOARD — 1980

Evaluation of soybean experimental lines in field-scale strip test
R. Brigham (Texas Agricultural Experiment Station, Lubbock)

Research involves field testing of new soybean genetic materials. ($5,000)

Comparative kinetics of seedling respiration and development in selected soybean varieties
J. Sij (Texas Agricultural Experiment Station, Beaumont)

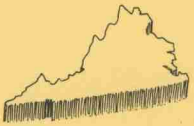
This research is directed toward the study of basic seed physiology and the development of biologically improved varieties. ($3,300)

Finding improved, agrinomic varieties through studying insect and disease resistant materials
Breeding Program (Texas Agricultural Experiment Station, Beaumont)

Research involves study of improved seed through hard-seeded qualities and inheritance. ($3,300)

Research Funded in State	$11,600
ASA Research Foundation	800
Total Research Investment	12,400

VIRGINIA SOYBEAN COMMISSION — 1980



Detection and correction of boron, copper and zinc deficiencies in soybeans
D. C. Martens (Virginia Polytechnic Institute and State University)

This research will study the trace mineral needs of soybeans and develop recommendations for mineral fertilization to maximize soybean yields. ($3,040)

Funds in support of the Virginia Polytechnic Institute and State University soybean breeding program
G. R. Buss (Virginia Polytechnic Institute and State University)

Funds will support ongoing soybean breeding program. ($2,500)

Graduate research assistantship
G. R. Buss (Virginia Polytechnic Institute and State University)

Funds to increase soybean research support ($7,200)

Identification and control of soybean viruses
C. W. Roane (Virginia Polytechnic Institute and State University)

Soybean viruses will be identified in field studies and control practices will be suggested. ($3,000)

Potential for solid seeded soybeans in Virginia and soybean extension agronomy test demonstration
P. Reid (Tidewater Research and Continuing Education Center)

Studies will be designed to determine the practical application of solid seed soybeans in the eastern soybean producing areas. ($13,000)

Trap crops for control of Mexican bean beetles
R. M. McPherson (Eastern Virginia Research Station)

Studies will be conducted with various crops to determine their application as a crop to attract the Mexican bean beetle. ($3,900)

Weed control research for soybeans in Eastern Virginia

H. Wilson (Virginia Truck and Ornamental Research Station)

Research will investigate the control of problem weeds in Virginia. ($2,500)

Research Funded in State	$35,140
ASA Research Foundation	-0-
Total Research Investment	35,140

ANNUAL REPORT

'80 soybean research

American Soybean Association
Research Foundation

Statement

June 1980

Again, we are pleased to present the Annual Report of the American Soybean Association (ASA) Research Foundation. This report will review progress in the research projects funded by 466,000 soybean producers through the Foundation. We hope this report will be of value to you in better understanding the American Soybean producer's Research Foundation program. If you would like additional information on any specific project, please feel free to contact the Foundation.

A short review of Foundation objectives and funding philosophies may be appropriate. The Foundation was established in 1965 to provide funding emphasis to soybean research areas not being adequately supported with federal, state or private funds. The complementary nature of Foundation funding has been successful in initiating several new soybean research efforts and has provided principal investigators additional support personnel to expand their investigations.

The chart on the preceding page illustrates the wide variety of soybean research activities being funded by soybean producers through the Foundation. The Foundation Board of producers has tried to equalize funding of basic production research and studies to improve the consumer acceptance of soybean products. This past year, a major research effort was initiated to improve the quality of soy oil. This effort involved basic studies to better understand the mechanism of genetic control of fatty acid synthesis, use of chemicals to alter fatty acid synthesis in the plant and breeding studies to develop low-linolenic acid soybeans. If successful, we should have soybean germ plasm with improved oil quality characteristics which will improve consumer acceptance of soy oil around the world.

Again this year, several of the production projects are designed to develop basic information for soybean breeders, physiologists and pathologists in their efforts to improve soybean yields and reduce production cost. A new effort has been the initiation of three projects to minimize erosion of soybean fields. This research effort will hopefully lessen the impact of land-use legislation on soybean production.

The ASA Research Foundation advisory panels have been busy during the past year. In January we solicited research preproposals. By our February 15 deadline, we had received 147 individual research requests. The panel has selected about one-third of the preproposals for further study. These selected proposals will again be evaluated and recommendations for funding will be provided to ASA. Much of the success of the Foundation's research program may be attributed to these hard-working advisory panels. The advisory panels' recommendations on soybean research needs and their evaluation of these proposals provide valuable information to the soybean grower-leader in developing Foundation budgets and programs.

Support of the Research Foundation has again set a record. Seventeen state grower investment checkoff programs are actively supporting the Foundation. Several states including Iowa, Illinois, Minnesota and Mississippi, are supporting the Foundation at one cent per acre of soybeans harvested. Most other states are at the one-half cent per acre level. State funding of this basic research program complements their investment in state research programs. Again this year, we have had an increase in the number of agribusiness firms supporting the Foundation and its programs. Long-term supporters, such as Deere and Company, Elanco Products Company and Monsanto, have been joined by BASF Wyandotte, FMC, International Minerals and Chemical Corporation, Rohm and Haas, Chevron Chemical Company, Continental Grain and Sperry New Holland. Several other companies provide products and services in support of the Foundation's research program.

We sincerely appreciate agribusiness's support since it allows for a more aggressive grants program.

The ASA Board of Directors authorized a special study committee to review ASA organization and develop recommendations for simplifying the organizational structure. After many meetings, hours of study and discussions, the recommendation was approved to combine the present ASA Research Foundation and the ASA Market Development Foundation. This reorganization will simplify the organizational structure (one board with representation from each state supporting the ASA program); provide greater funding opportunities (soybean research and promotion needs will be simultaneously evaluated and funded on a priority basis); and provide greater coordination between ASA's development of research needs and the Foundation's programs. The new foundation will be officially named the American Soybean Development Foundation. It is anticipated all established procedural guidelines developed for the ASA Research Foundation will be officially adopted by the American Soybean Development Foundation. The bottom line is a simpler organization, more coordination between research and international market development programs, and a greater possible funding if the priorities can be established.

We are proud of American soybean producers' accomplishments through the ASA Research Foundation, and are confident that the new American Soybean Development Foundation will continue to improve on our past record. While the structure may seem important, it is really the team of state and federal researchers studying soybean production and utilization opportunities that are impressive and the key to the Foundation's success. Through combining our programs with research efforts being supported by federal, state and private monies, we shall be successful in keeping soybean farming profitable.

Sincerely,

Eugene Glock

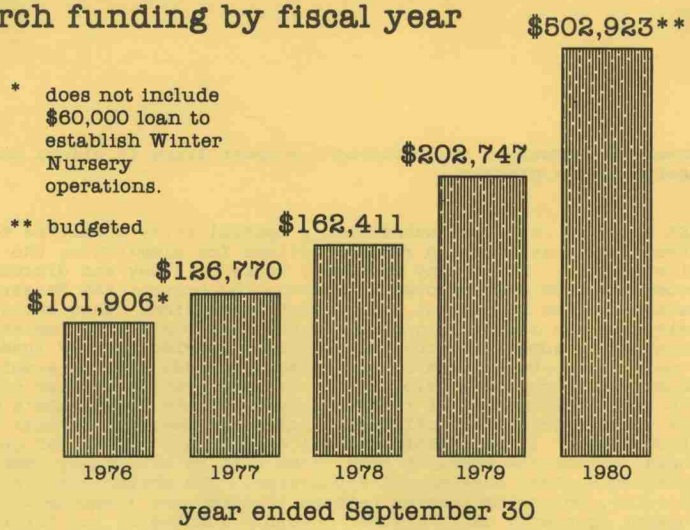
Eugene Glock, President
American Soybean Association
Research Foundation

Keith Smith

Keith J. Smith
Director of Research
American Soybean Association

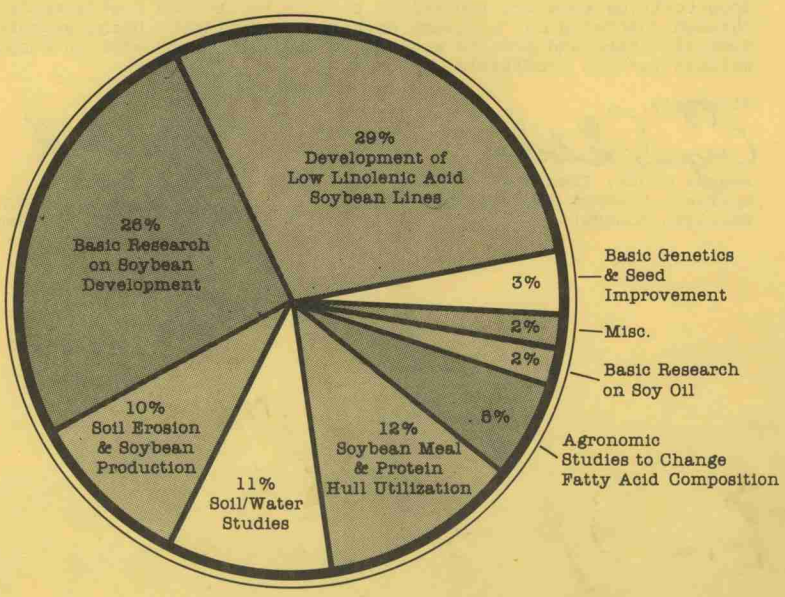
ASA Research Foundation

Research funding by fiscal year



ASA Research Foundation

Research funding by area FY80



Research Projects Funded
1967 - 1980

FISCAL YEAR FUNDED & ASARF NO.	TITLE, INVESTIGATORS, BUDGET
1967	**The Characterization and Control of Stink Bug Damage to Soybeans and the Effect of Stink Bug Damage to the Value of Soybeans,** Philip C. Stone, University of Missouri, Columbia, MO.
1967	**Studies on the Evaluation of Damage to Soybeans by Arthropods and its Effects on Yield, Quality, and Composition of Soybeans, with Emphasis to be Placed on Mites and Sucking Insects Other than the Green Stink Bug,** D. B. Broersma, University of Illinois, Urbana, IL.
1968	**Soybean Nutrition Studies,** Hugh Gauch, University of Maryland, College Park, MD.
1968	**Physiology of the Soybean Plant,** C. E. Caviness, University of Arkansas, Fayetteville, AR.
1968	**The Effects of Subsoil Compaction and Acidity on Soybean Yields,** Howard T. Rogers and D. L. Thurlow, Auburn University, Auburn, AL.
1968	**Reduction of Soybean Losses During Harvesting,** Wesley F. Buchele, Iowa State University, Ames, IA.
1968	**Chemical Analysis of Stink Bug Damaged Soybeans for Amino Acid and Fatty Acid Content,** David M. Daugherty, University of Missouri, Columbia, MO
1969	**Mexican Bean Beetle Resistance in Soybean Germplasm,** John A. Schillinger, University of Maryland, College Park, MD.
1970	**Locate and Develop Varieties of Soybeans Resistant to Race 4 of Soybean Cyst Nematode,** James M. Epps, University of Tennessee, Jackson, TN.
1972 72014	**The Application of Cytogenetics to a Soybean Improvement Program,** Reid G. Palmer, Iowa State University, Ames, IA.
1974 74013	**Feedback Inhibition of Photosynthetic Process in Glycine Max. (L) Merrill,** W. D. Hanson, T. J. Mann and Williamson, Jr., North Carolina Agricultural Experiment Station, Raleigh, NC.
1974 74023	**Improved Equipment for Soybean Harvesting** Ralph Nave, Roger R. Yoerger and Dean L. Hoag, University of Illinois, Urbana, IL.
1974 74033	**Leaf Photosynthesis and Soybean Productivity,** R. Shibles and D. E. Green, Iowa State University, Ames, IA.
1974 74043	**Interrelationship Between Nitrogen Metabolism and Photosynthate Supply as a Factor Regulating Soybean Yields,** R. H. Hageman, R. W. Howell and G. W. Salisbury, University of Illinois, Urbana, IL.
1974 74053	**Nitrogen Nutrition of Soybeans,** W. A. Brun, D. E Polson and G. E. Ham, University of Minnesota, St. Paul, MN.
1974 74062	**Carbon-14 Translocation in Relation to Nitrogen Metabolism in Soybeans,** D. Johnson, University of Missouri, Columbia, MO.
1975 75073	**Interrelationship Between Energy Requirements of Plant Roots and the Maintenance of Water Balance in Soybean Plant Communities,** R. R. Johnson, C. W. Boast and D. B. Peters, University of Illinois, Urbana, IL.

1975 75083 **Investigations of the Effect of Temperature on Soybean Root Growth and the Physiological Processes Related Thereto,** L. E. Schrader and J. W. Pendleton, University of Wisconsin, Madison, WI.

1975 75093 **Alleviation of Soybean Root Restriction in Soil with Compacted Pans by the Use of Deep-Rooted, Vigorous Grass,** Clarence E. Scarsbrook, D. L. Thurlow and C. B. Elkins, Auburn University, Auburn, AL.

1975 75103 **The Economic Importance of Root and Nodule Infesting Insect Pests of Soybeans,** L. D. Newsom, Louisiana State University, Baton Rouge, LA.

1975 75113 **Relation of Soybean Root Growth Rates and Root Morphology to P and K Uptake Rates, Shoot Growth Rate and Soybean Yield,** S. A. Barber, Purdue University, West Lafayette, IN.

1976 76123 **Impact of Pesticides on Fungal Pathogens in the Soybean Ecosystem,** G. R. Carner and C. W. Blackmon, Clemson University, Clemson, SC.

1976 76133 **Effects of Fungicides and Insecticides on Lepidopterous Pests and Their Associated Entomopathogenic Fungi and Selected Predators in Soybeans,** W. C. Yearian and S. Y. Young, University of Arkansas, Fayetteville, AR.

1976 76143 **Investigations on the Effects of Various Soybean Pesticide Interactions: Interactions Between Pesticides Reactions of Non-Target Organisms, and Soybean Plant Responses,** J. R. Bradley, Jr., F. T. Corbin, D. P. Schmitt and J. W. Van Duyn, North Carolina State University, Raleigh, NC.

1976 76153 **Identification and Evaluation of Potentially Beneficial Pesticide Interactions in Soybean Production,** D. V. Phillips and J. W. Todd, University of Georgia, Athens, GA.

1977 77163 **The Development of Low-Energy Tillage Tools and Weed Control Practices for Soybeans on Clay Soils,** G. R. Tupper and W. L. Barrentine, Mississippi State University, Mississippi State, MS.

1977 77173 **An Automatic Controller to Improve Harvest Efficiencies and to Reduce Soybean Damage,** G. E. Miles and M. K. Richardson, Clemson University, Clemson, SC.

1977 77183 **Improved Equipment for Pesticide Application in Soybeans,** B. J. Butler, University of Illinois, Urbana, IL

1977 77191 **Identification of Objectionable Flavor Components in Soy Protein Products,** S. S. Chang, Rutgers University, New Brunswick, NJ.

1977 77203 **The Elucidation of the Role of Phosphatidylcholine in the Formation of Bitterness in Soybean Protein Products,** C. G. Crawford, Northern Regional Research Center, SEA/USDA, Peoria, IL.

1978 78213 **Soybean Improvement Using Tissue Culture Techniques,** Jack M. Widholm, University of Illinois, Urbana, IL.

1978 78223 **Relationship of Soil Water Potential and Evaporative Demand on Canopy Photosynthesis and Transpiration of Soybeans,** K. J. Boote, L. C. Hammond and J. W. Jones, University of Florida, Gainesville, FL.

1978 78223 **A Baculovirus as a Management Tool for Velvetbean Caterpillar Populations in Soybeans,** S. G. Turnipseed and G. R. Carner, Clemson University, Clemson, SC.

1978 78243 **Biochemical and Subcellular Characterization of Oil and Protein Synthesis During Seed Development in High-Oil vs. High-Protein Soybean Lines,** Niels C. Nielson, Thomas L. Housley and James R. Wilcox, Purdue University, West Lafayette, IN.

1979
79253 **The Role of Root Nodules as Determinants of Physiological Activities in Soybean Plants,** William A. Brun and Mark L. Brenner, University of Minnesota, St. Paul, MN.

1979
79263 **Effects of Soil Water Stress on Growth, Accumulation and Redistribution on Nitrogen and Yield of Soybeans,** R. E. Phillips, James Leggett, Dennis Egli and Grant W. Thomas, University of Kentucky.

1979
79273 **Improved Removal of Phosphorous Compounds from Soybean Oil and Its Impact on Soybean Oil Stability,** A. Philip Handel and R. G. Arnold, University of Nebraska, Lincoln, NE.

1979
79282 **Influence of Soy Protein Diets on Blood Lipids and of High Phytate or Low Phytate Soy Protein Diets on Mineral Retention in Adult Human Males,** C. E. Bodwell, J. T. Judd and J. C. Smith, SEA/USDA, Beltsville, MD.

1979
79291 **Resistance of Extruded Soybean Meal and Extruded Whole Soybeans to Microbial Degradation in the Rumen,** Larry Satter and Marshall Stern, University of Wisconsin, Madison, WI.

1979
79303 **Estimation of Energy and Amino Acid Availabilities of Soy Protein Products for Humans Using Determinations Made in Cannulated Pigs,** T. D. Tanksley, Texas A&M University, College Station, TX.

1979
79313 **Improving the Nutritional Value of Soybean Meal for Ruminants by Heat Treatments,** L. L. Berger, G. C. Fahey, Jr. and J. B. Russell, University of Illinois, Urbana, IL.

1979
79322 **The Internal Control of Flower Abortion in Soybeans,** T. L. Housley and K. A. Beckmann, Purdue University, West Lafayette, IN.

1980
80333 **Effectiveness of Water Located at Different Soil Depths in Increasing Soybean Yield,** H. M. Taylor and J. J. Hanway, Iowa State University, Ames, IA.

1980
80344 **Tillage Systems for Corn and Soybeans,** J. C. Siemens, J. W. Hummel, R. A. Pope and J. K. Mitchell, University of Illinois, Urbana, IL.

1980
80353 **Evaluation of Soybean Germplasm within Subjenus Soya,** R. G. Palmer, D. Iseley and K. Sadanaga, Iowa State University, Ames, IA.

1980
80363 **Evaluation of Selected Soybean Cultivars for Tolerance to Drought Stress,** C. E. Caviness and D. A. Brown, University of Arkansas, Fayetteville, AR.

1980
80373 **Effects of Soybeans on Soil Erodability,** G. R. Blake, Univesity of Minnesota, St. Paul, MN.

1980
80383 **Partitioning of Photosynthate, Assimilation of Fixed N, and Transport to Developing Seeds of Soybeans,** L. E. Schrader, University of Wisconsin, Madison, WI.

1980
80394 **Development and Evaluation of Soybean-Corn Management System to Maximize Net Returns and Minimize Erosion and Energy Input,** T. S. Colvin, J. M. Laflen, and S. J. Marley, Iowa State University, Ames, IA.

1980
80403 **Increasing Tolerance of Soybeans to Water Stress by Photoperiodic Control of Pod-Fill Rate,** R. P. Patterson, C. D. Raper, Jr., and B. E. Caldwell, North Carolina State University, Raleigh, NC.

1980
80413 **Improved Utilization of Soybean Hulls by Cattle,** H. R. Conrad, Ohio Agricultural and Development Center, Wooster, OH.

1980
80422 **Maximizing the Value of Soybeans Hulls as a High Energy Feed for Ruminants,** T. J. Klopfenstein and M. McDonnell, University of Nebraska, Lincoln, NE.

1980
80433 **Chemical Reduction of Linolenic Acid Levels in Oil of Soybean Seed,** M. N. Christiansen and J. B. St. John, USDA/SEA/AR, Beltsville, MD.

1980
80446 **Breeding for Reduced Linolenic Acid Soybean Oil,** W. R. Fehr and E. G. Hammond, Iowa State University, Ames, IA.

1980
80455 **Response to Selection and Metabolism of Unsaturated Acyl-lipids in Soybean Oil,** B. E. Caldwell, R. F. Wilson and C. A. Brim, North Carolina State University, Raleigh NC., and R. W. Rinne, University of Illinois, Urbana, IL.

1980
80465 **Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil,** R. W.-Rinne, University of Illinois, Urbana, IL., and B. E. Caldwell, R. F. Wilson and C. A. Brim, North Carolina State University, Raleigh, NC.

1980
80475 **Studies on the Biochemical and Genetic Control of Linolenic Acid Synthesis in Developing Soybean Seeds,** J. H. Cherry and P. M. Hasaegawa, Purdue University, West Lafayette, IN.

1980
80485 **Induction of Fatty Acid Mutants in Soybean** *Glycine Max,* L. Merr., J. R. Wilcox and N. C. Nielsen, Purdue University, West Lafayette, IN.

1980
80493 **Chemical Reduction of Linolenic Acid Content of Soybeans,** R. E. Wilkinson and W. S. Hardcastle, University of Georgia, Athens, GA.

1980
80501 **Potential Use of a Soil-Borne Disease for Velvetleaf (Abutilon** *theoprasti* **Medic.) Controll and Hazards to Crop Production,** R. G. Harvey and C. R. Grau, University of Wisconsin, Madison, WI.

1980
80511 **Isolation of the Genes for the 11S Seed Protein of Soybean,** J. P. Mascarenhas, State University of New York at Albany, Albany, NY.

1980
80522 **Analyst for Improved Soybean Quality,** R. Kleiman, USDA/SEA/AR, Northern Regional Research Center, Peoria, IL.

1981
80531 **Financial Support for Germplasm Collection Trip to PRC,** T. Hymowitz, University, of IL, Champaign, IL

1981
81543 **Multigenic Resistance to** *Phytophthora Megasperma* **var.** *Sojae* **in Soybeans,** K. L. Athow and F. A. Laviolette, Purdue University, W. Lafayette, IN.

1981
81552 **Influence of Assimilate Supply on Soybean Seed Growth,** H. R. Koller, Purdue University, W. Lafayette, IN.

1981
81562 **Biochemical Processes Associated with Genetic Differences in Iron Utilization on Calcareous Soils,** C. L. Tipton, W. R. Fehr, J. J. Hanway and I. C. Anderson, Iowa State University, Ames, IA.

1981
81573 **Effects of Soil Oxygen Concentration and Water Availability on Soybean Root Extension,Water Uptake, Crop Photosynthesis and Yield,** F. D. Whisler, H. F. Hodges, B. Acock, D. N. Baker & J. M. McKinion, Mississippi State University, Mississippi State, MI.

1981
81582 **Superior Strains of Rhizobia for Soybean Inoculation,** W. D. Bauer, Charles F. Kettering Research Laboratory, Yellow Springs, OH.

1981
81592 **Enhancing Soybean Meal Protein for Feeding Ruminants,** F. N. Owens and R. A. Zinn, Oklahoma State University, Stillwater, OK.

1981
81602 **Effect of Food Processing Conditions Upon the Formation of Phytate-peptide-mineral Complexes in Soybean Foods,** W. Erdman, Jr. and R. M. Forbes, University of Illinois, Urbana, IL.

1981
81613 **Process Engineering Research on Co-Processing Soybean and Milk Proteins by Industrial Membranes,** J. T. Lawhon and E. W. Lusas, Texas A & M University, College Station, TX.

AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION

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Georgia Agricultural Commodity Commission for Soybeans
Illinois Soybean Program Operating Board
Iowa Soybean Promotion Board
Kansas Soybean Commission
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St. Louis, MO

National Program Staff
Wilda Martinez
SEA/USDA
Beltsville, MD

ASA Staff

Dr. Dave Erickson
Director, Soy Oil Program

Dr. Keith J. Smith
Director of Research

DEC 3 1 1980

TO: ASA Board of Directors
American Soybean Development Foundation
State Soybean Promotion Board Members
State Soybean Association Presidents
Soybean Production Advisory Panel
Soybean Utilization Research Advisory Panel
ASTA Soybean Basic Research & Seed Improv. Comm.
Food Protein Council Science & Nutrition Committee
National Soybean Crop Improvement Council
ASA County Directors
ASA Research Investigators
ASA Regional Managers
Wisconsin Soybean Association Directors
Ohio Soybean Association Directors
Indiana Soybean Association Directors

FROM: Keith J. Smith Keith

DATE: November 24, 1980

SUBJECT: RESEARCH SUPPORTED BY SOYBEAN GROWERS - 1980

Enclosed is a review of soybean research support with grower investment funds. The growers' investment has increased from $1.8m in 1978, to $2.3m in 1979 and $3.1m in 1980. Best yet, the investment is paying off in the development of new soybean varieties, new and improved cultural practice recommendations, and greater consumer acceptance of soybean products.

The challenge of the 1980's is upon us; we must continue our research emphasis to keep soybean profitable and supplying the increasing world demand.

If you would like further information on any particular project, please let us know.

KJS:js

Enclosure

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

Soybeans
American Soybean Association

UNITED STATES DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION

AUG 27 1980

B

AGRICULTURAL RESEARCH
NORTH CENTRAL REGION

W-315 Turner Hall
University of Illinois
Urbana, Illinois 61801

August 25, 1980

Subject: Equipment Purchase
ASARF 80465

To: Dr. Keith J. Smith

From: Dr. Bill Rinne

The research has been progressing satisfactorily, however, we have not reached the stage where a GLC would be needed. I have done some "spade work" and the instrument that I'm interested in will cost about $14,500 to $15,00. However, it will be impossible to get the paperwork done by September 15 as requested in your July 30 letter. Is it possible to have the University of Illinois bill you for the $15,000 even though the purchase will not be completed? If this is possible, the September 15 deadline could be met.

Also enclosed is a copy of the newsrelease which you requested.

Bill Rinne

cc: R. W. Howell
B. E. Caldwell

B

June 20, 1980

Mr. J. J. Kamerer
Campus Contract Office
University of Illinois
105 Davenport House
809 S. Wright Street
Champaign, IL 61820

Dear Mr. Kamerer:

RE: ASA RP 80645

Enclosed is ASA Research Foundation check in the amount of $7,570, representing the first quarterly payment for your research project entitled, "Response to selection and metabolism of unsaturated acyl-lipids in soybean oil."

The Foundation is pleased to be a part of your research program, and shall look forward to working with you during the new year.

Sincerely,

Keith J. Smith
Director of Research

rc/5/6

Enclosure

cc: Dr. R. W. Caldwell
Dr. R. W. Rinne

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

NORTH CAROLINA STATE UNIVERSITY | AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

DEPARTMENT OF CROP SCIENCE
BOX 5155 ZIP 27650

June 16, 1980

Dr. Keith J. Smith
Director of Research
American Soybean Association
Research Foundation
P. O. Box 27300
St. Louis, MO 63141

Dear Keith:

I want to acknowledge the ASARF check for $1,837.00 to support our research project entitled "Increasing Tolerance of Water Stress by Photoperiodic Control of Pod-fill Rate."

I appreciate the support of the Foundation.

Sincerely yours,

B. E. Caldwell, Head
Department of Crop Science

BEC/cr

June 12, 1980

Dr. B. E. Caldwell, Head
Department of Crop Science
Box 5155
North Carolina State Univ.
Raleigh, NC 27650

Dear Dr. Caldwell:

RE: ASARF 80403

Enclosed is ASA Research Foundation check in the amount of $1,837.00, representing the first quarterly payment for your research project entitled, "Increasing Tolerance of Water Stress by Photoperiodic Control of Pod-fill Rate."

The Foundation is pleased to be a part of your research program, and shall look forward to working with you during the new year.

Sincerely,

Keith J. Smith
Director of Research

mb/3/6

Enclosure

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

Soybeans
American Soybean Association

June 5, 1980

Mr. D. F. Bateman, Director
North Carolina State University
Agricultural Research Service
Box 5847
Raleigh, NC 27650

Dear Mr. Bateman:

RE: ASARP 80455

Enclosed is American Soybean Association check in the amount of $7,846.00, representing the first quarterly payment for your research project entitled, "Response to Selection and Metabolism of Unsaturated Acyl-lipids in Soybean Oil."

ASA is pleased to be a part of your research program, and shall look forward to working with you during the new year.

Sincerely,

Keith J. Smith
Director of Research

/db

Enclosure

cc: Dr. B. E. Caldwell
Dr. R. W. Rinne - University of Illinois

May 28, 1980

Mr. D. F. Bateman, Director
North Carolina State University
Agricultural Research Service
Box 5847
Raleigh, NC 27650

Dear Mr. Bateman:

RE: ASARP 80455

Enclosed are two fully executed copies of the revised Memorandum of Understanding between the North Carolina Agricultural Research Service and the American Soybean Association Research Foundation for the project entitled "Response to Selection and Metabolism of Unsaturated Acyl-lipids in Soybean Oil."

As agreed, we shall provide the first payment of the grant upon notification that the research has been initiated.

We are looking forward to cooperating with your researchers on this project.

Sincerely,

Keith J. Smith
Director of Research

KJS:db

Enclosures

cc: Dr. B. E. Caldwell

bcc: Eugene Glock
F. H. Bailey
Thurman Burleson
James Wilder
Dr. R. W. Rinne

B
Marlene
If I did not
a copy of my
letters on grant
initiation should
be sent to
Bateman
P

Rec'd
6/2/80
JJS.

MEMORANDUM OF UNDERSTANDING
Between the
NORTH CAROLINA AGRICULTURAL RESEARCH SERVICE
and the
AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION

THE AGREEMENT is made and entered into 15th day of May, 1980, by and between NORTH CAROLINA AGRICULTURAL RESEARCH SERVICE, hereinafter called the COOPERATOR, AND THE AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION, hereinafter called the FOUNDATION.

THIS AGREEMENT supplements our earlier Agreement to fund Research on "Response to Selection and Metabolism of Unsaturated Acyl-lipds in Soybean Oil" (ASARP 80455).

AGREEMENT: The contracting parties agree as follows:

I. The FOUNDATION agrees:

A. To provide the COOPERATOR a gas liquid chromatograph to be used to carryout the objectives set forth in Memorandum of Understanding on Project ASARP 80455 with the understanding that upon completion of the project or when the equipment is no longer used in soybean research, it will be returned to the FOUNDATION.

II. The COOPERATOR agrees:

A. Provide maintenance, needed repair, and servicing on the equipment to keep the instrument in running condition.

B. To return the equipment to the AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION when the project has been completed, or when the equipment is no longer used in the soybean research program.

IN WITNESS WHEREOF the parties have signed their names effective the day and year first above written.

NORTH CAROLINA AGRICULTURAL RESEARCH SERVICE
RALEIGH, NORTH CAROLINA

By Lucy E. Caldwell
Title Head, Crop Sci

Approved:
By [signature]
Title Asst. Director

AMERICAN SOYBEAN ASSOCIATION
RESEARCH FOUNDATION
ST. LOUIS, MISSOURI

By [signature]
Title Director, Business & Finance

By [signature]
Title [signature]

Caldwell + Wilson

NORTH CAROLINA STATE UNIVERSITY AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

DEPARTMENT OF CROP SCIENCE
BOX 5155 ZIP 27650

May 28, 1980

Dr. Keith J. Smith
Director of Research
American Soybean Association
P. O. Box 27300
St. Louis, MO 63141

Dear Keith:

This is to let you know we have begun the research proposed in ASARP 80455 "Response to Selection and Metabolism of Unsaturated Acyl-lipids in Soybean Oil." We have selected our postdoctoral candidate and hope to make him an offer next week. Also, an excellent graduate student has been selected and he plans to begin his program in July. Our field plantings are in and our laboratory program well underway. We appreciate your assistance in obtaining the GLC.

Dr. Joe Burton has assumed the leadership of the genetics phase of the program. Having worked with Dr. Brim for about six years, he is familiar with the program and we plan to accomplish the objectives as planned.

Thanks for your assistance and support.

Sincerely yours,

B. E. Caldwell, Head
Department of Crop Science

BEC/cr

Patterson

NORTH CAROLINA STATE UNIVERSITY | AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

DEPARTMENT OF CROP SCIENCE
BOX 5155 ZIP 27650

May 28, 1980

Dr. Keith J. Smith
Director of Research
American Soybean Association
P. O. Box 27300
St. Louis, MO 63141

Dear Keith:

We are getting underway with the research proposed in ASARP 80403, "Increasing Tolerance of Water Stress by Photoperiodic Control of Pod-Fill Rate." Plans are made and we are waiting space in the Phytotron. We are also waiting for Dr. Patterson to return from an African trip. We are now recruiting for a Research Assistant to assist Drs. Patterson and Raper in the program. Field planting will be made this week as a part of our overall program in the area.

I believe the project is on schedule and should be in full swing by this fall. We appreciate your support and the resources from ASARF.

Sincerely yours,

B. E. Caldwell, Head
Department of Crop Science

BEC/cr

BEC

TO: Honorary Life Members
Past Presidents of ASA
State Presidents and Promotion Board Chairmen
ASA National Board
Market Development Foundation Board
Soybean Industry Leaders
Regional Managers
Foreign Offices
Department Heads
Research Foundation Board
State Agricultural Experiment Station Directors
Research Foundation -- Advisory Panels

FROM: Kenneth L. Bader, Chief Executive Officer

DATE: April 29, 1980

The American Soybean Association annually recognizes those people who have conducted outstanding activities on behalf of American soybeans. Each year, thousands of people devote their time and talents to activities that have a significant impact on soybean production and marketing. Therefore, we would like to select and subsequently honor that person who has contributed the most during the past year in the fields of: education/research, agribusiness, agricommunications and market development.

One additional award, the highest honor given by the Association is the Life Membership. This award is designed to recognize individuals who have devoted a major portion of their lives in a significant manner to the Association and the soybean industry.

Awards will be presented during the 60th Annual Meeting of the American Soybean Association, August 1-5 in New Orleans. Judging will be conducted by peer groups and members of the Association.

Since you are part of the soybean industry leadership, I'm requesting your assistance in this most important matter. Please use the enclosed form to nominate the individual you feel is most deserving to be honored. It is not necessary that you nominate someone for each award.

Judges will use five equally-weighted criteria: soybean spirit, activity in Association affairs, professionalism, extra effort and recent activity. A copy of past recipients is attached for your information.

To allow adequate time for the panel of judges to reach their best decision, we must have all nominations by June 9. Nominations received after that date will not be considered.

We sincerely appreciate your assistance in our endeavor to honor those people responsible for helping reach the goals of the American Soybean Association and for helping soybean producers make the soybean the world's miracle crop.

Attachments

ANNUAL AWARDS
AMERICAN SOYBEAN ASSOCIATION

HONORARY LIFE MEMBERSHIP

Honorary Life Membership is the highest award the American Soybean Association bestows on soybean industry leaders. Persons involved in soybean farming, handling, processing, marketing, research or education are eligible for Honorary Life Membership. Winners of other award categories may be considered for Honorary Life Membership.

MERITORIOUS SERVICE AWARDS:

RESEARCH AND EDUCATION

Up to three awards are presented annually, one each in the areas of extension education, utilization research and production research.

MARKET DEVELOPMENT

Two awards are presented annually -- one to an individual or corporation for domestic support of soybean market development efforts, and the second, to an individual or corporation for international support of market development efforts.

AGRIBUSINESS

This is presented to an individual or company who has been actively involved in the soybean industry, through promotion and adoption of new cultural practices or through support of soybean government relations, market development or education programs.

NEWS MEDIA

Three awards are presented annually -- one each to a farm broadcaster, farm magazine writer and farm newspaper writer who have actively supported the objectives of the soybean industry. The news media awards are presented in November at the annual conventions of farm broadcasters, farm newspaper editors and farm magazine editors.

NOMINATION FORM

HONORARY LIFE MEMBERSHIP AWARD

AMERICAN SOYBEAN ASSOCIATION

I hereby nominate _____ Address _____

for the Honorary Life Membership Award. Occupation _____

Title _____ Organization _____

Education and Employment Experience:

Work Performance:

Outstanding Contributions to Soybeans and/or ASA:

Honors and Awards:

Use separate sheets if necessary to give additional qualifications. Supporting nominations may be submitted or co-signatures of others nominating a person.

Signed _____

Address _____

Please return by June 9, 1980 to: AWARDS PROGRAM, ASA, BOX 27300, ST. LOUIS, MISSOURI 63141

NOMINATION FORM

MERITORIOUS SERVICE AWARDS

AMERICAN SOYBEAN ASSOCIATION

Please check appropriate category:

☐ Production Research
☐ Extension Education
☐ Farm Radio/TV
☐ Farm Magazines
☐ Market Development -- Foreign
☐ Utilization Research
☐ Agribusiness
☐ Farm Newspapers
☐ Market Development -- Domestic

I hereby nominate _____ Address _____
for the Meritorious Service Award. Occupation _____
Title _____ Organization _____

Education and Employment Experience:

Work Performance:

Outstanding Contributions to Soybeans and/or to ASA:

Honors and Awards:

Use separate sheets if necessary to give additional qualifications. Supporting nominations may be submitted or co-signatures of others nominating a person.

Signed _____

Address _____

Please return by June 9, 1980 to: AWARDS PROGRAM, ASA, BOX 27300, ST. LOUIS, MISSOURI 63141

master file

March 28, 1980

Mr. William D. Morgan
Grants and Contracts Office
809 South Wright Street
Champaign, IL 61820

Dear Mr. Morgan:

RE: ASARF 80465

Enclosed are two copies of the MEMORANDUM OF UNDERSTANDING between The Board of Trustees of the University of Illinois and the American Soybean Association Research Foundation for the project entitled, "Response to Selection and Metabolism of Unsaturated Acyl-Lipds in Soybean Oil."

As agreed, we shall provide the first payment of the grant upon notification that the research has been initiated.

We are looking forward to cooperating with your researchers on this project.

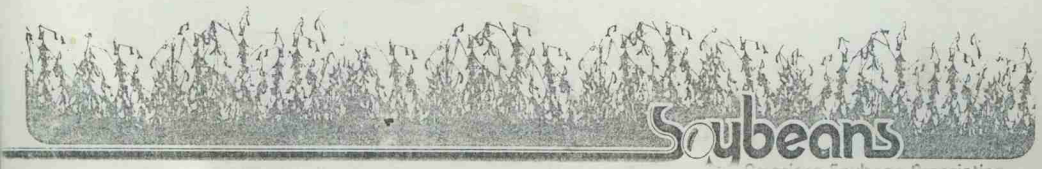
Sincerely,

Keith J. Smith
Director of Research

dk/5/10

Enclosure

cc: Dr. B. E. Caldwell
Dr. R. W. Rinne



Caldwell + Wilson Marlene

February 7, 1980

Mr. D. F. Bateman, Director
North Carolina State University
Agricultural Research Service
Box 5847
Raleigh, NC 27650

Dear Mr. Bateman:

RE: ASARP 80455

Enclosed are two copies of the MEMORANDUM OF UNDERSTANDING between North Carolina Agricultural Research Service and the American Soybean Association for the project entitled, "Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil."

As agreed, we shall provide the first payment of the grant upon notification that the research has been initiated.

We are looking forward to cooperating with your researchers on this project.

Sincerely,

Keith Smith

Keith J. Smith
Director of Research

dk

Enclosure

cc: Dr. B. E. Caldwell

ASARP 80455

MEMORANDUM OF UNDERSTANDING

between the

North Carolina Agricultural Research Service

and the

AMERICAN SOYBEAN ASSOCIATION

THIS AGREEMENT is made and entered into this 30 day of January, 1980, by and between N.C. Agri. Research Svs., hereinafter called the COOPERATOR, and the AMERICAN SOYBEAN ASSOCIATION, hereinafter called ASSOCIATION.

I AGREEMENT: The contracting parties agree as follows:

The ASSOCIATION agrees:

A. To pay the COOPERATOR $181,681 in 20 quarterly installments, according to the budget submitted with the research proposal. The first payment will be provided upon notification by the COOPERATOR that the research effort has been initiated according to the approved research proposal.

II The COOPERATOR agrees:

A. That the COOPERATOR's division of sponsored research, or their designated representative, will act for the COOPERATOR in administering this Agreement, and liaison with the ASSOCIATION will be through its Director of Research.

B. To make available such qualified personnel, physical facilities and services as the COOPERATOR possesses and as may be required to carry out the terms of this Agreement.

C. To conduct experiments on the "Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil." (Attachment I).

D. To prepare and furnish to the ASSOCIATION interim progress reports on such experiments as may be mutually agreed upon and an annual progress report on or before April 1 of each year this Agreement remains in effect, and to furnish the ASSOCIATION a copy of any published research reports and/or dissertations resulting from this Agreement.

III It is mutually understood and agreed that:

A. Funds made available to the COOPERATOR under the terms of this Agreement shall be expended in accordance with the fiscal regulations governing said COOPERATOR.

B. The COOPERATOR is encouraged to publish the findings made by these studies, but will send all manuscripts to the ASSOCIATION in reasonable time for comments and criticism to be received and considered prior to publication. The COOPERATOR reserves the right to accept or reject such suggestions and to be the final judge of what it will publish. In the event the COOPERATOR publishes any such findings, the aid provided by the ASSOCIATION will be acknowledged in such publications. The ASSOCIATION reserves the right to use such published findings and to release public announcements concerning the initiation of such research at any time. Further, the ASSOCIATION reserves the right to use all or any portion thereof of the information contained in the interim reports as it may desire, provided it has been released for publication or unless otherwise agreed to by the COOPERATOR. Due credit is to be given to the COOPERATOR along with the ASSOCIATION on any publication of such findings.

C. The name of either party to this Agreement shall not be used by the other in any advertising, publicity, news release, etc., related to the work undertaken under the terms of this Agreement without the consent of the other.

D. The COOPERATOR agrees to follow the guidelines as set out in the attached American Soybean Association Research Foundation Patent Policy (Attachment II) with any differences subject to negotiation between the ASSOCIATION and the COOPERATOR prior to initiation of this memorandum.

E. This Agreement shall remain in force for a period of 60 months, unless terminated by either party on any October 1 hereafter by giving the other party written notice of such termination at least 30 days prior to such October 1. However, if the COOPERATOR's annual report described above is received after April 1 of any year, the ASSOCIATION may elect to terminate this Agreement at any time during the 30-day period subsequent to the actual receipt of such annual report by the ASSOCIATION. This Agreement may be extended or amended at any time by mutual agreement.

IN WITNESS WHEREOF the parties have signed their names effective the day and year first above written.

NORTH CAROLINA AGRICULTURAL
RESEARCH SERVICE
RALEIGH, N.C.

By W. F. Baleman

Title Director

AMERICAN SOYBEAN ASSOCIATION

ST. LOUIS, MISSOURI

By Keith L. Smith

Title Director of Research

Approved:

By

Title

By

Title CEO

RESEARCH PROPOSAL SUBMITTED TO

RESEARCH FOUNDATION

AMERICAN SOYBEAN ASSOCIATION

TITLE: Response to Selection and Metabolism of Unsaturated Acyl-lipids in Soybean Oil.

Submitted by:

The North Carolina Agricultural Research Service

North Carolina State University

Raleigh, North Carolina 27650

and the

Illinois Agricultural Experiment Station

University of Illinois

Urbana, Illinois 61801

Principal Investigator: Dr. B. E. Caldwell
Head, Department of Crop Science
North Carolina State University
Raleigh, North Carolina

Co-Investigators: Dr. C. A. Brim, Research Agronomist
Dr. R. F. Wilson, Research Plant Physiologist
USDA-SEA-AR
Department of Crop Science
North Carolina State University
Raleigh, North Carolina

Dr. R. W. Rinne, Research Plant Physiologist
USDA-SEA-AR
Department of Agronomy
University of Illinois
Urbana, Illinois

Endorsements:

Billy E. Caldwell
Principal Investigator
B. E. Caldwell

Co-investigator
R. W. Rinne

Charles A. Brim
Co-investigator
Charles A. Brim

R. W. Howell, Head
Department of Agronomy

Richard F. Wilson
Co-investigator
R. F. Wilson

G. W. Salisbury
Director of Research
Illinois Agricultural
Experiment Station

Billy E. Caldwell
B. E. Caldwell, Head
Department of Crop Science

D. F. Bateman
Director of Research
North Carolina Agricultural
Research Service

Response to selection and metabolism of unsaturated Acyl-lipids in soybean oil.

The co-investigators of the proposed research have been engaged in an interdisciplinary effort to improve soybean oil quality for nearly ten years. The intent of the plant geneticist and physiologists engaged in the cooperative effort was to gain basic information on the genetic control of biosynthetic pathways of lipid metabolism in the soybean. The ultimate goal was to provide germplasm resources which would provide a vegetable oil of greater versatility for industrial use. Primary emphasis was therefore placed on development of germplasm with minimum levels of the linolenic acid fraction of soybean oil.

There now exists within the two laboratories considerable expertise in lipid biochemistry, in analytical methodology, and in selection methodology for fatty acid alteration. Plant genotypes have been developed at North Carolina State University which provide unique test material for biochemical studies and for further manipulation through selection.

The proposed research will supplement the existing cooperative research conducted by the co-investigators and others at the sponsoring institutions. The intent of the research is to obtain basic information on response to selection, selection limits, the effect of the environment on the constituents of oil, the biochemistry of key pathways of lipid metabolism, and on the ontogeny of lipid bodies in soybeans.

Review of Pertinent Research.

Soybean oil contains approximately 8% linolenic acid. The association of linolenic acid and the "off-flavor" of soybean oil has been well documented. In order to alleviate this problem and to improve oil quality, the edible vegetable oil processing industry has employed both chemical and physical means for reducing linolenic acid levels in soybean oil. The principal chemical process for reducing linolenic acid is "Hydrogenation." Hydrogenation transforms polyunsaturated fatty acids by increasing the level of acyl saturation. It is estimated that 60% of the soybean oil processed in the United States is used as liquid cooking oil and 30% of that amount is hydrogenated. In a recent report on the fatty acid composition of "Brand Name" vegetable cooking oils (1) it was revealed that high quality soybean oil products contained approximately 3% linolenic acid.

The demand for soybean oil is a function of both availability and cost production. With the escalating cost of energy, hydrogenation has become an increasingly expensive process. It is conservatively estimated that the cost of hydrogenation in the processing of soybean oil is approximately 3¢ per pound. Current data on soybean oil production and utilization in the United States indicate that the edible vegetable oil processing industry spent approximately $150 million for the hydrogenation of soybean oil in 1978 alone. Although the vegetable oil processing industry would continue to depend heavily on hydrogenation, winterization, and chemical additives in the preparation of food regardless of the vegetable oil used, the necessity for hydrogenation would be diminished in the preparation of liquid soybean cooking oils if the composition of the raw soybean oil contained approximately 3% linolenic acid. Such an alternative would have a favorable economic impact upon processing costs and in turn enhance the competitive position of soybeans and soybean oil in world trade.

Commercial soybean varieties presently in production contain high levels of linolenic acid. However, certain unadapted accessions of the World Soybean Germplasm Collection have been identified that contain very low levels of linolenic acid (3). In order to capitalize upon the desired traits, the appropriate genes must be incorporated into an adapted germplasm before varietal development can be considered. In addition, any advances in genetic selection for low linolenic acid in soybean seed oil will be contingent upon: a) the number of genes involved and the mode of inheritance for the desired traits, b) the nature of the lipid synthetic apparatus, and c) the effect of environmental interaction with the genotypes selected.

It is surmised from the current literature that three or more genes are involved in linolenic acid synthesis (3), and the inheritance of those genes is quantitative (8). Although the genetic mechanism for linolenic acid synthesis has not been identified in soybeans, polyunsaturated fatty acids are synthesized by a consecutive desaturation of oleic acid (6, 7). Apparently saturated fatty acid intermediates are not substrates for polyunsaturated fatty acid synthesis (6, 7). At least three different enzymes are required for the desaturation of oleic acid to linoleic acid. However there are two possible mechanisms for oleic acid desaturation: a) oleoyl-CoA desaturase, and b) oleoyl-phospholipid desaturase. Evidence has been obtained that implicates both mechanisms in soybean oil synthesis and both mechanisms furnish linolenic acid for triacylglycerol synthesis in the following manner. Desaturated phospholipids are metabolized to diacylglycerol, which forms the sn-1 and sn-2 acylglycerol portion of triacylglycerol. The sn-3 acyl unit of triacylglycerol is derived via the acyl-CoA desaturation mechanism. The enzyme which catalyzes the condensation of diacylglycerol and acyl-CoA intermediates in triacylglycerol biosynthesis is diacylglycerol-acyltransferase. Because triacylglycerol accounts for 85% of soybean oil, this glycerol lipid is the major repository for linolenic acid. At maturity approximately 90% of the linolenic acid in soybean oil is associated with one particular triacylglycerol

molecular species. Thus, precursory inspection of the lipid synthetic apparatus suggests several points for the genetic control of linolenic acid metabolism: a) linoloyl-CoA desaturation to linolenoyl-CoA, b) linoloyl-phospholipid to linolenoyl-phospholipid, and c) substrate specificity for linolenoyl-CoA and linolenoyl diacylglycerol by diacylglycerol-acyltransferase.

In view of the reported genotype x environment interaction on fatty acid composition (2, 4, 5), the consistent maintenance of fatty acid composition in low linolenic acid soybean genotypes grown in different environments must be accounted for during selection. Selection response as the experimental material becomes more homogenous may be overpowered by environmental effects and difficult to detect based singly upon fatty acid analysis of total lipid extracts. With the presumption that selection progress could be sustained or improved under such circumstances with more elaborate screening techniques, it will be necessary to investigate the relative importance of the various biochemical pathways involved in linolenic acid metabolism. This research will provide valuable information necessary for our understanding of fatty acid and triacylglycerol metabolism in soybean, and provide direction for selective breeding for the development of soybean germplasm with high oil quality.

References Cited.

1. Carpenter, D. L., J. Lehmann, B. S. Mason, and H. T. Slover. 1976. JOACS 53:713-718.
2. Chu, W. S., and V. L. Sheldon. 1979. JOACS 56:71-73.
3. Howell, R. W., C. A. Brim, and R. W. Rinne. 1972. JOACS 49:30-32.
4. Howell, R. W. and J. L. Cartter. 1953. Agron. J. 45:526.
5. Howell, R. W. and F. I. Collins. 1957. Agron. J. 49:593.
6. Stumpf, P. K. and N. Weber. 1977. Lipids 12:120-124.
7. Wilson, R. F. and J. A. Buck. 1978. Agron. Abst. p. 88.
8. White, H. B., F. W. Quackenbush, and A. H. Probst. 1961. JOACS 38:113.

Statement of Procedures.

Both genetic techniques and physiological studies will be used in attempts to fulfill project objectives. Genetic material developed at Raleigh will be available and freely exchanged between co-workers for all genetic and biochemical analyses. All genetic and selection studies are to be conducted at Raleigh. These studies will require routine screening by Gas-Liquid Chromotography for fatty acid composition of selected genotypes. Biochemical investigations conducted at the sponsoring institutions are designed to study two distinct phases of linolenic acid metabolism, i.e., synthesis or utilization of poly-unsaturated acids in triglyceride biosynthesis. The intent of these studies is to provide selection criteria that may lead to increased selection efficiency. Specific responsibilities for germplasm development and for biochemical studies are outlined below.

I. Germplasm Development (Raleigh, North Carolina)

Variability among types in the soybean germplasm for 18:1 and 18:2 fatty acids constituted the basis for experiments initiated in 1967. Based on a simple model of oleic-linoleic and linoleic-linolenic conversion, crosses were made to study the mode of inheritance. Preliminary results indicated that inheritance of the oleic acid fraction was not simple. Brim et al also showed that fatty acid composition is determined primarily by the genotype of the maternal parent, thus selection of F_2 seed analysis would be ineffective.

A simple recurrent selection scheme based on mass selection among male-sterile plants in a natural crossing block was initiated in 1973. The selection goal was reduced 18:3. The base population was synthesized from the cross of six F_3 progenies high in 18:1 to the North Carolina male-sterile. The six F_3 progenies from the cross of PI 90406 x PI 92567

are agronomically unadapted. The scheme was only recently expanded to include within half-sib family selection. Analysis of seed from male-fertile plants grown in a winter nursery is used to select parents for the subsequent cycle of selection. Thus a cycle of selection consists of two phases: 1) mass selection on male-sterile plants; and 2) within half-sib family selection on male-fertile plants. A cycle is accomplished in one year.

Progress from selection for the various cycles of selection is being measured in 1979 in three environments. Current information shows that there has been a seven-fold increase in the oleic/linoleic and linolenic ratio of lines from cycle six material compared to the cultivar Dare. The average level of linolenic and oleic acid is 4.0 and 59.0 percent compared to 8.1 and 20.2 percent for Dare.

Selection on single plants in the two phase recurrent selection scheme for percent oil is successful (Burton and Brim, personal communication) and appears to be fruitful for fatty acid composition. However, as physiological limits, if they exist, are approached, progress may be more difficult to attain with current procedures. Moreover genotype x environment interactions are likely to become more of a factor in selecting for smaller and smaller differences. Testing over environments and extended cycle time will be required. Thus additional effort and information will be required to make accurate selection decisions. Increased analytical facilities are basic to these decisions. Experiments designed to provide the necessary information are the basis for this research proposal and include: a) to increase selection efficiency by practicing within half-sib family selection; b) determination of the magnitude of genotype x environment interactions for fatty acid composition; c) disruptive selection within advanced cycles to determine the magnitude of

genetic variability within the selected population; d) investigation of the inheritance of the genes involved in linolenic acid synthesis and incorporation into glycerol lipid; and e) evaluation of plant to plant variability within superior S_2 progenies from the last cycle of selection. Quantitative evaluation of fatty acid composition in these experiments will be determined by gas-chromotography.

II. Physiological Studies (Raleigh, North Carolina)

The effect of genetic selection upon the fatty acid and molecular species composition of triacylglycerol will be determined through studies on the enzyme diacylglycerol-acyltransferase (EC 2.3.1.20). Virtually nothing is known about this enzyme in plant tissues. However the function of this enzyme in triacylglycerol biosynthesis warrants speculation that it is a potentially important step in the genetic regulation of linolenic acid incorporation into storage lipid. Selective utilization of substrates, based on fatty acid composition, has been demonstrated in maize triacylglycerol biosynthesis. It is conceivable that isoenzymes with differing substrate specificity are present in soybean and subject to genetic control. Thus through selective discrimination against isoenzymes that recognize intermediates containing linolenic acid, there would be reduced accumulation of triacylglycerol molecular species with linolenic acid.

The feasibility of this approach will be tested by the incorporation of specifically labeled [^{14}C] diacylglycerol of known stereospecific composition and radiolabeled [^{3}H] acyl-CoA by intact developing soybean cotyledons. There are potentially 25 different diacylglycerol substrates and five different acyl-CoA intermediates to be tested. Comparison of incorporation rates and stereospecific labeling of triacylglycerol will be determined between the cv. Dare and experimental material selected for low linolenic acid. Positive results will mandate purification and characterization of this enzyme system to determine the specific nature of diacylglycerol and acyl-CoA specificity requirements *in vitro*. The technique will be adapted to provide routine information on linolenic acid deposition in selected genotypes.

III. Physiological Studies (Urbana, Illinois)

The physiological and anatomical effects of genetic selection upon linolenic acid biosynthesis will be studied in developing soybean cotyledons. The enzymatic systems leading to linolenic acid production have never been

fully characterized in plants. Possibly two separate mechanisms are operative utilizing oleoyl-CoA or oleoyl-phospholipid as the precursors of linoleic and linolenic acids. Developing soybean seeds will be fractionated and assayed for desaturase activities using radioactive substrates and the products characterized using chromatographic and radiochemical techniques. The desaturation mechanism actually operating in developing soybean cotyledons will be investigated and determined in experimental materials containing a range of levels of linolenic acid. The desaturation process probably occurs on a particulate fraction of the soybean cotyledon, the microsmal fraction. This suggests that the sub-cellular structure of the cotyledon is intimately involved in linolenic acid biosynthesis. The components of those fractions containing the desaturase mechanism will be studied using electron microscopy. This approach should indicate the particular cellular structures associated with linolenic acid production and give criteria to look for in experimental selections. The microsomal fraction and endoplasmic reticulum may also be involved in the production of lipid bodies. These organelles are the ultimate repository of the triacylglycides which make up soybean oil and contain linolenic acid residues. The sub-cellular ultrastructure and the ontogeny of lipid bodies will be followed during development of soybean cotyledons using electron microscopic techniques and lipid analyses by gas chromatography. The nature of the triglycerides in these lipid bodies during development is unknown. The rate of appearance of linolenic acid in these organelles will be determined. This should provide useful correlative data, along with the desaturase activities, from lines with variable linolenic acid. Whenever possible, the techniques developed will be adapted for routine screening of experimentally selected materials. This will allow the monitoring of stages in linolenic acid production previously ignored in developing soybean cotyledons.

IV. Summary

This program is a multi-university integrated research effort and will report as a single unit through the Principal Investigator. The combined effort and expertise of scientists at Raleigh and Urbana is necessary and will expedite the fulfillment of the project objectives. These studies will cause a considerable increase in the numbers of samples analyzed routinely by GLC annually, in addition to the proposed biochemical studies. Investigations at Raleigh have confirmed that the consecutive

desaturation of oleic acid to linolenic acid occurs through phospholipid as well as acyl-CoA intermediates. Basic information on the relative importance and interaction of these two pathways for polyunsaturated fatty acid biosynthesis with respect to providing linolenic acid for triacylglycerol biosynthesis will be developed at Urbana. In addition the Urbana group will determine, through ontogenic studies of the selected germplasm, the optimum stage of soybean development for gene expression that directs the synthesis of lipids with altered fatty acid composition. Utilization of linolenic acid in triacylglycerol biosynthesis will be examined at Raleigh by the characterization of the enzyme(s) and specific phospholipid and acyl-CoA substrates for triacylglycerol biosynthesis. Results from these investigations on the distinctly separate biochemical components of linolenic acid metabolism will be used to identify the central metabolic control points regulated by genetic manipulation; and will foster improved assays that will supplement GLC procedures of screening selected germplasm with superior oil quality.

Duration of Requested Support

Support for this project is requested for a period of five years. If approved, the funds allocated should be administered separately through the respective institutions.

Qualifications of Investigators

Principal Investigator:

B. E. Caldwell. Soybean Geneticist, Head, Crop Science Department, North Carolina State University, Raleigh, North Carolina. Dr. Caldwell will be the principal investigator for the North Carolina group.

Co-Investigators:

C. A. Brim. Research Leader, Soybeans and Nitrogen Fixation Research Unit, USDA-SEA-AR, Raleigh, North Carolina. Dr. Brim has 25 years experience in soybean genetics and breeding methodology.

R. F. Wilson. Research Plant Physiologist, Soybean Research Unit, USDA-SEA-AR, Raleigh, North Carolina. Dr. Wilson received his advanced degrees at the University of Illinois at Urbana, has had one year post-doctoral experience in soybean lipid metabolism, and has three years experience in soybean physiology and biochemistry at Raleigh

R. W. Rinne. Research Plant Physiologist, Soybean Research Unit, USDA-SEA-AR, Urbana, Illinois. Dr. Rinne has 15 years experience studying the biochemical reactions in the developing soybean seed as they relate to oil synthesis. Dr. Rinne will be the research leader for the Illinois group.

Related Publications

1. Brim, C. A., W. M. Schutz and F. I. Collins. 1968. Maternal effect on fatty acid composition and oil content of soybeans, Glycine max (L.) Merrill. Crop Sci. 8:517-518.

2. Rinne, R. W. and D. T. Canvin. 1971. Fractionation of the fatty acid synthesizing system from the developing soybean cotyledon into a particulate and soluble component. Plant and Cell Physiol. 12:395-403.

3. Rubel, A., R. W. Rinne, and D. T. Canvin. 1972. Protein, oil, and fatty acids in developing soybean. Crop Sci. 12:739-741.

4. Howell, R. W., C. A. Brim, and R. W. Rinne. 1972. The plant geneticist's contribution toward changing lipid and amino acid composition of soybeans. JOACS 49:30-32.

5. Brim, C. A. and C. W. Stuber. 1973. Application of genetic male sterility to recurrent selection schemes in soybeans. Crop Sci. 13:528-530.

6. Wilson, R. F. and R. W. Rinne. 1976. Studies of lipid synthesis and degradation in developing soybean cotyledons. Plant Physiol. 57:375-381.

7. Wilson, R. F. and R. W. Rinne. 1976. Involvement of phospholipids in triglyceride biosynthesis by developing soybean cotyledons. Plant Physiol. 57:556-559.

8. Wilson, R. F., R. W. Rinne, and C. A. Brim. 1976. Alteration of soybean oil composition by plant breeding. JOACS 53:595-597.

9. Yazdi-Samadi, B., R. W. Rinne, and R. D. Seif. 1977. Components of developing soybean seeds: Oil, protein, sugars, organic acids, and amino acids. Agron. J. 69:481-486.

10. Wilson, R. F. and R. W. Rinne. 1978. Lipid molecular species composition in developing cotyledons. Plant Physiol. 61:830-833.

11. Wilson, R. F. and R. W. Rinne. 1978. Studies on the metabolism of lipid molecular species in immature soybean cotyledons. Plant Physiol. 61:871-874.

12. Wilson, R. F. 1978. Breeding for oil quality in soybeans. Proceedings Eighth Soybean Seed Research Conference. 8:49-56.

Budget Summary:

A. North Carolina State University

	1980	1981	1982	1983	1984
1) Salaries:					
a. One Post-Doctoral	15,000	16,050	17,173	18,375	19,661
b. One Graduate Assistant	5,500	5,885	6,297	6,738	7,210
2) Wages (Hourly)	3,000	4,000	4,000	4,000	4,000
3) Fringe Benefits - 18% on Post-Doctoral and 6.13% on hourly wages	2,884	3,135	3,337	3,552	3,784
4) Supplies	4,000	4,000	4,000	4,000	4,000
5) Travel	1,000	1,600	1,700	1,800	2,000
6) Equipment	~~15,000~~ 1/				
Funds requested from ASARF	~~46,384~~ 2384	34,670	36,507	38,465	40,655
Support from N. C. Agricultural Research Service	15,000	15,000	15,000	15,000	15,000

B. University of Illinois

	1980	1981	1982	1983	1984
1) Salaries:					
a. One Post-Doctoral	15,000	16,050	17,173	18,375	19,661
b. One Graduate Assistant	5,500	5,885	6,297	6,738	7,210
2) Fringe Benefits - 16.45% of Post-Doctoral and 0.29% on Graduate Assistant	2,628	2,811	3,008	3,218	3,444
3) Supplies	2,900	2,900	2,900	2,900	2,900
4) Travel	1,500	1,500	1,500	1,500	1,500
5) Equipment	~~15,000~~ 1/	~~8,000~~ 2/			
Total Direct Cost:	~~42,528~~ 27588	~~37,146~~ 29146	30,878	32,731	34,715
Indirect Cost - 10%:	~~4,253~~ 2753	~~3,715~~ 2915	3,088	3,273	3,472
Funds requested from ASARF	~~46,781~~ 30281	~~40,861~~ 32061	33,966	36,004	38,187
Univ. of Illinois Contribution	18,000	18,000	18,000	18,000	18,000

1/ GLC

2/ Centrifuge

Was not approved at ASARF December meetings

May 1978

AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION
PATENT POLICY

A. The basic policy of Sponsor (American Soybean Association Research Foundation), and the purpose of these Patent Provisions, is to insure that the results of sponsored research are applied in a manner which best serves the interest of the producers of soybeans and the public, while also protecting the interests of Cooperator and the inventor or inventors. To secure these ends, Cooperator may, in appropriate cases, seek to secure patents or certificates of plant variety protection, or to negotiate licensing or royalty arrangements, especially when such arrangements can provide an incentive for wider use or exploitation of any invention, new seed variety or discovery made under sponsored research.

B. In furtherance of this purpose and policy, the following provisions are mutually agreed to:

1. Any invention, new seed variety or other discovery which results from work performed by Cooperator under this agreement shall be promptly made known to Sponsor in writing.

2. Cooperator will own any inventions, certificates of plant variety protection, and patent rights developed under this agreement, and proceeds and profits derived therefrom shall be divided between Sponsor and Cooperator as provided in paragraph B(4) below.

   If Cooperator wishes to file domestic or foreign patent applications or to seek certificates of plant variety protection, it shall be done according to the terms of Paragraphs B (3) and B (4) hereof. If Cooperator decides not to so protect inventions developed hereunder, Sponsor may elect to do so at its expense, and Cooperator agrees that it will cause all necessary documents to be executed to permit Sponsor to protect such inventions.

3. The application for Letters Patent or Certificates of Plant Variety Protection shall be made at the expense of the party filing application and through attorneys named by them, and all expenses, including staff time, and travel for or in connection with the preparation, filing, prosecution,

assignment and recording, are payable by Cooperator. All such expenses incurred by Cooperator under this section shall be paid from funds other than those provided by Sponsor for the conduct of research described under this agreement. Sponsor may, at its election, in special cases, provide funds to help defray cost of obtaining patent and plant variety protection certificates.

4. Net revenues from such inventions, certificates and patents shall be divided between Sponsor and Cooperator in proportion to the declared and verified contribution which each party makes to the research during the period of this agreement. Sponsor is a non-profit organization and any such revenues accruing to it will be used for further research or market development programs beneficial to the producers of soybeans and to the public.

C. Cooperator shall observe the usual and reasonable precautions to maintain research records which can be referred to for the purpose of establishing priority of inventorship. Such precautions on the part of a research worker include the recording and disclosure to a knowledgeable co-worker of research findings which may be of patentable significance and having the co-worker witness the record. Although, ideally, the witness should also have observed the experimental work, the Cooperator need not cause to be performed any unnecessary experiments in the presence of otherwise unnecessary observers for the sole purpose of establishing a good record.

D. Exceptions or other conditions mutually agreed to concerning patents or plant variety protection certificates are to be noted, if any.

B/

NORTH CAROLINA STATE UNIVERSITY | AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

AGRICULTURAL RESEARCH SERVICE
BOX 5847 ZIP 27650

January 29, 1980

Mr. Keith J. Smith, Director of Research
American Soybean Association
P. O. Box 27300
St. Louis, MO 63141

Dear Mr. Smith:

As requested in your letters addressed to Dr. R. P. Patterson and Dr. B. E. Caldwell, we are enclosing four signed copies of the memoranda of understanding covering the two research projects listed below:

1. Increasing Tolerance of Soybeans to Water Stress by Photoperiodic Control of Pod-Fill Rate

2. Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil

We have corrected the total figure on Dr. Caldwell's agreement as discussed with you by telephone. We would appreciate receiving two fully executed copies of each of these agreements. Checks covering the quarterly payments should be made payable to the "North Carolina Agricultural Research Service" and sent to this office. Dr. Patterson and Dr. Caldwell will notify you when work under these agreements is officially initiated.

We are also enclosing a letter and supplemental project from Dr. Caldwell. I believe he has discussed this with you by telephone.

We appreciate very much the support of the American Soybean Association for our research program.

Very truly yours,

D. F. Bateman

D. F. Bateman
Director

ac

cc: Dr. R. P. Patterson
Dr. B. E. Caldwell

January 28, 1980

Mr. F. H. (Ted) Bailey
Drawer V
New Bern, NC 28560

Dear Ted:

I want to express our appreciation to you for the support you gave our proposals to the ASARF. Even with the loss of Dr. Brim we will still meet our objectives and continue to have one of the best soybean programs in the U.S. I also want to say thanks for your generous personal comments. As you know I'm proud of my relationships to soybean producers in North Carolina and the U.S. I am most appreciative of their recognition. The recent recognition was a real surprise and I consider it one of my highest honors.

Ted, I am enclosing a copy of a proposal to the American Soybean Research Foundation for the equipment needed to carry out the project. In this proposal we have attempted to justify why the chromatographs are critical to meeting our objectives. The larger amount for North Carolina is because the machine we want will analyze more samples. We need this larger capacity to analyze the genetic material we have in the program.

If you have any questions please let me know. Again, thank you for your support and we enjoyed having you and Kitty in Raleigh for the meeting.

Sincerely,

B. E. Caldwell, Head
Department of Crop Science

BEC/cb

Enclosure

January 28, 1980

Dr. Keith Smith
Director of Research
American Soybean Association
Research Foundation
P. O. Box 27300
St. Louis, MO 63141

Dear Keith:

I am enclosing the supplemental project we discussed. We have attempted to justify the need for the two GLC. Please notice we have deleted the centrifuge for Urbana. The North Carolina unit cost is higher than the Urbana unit because we feel a double detector unit is needed to run the large amount of breeding material projected in the program. Otherwise the two units are similar.

Dr. Brim has decided to take the position with Funks. I appreciate your willingness to work with us, but we just could not get things together fast enough nor meet Funks' offer. We have now begun to make the appropriate adjustment to insure we do not lose any momentum. Dr. Joe Burton who is on our staff and has worked with Dr. Brim will assume the genetics responsibility until we can get a replacement for Dr. Brim. I have already begun discussion to obtain someone to assume Dr. Brim's responsibilities.

Again, I appreciate your help and support. If you have any questions please let me know.

Sincerely,

B. E. Caldwell, Head
Department of Crop Science

BEC/cb

Enclosure

cc: Mr. J. F. Wilder
Mr. F. H. Bailey
Dr. R. F. Wilson

MEMORANDUM OF UNDERSTANDING

between the

North Carolina Agricultural Research Service

and the

AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION

THIS AGREEMENT is made and entered into this 24 day of January, 1980, by and between N.C. Agri. Research Svs., hereinafter called the COOPERATOR, and the AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION, hereinafter called the FOUNDATION.

I AGREEMENT: The contracting parties agree as follows:

The FOUNDATION agrees:

A. To pay the COOPERATOR $51,360 in 12 quarterly installments, according to the budget submitted with the research proposal. The first payment will be provided upon notification by the COOPERATOR that the research effort has been initiated according to the approved research proposal.

The COOPERATOR agrees:

A. That the COOPERATOR's division of sponsored research, or their designated representative, will act for the COOPERATOR in administering this Agreement, and liaison with the FOUNDATION will be through its Director of Research.

B. To make available such qualified personnel, physical facilities and services as the COOPERATOR possesses and as may be required to carry out the terms of this Agreement.

C. To conduct experiments on the "Increasing Tolerance of Soybeans to Water Stress by Photoperiodic Control of Pod-Fill Rate." (Attachment I).

D. To prepare and furnish to the FOUNDATION interim progress reports on such experiments as may be mutually agreed upon and an annual progress report on or before April 1 of each year this Agreement remains in effect, and to furnish the FOUNDATION a copy of any published research reports and/or dissertations resulting from this Agreement.

It is mutually understood and agreed that:

A. Funds made available to the COOPERATOR under the terms of this Agreement shall be expended in accordance with the fiscal regulations governing said COOPERATOR.

B. The COOPERATOR is encouraged to publish the findings made by these studies, but will send all manuscripts to the FOUNDATION in reasonable time for comments and criticism to be received and considered prior to publication. The COOPERATOR reserves the right to accept or reject such suggestions and to be the final judge of what it will publish. In the event the COOPERATOR publishes any such findings, the aid provided by the FOUNDATION will be acknowledged in such publications. The FOUNDATION reserves the right to use such published findings and to release public announcements concerning the initiation of such research at any time. Further, the FOUNDATION reserves the right to use all or any portion thereof of the information contained in the interim reports as it may desire, provided it has been released for publication or unless otherwise agreed to by the COOPERATOR. Due credit is to be given to the COOPERATOR along with the FOUNDATION on any publication of such findings.

C. The name of either party to this Agreement shall not be used by the other in any advertising, publicity, news release, etc., related to the work undertaken under the terms of this Agreement without the consent of the other.

D. The COOPERATOR agrees to follow the guidelines as set out in the attached FOUNDATION Patent Policy (Attachment II) with any differences subject to negotiation between the FOUNDATION and the COOPERATOR prior to initiation of this memorandum.

E. This Agreement shall remain in force for a period of 36 months, unless terminated by either party on any October 1 hereafter by giving the other party written notice of such termination at least 30 days prior to such October 1. However, if the COOPERATOR's annual report described above is received after April 1 of any year, the FOUNDATION may elect to terminate this Agreement at any time during the 30-day period subsequent to the actual receipt of such annual report by the FOUNDATION. This Agreement may be extended or amended at any time by mutual agreement.

IN WITNESS WHEREOF the parties have signed their names effective the day and year first above written.

NORTH CAROLINA AGRICULTURAL
RESEARCH SERVICE
RALEIGH, N.C.

By D. L. Bateman

Title Director

Approved:

By _____

Title _____

AMERICAN SOYBEAN ASSOCIATION
RESEARCH FOUNDATION
ST. LOUIS, MISSOURI

By _____

Title _____

By _____

Title CEO

ASARF-80403
RPP-9

RESEARCH PROPOSAL SUBMITTED TO

THE AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION

Post Office Box 27300, St. Louis, Missouri 63141

Submitted by: The North Carolina Agricultural Research Service
North Carolina State University, Raleigh, NC 27650

1. PRINCIPAL INVESTIGATORS:

Robert P. Patterson
Department of Crop Science
North Carolina State University
Raleigh, North Carolina 27650

C. David Raper, Jr.
Department of Soil Science
North Carolina State University
Raleigh, North Carolina 27650

2. TITLE: INCREASING TOLERANCE OF SOYBEANS TO WATER STRESS BY PHOTOPERIODIC CONTROL OF POD-FILL RATE

Robert P. Patterson
Robert P. Patterson
Principal Investigator

David Raper
C. David Raper, Jr.
Principal Investigator

Billy E Caldwell
B. E. Caldwell
Head
Department of Crop Science

C. B. McCants
C. B. McCants
Head
Department of Soil Science

D. F. Bateman
D. F. Bateman
Director
North Carolina Agricultural Research Service

3. OBJECTIVES:

A possible way to reduce the impact of water stress during reproductive development would be to lessen the intensity of reproductive demand for carbon and nitrogen by reducing the rate, and correspondingly increasing the duration, of seed-fill. We have demonstrated that seed-fill rate can be reduced, and duration increased, by lengthening photoperiod during pod-fill and seed-fill. We have preliminary evidence that when a water stress occurs during seed-fill, leaf senescence and pod maturity occur later under long-day than short-day photoperiods. Indirect evidence suggests that the receptor of the photoperiodic signal is the pod and that photoperiodic response in rate of seed-fill is distinct from the photoperiodic signal for floral induction which is received by the leaves. We have identified two genotypes in which seed-filling rate apparently responds differently to photoperiod duration. If these relationships can be substantiated, then a specific characteristic for enhancing tolerance of soybeans to water stress is identified for inclusion in a breeding program. Thus, the specific objectives are:

A. To establish that rate of seed-fill is a photoperiodic response distinct from floral initiation;
B. To identify genotypic differences in the photoperiodic response of rate of seed-fill;
C. To demonstrate that variation in rate of seed-fill can increase soybean yields through enhanced drought tolerance during reproductive growth.

4. REVIEW OF PERTINENT RESEARCH:

Drought occurrence in the temperate Southeastern United States is intermittent rather than seasonal. In North Carolina precipitation generally exceeds evapotranspiration during the growing season for soybeans (19). However, because of short periods of inadequate rainfall distribution, there is a 50% probability of 40 days of drought scattered throughout the season in most production areas (19). Although a brief interval of water stress can affect the physiological processes of growth, a stress period occurring during

the later stages of reproductive development is particularly influencial in reducing seed yield of soybeans (15, 16). At least five days of drought can be expected every other year during the period of reproductive growth and as many as 16 days of drought can be expected in three out of ten years (19).

The extent of yield reduction from a single incident of water stress increases as the reproductive stage advances toward maturity. The component of yield associated with the reduction also changes from number of seed (and pods) for a stress during flowering and early pod-fill stages to size of seed for a stress during seed-fill stage (15). Although some yield loss results, the abortion of pods and seeds associated with a water stress during early reproductive development may minimize effects of the stress. Rates of photosynthesis and nitrogen fixation by the soybean plant during reproductive growth are less than demand for carbon and nitrogen by developing pods and seeds (13, 14). The excessive demand for assimilates during reproductive growth depletes the reserves of carbon and nitrogen in leaves and roots which are critical for maintenance of leaf and root functioning in supplying new carbon and nitrogen for seed development. Abortion of pods and seeds apparently lessens the reproductive demands on the critical reserves. The adjustment in size of reproductive sink demand prevents depletion of reserves to a level which would impair capacity for photosynthesis and nitrogen fixation. Following relief of a water stress during early reproductive growth, the rates of photosynthesis and nitrogen fixation do return to prestress levels (8, 11). During the later, seed-fill stages, pod and seed abortion do not occur during a period of water stress (15). Without such an adjustment in size of reproductive sink demand exhaustion of critical carbon and nitrogen reserves can irreversibly reduce the photosynthetic and nitrogen fixation capacity of the plant and abbreviate the seed-filling period through forced leaf senescence. The effects of a water stress thus are maximized by a greatly reduced size of individual seed.

The impact of water stress during reproductive development could be lessened if the intensity of reproductive demand for carbon and nitrogen were reduced. Since neither partial defoliation (or shading) nor partial pod removal greatly alters the rate of dry matter

accumulation per seed (2, 3), it is generally assumed that intensity of seed-fill is constant within genotype and, when the option of altering sink capacity by pod or seed abortion has been lost to the plant, effective demand is a fixed characteristic of intensity which restricts the duration of seed-fill (13, 14). However, in both determinate and indeterminate cultivars, shortening the photoperiod after floral initiation reduces the interval between seed-set and maturity (4, 5, 6) and accelerates the rate of leaf yellowing and shedding (4). In our research in the phytotron, we (12, 17) have demonstrated that intensity of pod-fill is reduced, and duration is increased, in the determinate cultivar 'Ransom' by lengthening photoperiod during pod-fill and seed-fill. We have preliminary evidence that when a water stress occurs during seed-fill, leaf senescence and pod maturity occur later under long-day than short-day photoperiods. These data support our postulate that a reduction in the intensity of seed-fill can increase the tolerance of soybeans to a period of water stress by lengthening the duration of seed-fill and that intensity of seed-fill is a photoperiodic response.

Obviously, altering the photoperiod is not a feasible field practice. However, the genetic characteristic involved in photoperiodic regulation of intensity of seed-fill does have potential for exploitation in a breeding program if it is distinct from the photoperiodic requirement for floral development. Evidence suggests that the receptor of the photoperiodic signal for seed-fill is either the pod or the seed. Effects of long-day photoperiods on seed and plant development during reproductive growth (12) are almost identical to effects reported by Quebedeaux and Hardy (10) for subambient oxygen levels. The effect of subambient oxygen occurs when only attached pods are exposed to subambient oxygen and leaves remain in normal oxygen levels. The similarity in response suggests that the two effects may be related through a common mechanism such as permeability of a membrane. More direct evidence is an observation (9) that seed maturity and leaf senescence were delayed when pods of soybean plants were covered with opaque materials. For pods partially covered, the effects on pod maturity were localized to the

covered portion of the pods. Obendorf et al. (7) have reported a light requirement for continued development of detached soybean seed in liquid culture, although they have not demonstrated that the light requirement is for a wavelength in the photomorphogenic range. Since the seedcoat serves as the primary route for assimilate import into the seed (18), these reports suggest that the permeability of the membrane connection between the seedcoat and enclosed sporophyte is mediated by a light-sensitive response.

Soybean genotypes have been reported which maintain green leaves and high leaf protein, including ribulosebiphosphate carboxylase, after pod maturation (1). Since the plants which show delayed leaf senescence also flower earlier and mature later than normal plants, we propose that the physiological mechanism involved is a difference in photoperiodic responsiveness for intensity of seed-fill. We have tentative data from a preliminary experiment to support this postulate. During seed-fill, a water stress was applied to plants of the cultivar 'Ransom' and a line with delayed senescence characteristics, both growing under short-day photoperiods. Plants of the delayed senescence line had a substantial recovery upon watering while the 'Ransom' plants underwent almost complete leaf abscission. If it can be demonstrated that the delayed senescence characteristic is related to photoperiodic responsiveness for rate of seed-fill, then these genotypes would represent genetic potential for utilization in a breeding program to increase the tolerance of soybeans to water stress.

REFERENCES:

1. Abu-Shakra, S. S., D. A. Phillips and R. C. Huffaker. 1978. Science 199: 973-975.

2. Egli, D. B., D. R. Gossett and J. E. Leggett. 1976. Crop Sci. 16: 791-794.

3. Egli, D. B., and J. E. Leggett. 1976. Agron. J. 68: 371-374.

4. Fukui, J., and H. Yarimizu. 1952. Crop Sci. Soc. Japan Proc. 21: 123-124.

5. Johnson, H. W., H. A. Borthwick and R. C. Leffel. 1960. Bot. Gaz. 122: 77-95.

6. Nagata, T. 1958. Crop Sci. Soc. Japan Proc. 27: 87-90.

7. Obendorf, R. L., E. E. Timpo, M. C. Byrne, and F. C. Hsu. 1979. Agronomy Abstracts, p. 91; Plant Physiol. supplement 63 (5): 87.

8. Patterson, R. P., C. D. Raper, Jr. and H. D. Gross. 1979. Plant Physiol. 64: in press.

9. Peet, M. M., and P. J. Kramer. 1978. Agronomy Abstracts, p. 83.

10. Quebedeaux, B., and R. W. F. Hardy. 1976. In R. H. Burris and C. C. Black (eds.) CO_2 metabolism and plant productivity. University Park Press, Baltimore, Maryland. pp. 185-204.

11. Raper, C. D., Jr. and R. P. Patterson. in review.

12. Raper, C. D., Jr. and J. F. Thomas. 1978. Crop Sci. 18: 654-656.

13. Sinclair, T. R., and C. T. deWit. 1975. Science 189: 565-567.

14. Sinclair, T. R., and C. T. deWit. 1976. Agron. J. 68: 319-324.

15. Sionit, N., and P. J. Kramer. 1977. Agron. J. 69: 274-278.

16. Tambi, A. B., R. P. Patterson, H. D. Gross, and C. D. Raper, Jr. 1979. Abstracts, World Soybean Research Conference-II.

17. Thomas, J. F., and C. D. Raper, Jr. 1976. Crop Sci. 16: 667-672.

18. Thorne, J. H. 1979. Agronomy Abstracts, p. 17.

19. van Bavel, C. H. M., and F. J. Verlinden. 1956. North Carolina Agri. Exp. Stn. Tech. Bul. No. 122.

5. PROCEDURES:

The general objective is to investigate photoperiodically regulated rate of seed-fill as a mechanism of increasing the tolerance of soybeans to intervals of water stress. Phytotron experiments will be used to establish that rate of seed-fill is a photoperiodic response distinct from flower initiation and to identify genotypic differences in this response. Both phytotron and field experiments will be used to demonstrate that these variations in rate of seed-fill can greatly reduce the deleterious effects of late-season drought on seed yield.

Phytotron Experiments: Phytotron experiments initially will utilize whole plants to establish that rate of seed-fill is a photoperiodic response and the receptor for the photoperiodic stimulus is either the pod or the seed. Plants of the cultivar 'Ransom', with demonstrated sensitivity of seed-fill rate to photoperiod (12, 17), will be grown as previously described (12) under long-days until the V6 stage, then moved to short-day photoperiods until beginning pod stage (V3). Half of the plants then will be returned to long-day photoperiods and half will be retained in short-day photoperiods until seed maturity. Within each photoperiod, pods on a few plants will be covered with foil to exclude all light. Whole plants will be sampled periodically until maturity for measurement of rates of reproductive and vegetative growth. For plants with exposed pods, we expect to find the fastest rate of seed growth and an almost zero rate of vegetative growth under short-day photoperiods and the slowest rate of seed growth and a moderate rate of vegetative growth under long-day photoperiods. For plants with covered pods, we expect to find in both photoperiods almost no seed growth and fast, nearly identical rates of vegetative growth. The photoperiod treatment will be repeated with plants of a delayed senescence genotype.

Because whole plant experiments for measuring rates of seed growth have a large requirement for both time and phytotron space, we propose to adapt the methods of Obendorf (7) to culture detached pods and seeds using a liquid medium containing sucrose as a carbohydrate source, glycine as a nitrogen source, mineral nutrients, and vitamins. No growth regulators are required. Pods from a single mother plant can be divided among several photoperiod treatments and light sources to determine photoperiodic effects on rates of seed growth. Detached seed from 'Ransom' and the delayed senescence cultivar initially will be cultured under the same photoperiods and light sources used in the whole plant study described above. Rates of seed growth in detached culture will be compared with rates from whole plant culture for validation of the procedure. Then the procedure will be used in phytotron facilities to screen a wide range of genotypes for variations in photoperiodic sensitivity and requirements of rate of seed development. Since previous experiments (12, 17) have indicated

an interaction between temperature and photoperiodic response in seed-fill, temperature will be included as an environmental variable. Genotypes will be selected for whole plant experiments on applied water stress.

Initial experiments on ability of photoperiodic control of seed-fill rate to enhance tolerance of soybeans to water stress also will be conducted in the phytotron. Plants of genotypes contrasting in response of seed-fill rate to photoperiod will be grown until the R3 stage as described in the first experiments, and then be divided between short-day and long-day photoperiods. At the R5 or R6 stage, water will be withheld from half of the plants in each photoperiod until leaf water potentials reach a stress level of about -22 bars. After rewatering, these plants will be grown to maturity along with control plants. Stressed and control plants will be sampled at frequent intervals from time of application of stress treatment until pod maturity. Measurements to be made include net CO_2 exchange rate by infrared gas analysis, apparent nitrogenase activity by the acetylene reduction technique, and nitrogen composition and dry matter content of leaves, stems, roots, and pods and seed. For the genotypes in which seed-fill rates are more sensitive to photoperiod, we expect to find that seed yields of stressed relative to control plants are greatly reduced and leaf senescence at pod maturity more advanced under short-day photoperiods but only slightly reduced under long-day photoperiods. Short days are characteristic of field environments during reproductive growth stages. For the genotypes in which seed-fill rates are less sensitive to photoperiod, we expect to find little difference in seed yields and leaf senescence of stressed relative to control plants between long-day and short-day photoperiods.

Field Experiments: The genotypes included in the latter phytotron experiment will be evaluated in field experiments during the second and third years of the project. Rain-out shelters will be used to induce leaf water stresses during seed-fill periods. Irrigation will be used to assure a lack of stress for control plants. Supplemental lights may be required to control floral initiation and assure that reproductive development of all genotypes is synchronized. Plants will be sampled at frequent intervals for the same measurements as in the phytotron experiment. We expect to find that in the natural short-days yields of genotypes in which

rate of seed-fill is less sensitive to photoperiod will be less affected by the late-season water stress.

Facilities: The necessary facilities and equipment for the proposed research are available to the investigators at North Carolina State University. The phytotron provides superior controlled-environmental facilities. Field research facilities are available on university research stations. To support the field experiments, we have a mobile environmental monitoring unit with instrumentation which corresponds to that used in the phytotron. We have arranged to adapt the procedure for culture of detached pods and seed for our facilities. We have a gas chromatograph, infrared gas analyzer, freeze-drier, and laboratory adequately equipped to conduct supporting enzymatic or other assays that may be desirable.

6. DURATION OF REQUESTED SUPPORT: Three years.

7. BUDGET SUMMARY:

	Requested from Foundation		
	Fiscal Year		
	1980-81	1981-82	1982-83
A. Salaries and Wages			
Principal Investigators			
R. P. Patterson (10%)	-	-	-
C. D. Raper, Jr. (10%)	-	-	-
Technician (1/2 time)	$ 5,868	6,278	6,718
Temporary Student Labor	5,200	5,200	5,200
Total Salaries	11,068	11,478	11,918
B. Employee Benefits			
18% of Technician	1,056	1,130	1,210
C. Supplies and Expendable Equipment	3,000	3,000	3,000
D. Phytotron Space Charges	500	500	500
E. Other Costs	1,000	1,000	1,000
TOTAL ANNUAL	$16,624	$17,108	$17,628
GRAND TOTAL			$51,360.
F. Support from North Carolina Agricultural Research Service			
Professional salaries (10%) Clerical and Technician support and other operational expenses to supplement proposed research	$ 16,500	$17,650	$18,885

8. QUALIFICATIONS OF PRINCIPAL INVESTIGATORS:

A. Research Involvement:

The principal investigators, Dr. R. P. Patterson and Dr. C. D. Raper, Jr., have considerable experience in combining field and phytotron research to investigate crop response to environmental stress. Dr. Patterson has worked extensively on water and temperature stresses on nitrogen fixation and soybean yield and has eight papers published or in press. He is currently directing the thesis research of one M.S. and one Ph.D. student working on relationships between water stress and yield of soybeans. Dr. Raper has investigated environmental effects of photosynthesis, nutrition, assimilate partitioning and ontogeny and has 41 publications. His recent work has been directed toward effects of photoperiod and temperature on rates reproductive development of soybeans with attention to associated dynamics of carbon and nitrogen assimilation within the plant. He is currently working with Dr. Paul Kramer of Duke University as co-organizer, to organize a workshop on effects of the intermittent water and temperature stresses of temperate regions on crop yields.

B. Education:

Robert P. Patterson; B. S. and M. S. in Soil Science, North Carolina State University, 1961 and 1963; Ph.D. in Agronomy, Cornell University, 1968.

C. David Raper, Jr.; B. S. and M. S. in Soil Science, North Carolina State University, 1963 and 1966; Ph.D. in Agronomy, Purdue University, 1970.

C. Employment:

Robert P. Patterson; Assistant Professor (1968-1973) and Associate Professor (1973-present), Department of Crop Science, North Carolina State University.

C. David Raper, Jr.; Visiting Assistant Professor (1969-1971) Assistant Professor (1971-1975), and Associate Professor (1975-present), Department of Soil Science, North Carolina State University.

D. Pertinent Publications:

Robert P. Patterson (8 total)

Prior, R. L., D. L. Grunes, R. P. Patterson, F. W. Smith, H. F. Mayland, and W. J. Visek. 1973. Partition column chromatography for quantitating effects of fertilization on plant acids. J. Agric. Food Chem. 21:73-77.

Crompton, C., J. C. Wynne, and R. P. Patterson, 1978. Calcium content, adenylate energy level, and seed vigor in peanuts. Crop Sci. 18:736-739.

Patterson, R. P., C. D. Raper, Jr., and H. D. Gross. 1979. Growth and specific nodule activity of soybeans during application and recovery of a leaf moisture stress. Plant Physiol. 64: in press.

Tambi, A. B. 1979. The effect of water deficit on vegetative and reproductive growth and nitrogen assimilation of field-grown soybeans. M. S. Thesis under the direction of R. P. Patterson, North Carolina State University, Raleigh, N. C.

C. David Raper, Jr. (41 total)

Thomas, J. F. and C. D. Raper, Jr. 1977. Morphological response of soybeans as governed by photoperiod, temperature, and age of treatment. Bot. Gaz. 138: 321-328.

Raper, C. D., Jr., and J. F. Thomas. 1978. Photoperiodic alteration of dry matter partitioning and seed yield in soybeans. Crop Sci. 18:654-656.

Raper, C. D., Jr., D. L. Osmond, M. Wann, and W. W. Weeks. 1978. Interdependence of root and shoot activities in determining nitrogen uptake rate of roots. Bot. Gaz. 139:289-294.

Wann, M., and C. D. Raper, Jr. 1979. A dynamic model for plant growth: Adaptation for vegetative growth of soybeans. Crop Sci. 19:461-467.

May 1978

AMERICAN SOYBEAN ASSOCIATION RESEARCH FOUNDATION
PATENT POLICY

A. The basic policy of Sponsor (American Soybean Association Research Foundation), and the purpose of these Patent Provisions, is to insure that the results of sponsored research are applied in a manner which best serves the interest of the producers of soybeans and the public, while also protecting the interests of Cooperator and the inventor or inventors. To secure these ends, Cooperator may, in appropriate cases, seek to secure patents or certificates of plant variety protection, or to negotiate licensing or royalty arrangements, especially when such arrangements can provide an incentive for wider use or exploitation of any invention, new seed variety or discovery made under sponsored research.

B. In furtherance of this purpose and policy, the following provisions are mutually agreed to:

1. Any invention, new seed variety or other discovery which results from work performed by Cooperator under this agreement shall be promptly made known to Sponsor in writing.

2. Cooperator will own any inventions, certificates of plant variety protection, and patent rights developed under this agreement, and proceeds and profits derived therefrom shall be divided between Sponsor and Cooperator as provided in paragraph B(4) below.

   If Cooperator wishes to file domestic or foreign patent applications or to seek certificates of plant variety protection, it shall be done according to the terms of Paragraphs B (3) and B (4) hereof. If Cooperator decides not to so protect inventions developed hereunder, Sponsor may elect to do so at its expense, and Cooperator agrees that it will cause all necessary documents to be executed to permit Sponsor to protect such inventions.

3. The application for Letters Patent or Certificates of Plant Variety Protection shall be made at the expense of the party filing application and through attorneys named by them, and all expenses, including staff time, and travel for or in connection with the preparation, filing, prosecution,

assignment and recording, are payable by Cooperator. All such expenses incurred by Cooperator under this section shall be paid from funds other than those provided by Sponsor for the conduct of research described under this agreement. Sponsor may, at its election, in special cases, provide funds to help defray cost of obtaining patent and plant variety protection certificates.

4. Net revenues from such inventions, certificates and patents shall be divided between Sponsor and Cooperator in proportion to the declared and verified contribution which each party makes to the research during the period of this agreement. Sponsor is a non-profit organization and any such revenues accruing to it will be used for further research or market development programs beneficial to the producers of soybeans and to the public.

C. Cooperator shall observe the usual and reasonable precautions to maintain research records which can be referred to for the purpose of establishing priority of inventorship. Such precautions on the part of a research worker include the recording and disclosure to a knowledgeable co-worker of research findings which may be of patentable significance and having the co-worker witness the record. Although, ideally, the witness should also have observed the experimental work, the Cooperator need not cause to be performed any unnecessary experiments in the presence of otherwise unnecessary observers for the sole purpose of establishing a good record.

D. Exceptions or other conditions mutually agreed to concerning patents or plant variety protection certificates are to be noted, if any.

January 7, 1980

Dr. Robert T. Patterson
Department of Crop Science
North Carolina State University
Raleigh, NC 27650

RE: ASARF 80403

Dear Dr. Patterson:

To confirm our earlier correspondence, the American Soybean Association Research Foundation approved funding of your research project entitled, "Increasing Tolerance of Soybeans to Water Stress by Photoperiodic Control of Pod-Fill Rate." We are pleased to be a part of your comprehensive research program.

Enclosed is a Memorandum of Understanding for your administration's review. If acceptable, please obtain the needed signatures and return four copies to our office. We will sign the Memorandum and return two copies.

We will provide the first grant payment as soon as you notify us that the project is officially initiated according to Section 1-A of the Memorandum. We would also appreciate instructions on the procedure to be followed (name/address) in providing our quarterly payment since often the payment goes directly to your business office.

If you should have any questions pertaining to the initiation of this project, please do not hesitate to contact me.

Sincerely,

Keith J. Smith
Director of Research

dk/4/9

Enclosures

cc: Eugene Glock
F. H. Bailey
Thurman Burleson
James Wilder

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

Soybeans
American Soybean Association

January 8, 1980

Agreement sent to AC for Approval 1/17/80

Dr. R. W. Rinne
Research Plant Physiologist
USDA/SEA/AR
Department of Agronomy
University of Illinois
Urbana, IL 61801

RE: ASARP 80465

Dear Dr. Rinne:

To confirm our earlier correspondence, the American Soybean Association approved funding of your research project entitled, "Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil." We are pleased to be a part of your comprehensive research program. Please note the Foundation did not approve your request for capital equipment purchases. If this new equipment is essential to your project, please contact ASA staff.

Enclosed is a Memorandum of Understanding for your administration's review. If acceptable, please obtain the needed signatures and return four copies to our office. We will sign the Memorandum and return two copies.

We will provide the first grant payment as soon as you notify us that the project is officially initiated according to Section 1-A of the Memorandum. We would also appreciate instructions on the procedure to be followed (name/address) in providing our quarterly payment since often the payment goes directly to your business office.

If you should have any questions pertaining to the initiation of this project, please do not hesitate to contact me.

Sincerely,

Keith J. Smith
Director of Research

dk/4/10

Enclosures

cc: Eugene Glock
F. H. Bailey
Lloyd Wilken
Allan Aves
Carl Marriott
William Mathena
Bill Tiberend
Dr. B. E. Caldwell

January 8, 1980

Dr. B. E. Caldwell
Department of Crop Science
North Carolina State University
Raleigh, NC 27650

RE: ASARP 80455

Dear Dr. Caldwell:

To confirm our earlier correspondence, the American Soybean Association approved funding of your research project entitled, "Response to Selection and Metabolism of Unsaturated Acyl-Lipids in Soybean Oil." We are pleased to be a part of your comprehensive research program. Please note the Foundation did not approve your request for capital equipment purchases. If this new equipment is essential to your project, please contact ASA staff.

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If you should have any questions pertaining to the initiation of this project, please do not hesitate to contact me.

Sincerely,

Keith J. Smith
Director of Research

dk/4/10

Enclosures

cc: Eugene Glock
F. H. Bailey
Thurman Burleson
James Wilder
Dr. R. W. Rinne

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

DEPARTMENT OF CROP SCIENCE

North Carolina State University and Agricultural Experiment Station

MEMORANDUM

TO Dr. Caldwell

Bill,

when convenient, could we discuss this memo of Understanding? I have a question regarding start-up date. Also, could we discuss the matter of use of part of these funds to obtain a full-time technician for me on this project as well as my state-supported work. Dave Rapp & I have discussed this matter & we are agreed that a full-time technician is our greatest need. The basic question is, could this money (or a part of it) be used for a technician position?

ATTACHED PAPERS

_____ Please note and return.
_____ Please note, do not return.
_____ For your information.
_____ File.
_____ For your record.
_____ Hold for conference.
_____ Please handle.
✓ Speak to me concerning.
_____ Please answer.
_____ Note opinion and return.
_____ Needs your signature.
_____ Please approve.
_____ Please give me all data.
_____ Refer to me.

SIGNED _____

Date as "seed" mtg. to work toward BDL 1-15-80

Agreement sent to AC for Approval 1/17/80

January 7, 1980

Dr. Robert T. Patterson
Department of Crop Science
North Carolina State University
Raleigh, NC 27650

RE: ASARF 80403

Dear Dr. Patterson:

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If you should have any questions pertaining to the initiation of this project, please do not hesitate to contact me.

Sincerely,

Keith J. Smith
Director of Research

dk/4/9

Enclosures

cc: Eugene Glock
F. H. Bailey
Thurman Burleson
James Wilder

777 CRAIG ROAD, P.O. BOX 27300, ST. LOUIS, MO 63141, TELEX 447297, PHONE (314) 432-1600

Marketing file

TO: Charles Brim, Walt Fehr, Jim Wilcox, Roger Boerma, Robert Judd, Robert Leffel, John Schillinger

FROM: Keith Smith

DATE: January 2, 1980

SUBJECT: Special Meeting of Researchers Involved in Linolenic Acid Breeding Studies

CC: Dick Shibles, Billy Caldwell, Rich Wilson, Earl Hammond, Bill Rinne, Joe Cherry, Eugene Glock, Dave Erickson

Just a note to confirm our telephone conversation. We will plan to have lunch together Thursday noon, February 21, 1980, and spend some time discussing your planned research on breeding for reduced linolenic acid content of soybeans. Therefore, you should plan your travel to leave St. Louis after 3:00 p.m.

This get-together should help in coordinating the exchange of information on linolenic acid research. We look forward to seeing you in February.

cj 3/9

PS: After typing this letter, we realized how many people were carbon copied. The purpose of this meeting is primarily, to get the three soybean growers with ASARF grants together to discuss their research plans. Each of you will be informed of the results of this meeting.

Soybeans
American Soybean Association
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