SUNFLOWER RESEARCH IN THE PHILIPPINES

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Sunflower (*Helianthus annus* L.) is a member of the family Compositae. The inflorescence is a head in which the disk flowers upon fertilization bear the oil seed. The main product derived from the seeds is an edible oil of superior quality highly poly-unsaturated, relatively cholesterol free and contains no trypsin-inhibitory factors.

In terms of its production potential in relation to other oil crops, it is a higher yielder per unit area per unit time. The oil content ranges from 33-45 percent by weight depending on the variety, the biotic and agro-climatic conditions prevailing in the production area.

Aside from the oil, the meal after oil-extraction has been used for human food and to a great extent as animal feed. Other by-products such as chip-boards from the stalks, green fodder for animal feed and certain chemical extracts have been derived from various parts of the plant.

Research on sunflower in the Philippines has been motivated by the Philippine Refining Co. some nine (9) years ago where it tapped Central Luzon State University to spearhead the development of a package of production technology in order to introduce sunflower in the mainstream of Philippine agriculture.

An integrated and multidisciplinary research program "Sunflower Breeding and Production Under Tropical Conditions" was submitted by Central Luzon State University to the NSDB which was immediately approved and funded.

This paper highlights the significant research accomplishments; discuss the major problems and constraints apertain to the development of the technology pack and its adoption and focus attention on the research thrust for the immediate future.

A. *Major Areas of Research*

It is worth emphasizing that the research program was multidisciplinary in approach and total integration of research results was the target concern.

Listed herewith are the project/studies undertaken over a period of nine years.

A. Sunflower Researches Conducted at Central Luzon State University through NSDB Funding, October 1971 to December 1979.

Title	*CY Conducted*
I. Varietal Improvements	
1.1 Introduction and Maintenance of Sunflower Varieties	1971-1972
1.2 Trial Planting of Different Varieties of Sunflower Under CLSU Condition	1971-1972
1.3 Performance of Different Lines Within Varieties of Sunflower	1971-1972
1.4 Varietal Evaluation and Maintenance of Sunflower Varieties	1972-1979
1.5 The Use of Ethrel in the Induction of Male Sterility in Sunflower	1973
II. Cultural Management	
2.1 Planting Density	
2.1.1 Interaction of Plant Population, Time and Rate of Nitrogen Fertilization on the Yield of Sunflower	July-Sept. 1971
2.1.2 Variation in the Response to Planting Density in Sunflower	Jan.-March 1972
2.1.3 Interaction of Distance of Planting and Number of Plants Per Hill on the Growth and Yield of Large Seeded Variety of Sunflower	Nov. 1971-Feb. 1972
2.1.4 Response of Sunflower to Different Row and Hill Spacings	1974
2.1.5 Interaction of Seeding Rate Per Hill and Levels of Nitrogen	1974
2.1.6 Effect of Different Rates of Seeding and Distance Between Hills on the Growth and Yield of Sunflower	1974-1975
2.1.7 Seedset in Sunflower as Affected by Agents of	

	Pollination and Time of Planting	1975-1976
2.2	Fertilizer Studies	
2.2.1	Sunflower Seed Production as Influenced by Levels of Fertilizer and Plant Population	Feb.-May 1971
2.2.2	Effect of Different Grades of Fertilizer on Sunflower	Nov. 1971-June 1972
2.2.3	Response of Sunflower to Different Levels of N, P, K	Nov. 1971-June 1972
2.2.4	Response of Sunflower to Various Sources and Rates of Fertilizer	June-April 1972
2.2.5	Rate and Time of Nitrogen Application on Sunflower	Oct. 1972-Jan. 1973
2.2.6	Yield Performance of Sunflower on Different Levels of Nitrogen Fertilizer	Oct. 1972-Jan. 1973
2.2.7	Effect of P and N with Constant K on Sunflower	Oct. 1972-Jan. 1973
2.2.8	Response of Sunflower to different grades of P and K with Fixed N	Oct. 1972-Jan. 1973
2.2.9	Response of Sunflower to Different Levels of Nitrogen	Oct. 1972-Jan. 1973
2.2.10	Response of Sunflower to Plant Density and Fertilizer on Cultivated and Uncultivated Riceland	Jan.-April 1973
2.2.11	Effect of Different Levels of Complete Fertilizer	1974
2.2.12	Effect of Different Sources and Levels of N	1974
2.2.13	Time and Method of Nitrogen Fertilizer Application	1974

2.2.14	Response of Sunflower to Different Grades of Liquid Fertilizer	1974
2.2.15	Effect of Varying Levels of Urea as Liquid or in Granular Form on the Growth and Yield of Sunflower	1974-1975
2.2.16	Study on the Use of Chicken Manure and Sagana 100 as Supplement to Inorganic Nitrogen in Sunflower Production	1975-1976
2.2.17	Response of Sunflower to Different Level Combination of Nitrogen and Phosphorus	1975-1976
2.2.18	Effect of Nitrogen from Vitasoil and Urea on the Yield of Sunflower	1975-1976
2.2.19	Effect of Liquid Fertilizer Combined with Insecticide on Sunflower Production	1975-1976
2.2.20	Effect on Cytozyme's Crop on the Growth and Yield of Sunflower	1979
2.3	Cultural Management	
2.3.1	Response of Different Time of Cultivation and Method of Fertilizer Application	1972
2.3.2	Growth and Yield Performance as Affected by Five Practices of Land Preparation Using Hand Tractors	1975
2.4	Irrigation Studies	
2.4.1	Preliminary Study on the Effect of Different Systems of Planting and Irrigation on the Growth and Yield of Sunflower	1974-1975
2.4.2	Consumptive Use of Water by Sunflower	Nov. 1971-Feb. 1972
2.4.3	Irrigation Timing on Sunflower as Used on Available Soil Moisture	Nov. 1971-Feb. 1972

2.4.4	Study on the Proper Time of Terminating Irrigation on Sunflower	1973
2.4.5	Evapotranspiration of Sunflower as a Function of Climatic Factors, Soil Moisture Content and Plant Age	1975
2.4.6	Further Study on the Tolerance of Sunflower to Waterlogging	1975
2.4.7	The Effects of Different Irrigation Schemes and Methods of Land Preparation on the Growth and Yield of Sunflower	1976
2.4.8	The Viability of Sunflower Seeds as Affected by Different Water Management Practices, Initial Moisture Content and Storage	1976
2.4.9	Further Study on the effect of Different Systems of Planting and Irrigation on the Growth and Yield of Sunflower	1976

2.5 Cropping Systems

2.5.1	Trial Planting of Sunflower Under Dry and Wet Season	June-Aug. 1971 Jan.-April 1971
2.5.2	Monthly Planting of Sunflower Under CLSU Condition	Oct. 1972-Sept. 1973
2.5.3	Comparative Study of Three Legumes as Intercrop With Sunflower	1973-1974
2.5.4	Study on Intercropping and Mixed Cropping	1975
2.5.5	Feasibility Study of Intercropping Sunflower With Upland Rice	1974-1975
2.5.6	Study on Intercropping Sunflower With Peanut	1974-1975

Species Associated With Sunflower and Other Upland Crops	1974-1976
3.12 Effect of Weeding and Intercropping Within Rows on the Growth and Yield of Sunflower and Peanut	April-July 1975
3.13 Phenology and Life Span Observation of Weeds Associated with Peanut, Sunflower and Sesame	April-Aug. 1975
3.14 Effect of Duration of Weed Control on Growth and Yield of Sunflower	April-July 1975
3.15 Effect of the Duration of Weed Competition on the Growth and Yield of Sunflower	April-June 1975
3.16 Study on Weed Control	1975
3.17 Effect of Different Positions of Weeds on the Growth and Yield of Sunflower	April-July 1975
3.18 Fungicide Screening for the Control of Sunflower Wilt	1975-1976
3.19 Field Evaluation of Fluometuron for Weed Control of Sunflower	Nov. 1975-Feb. 1976
3.20 Field Evaluation of Diuron for Weed Control in Sunflower	Nov. 1975-Feb. 1976
3.21 Insecticide Recommendation for Sunflower Production	1976-1977
3.22 Comparison in Yield Between Sprayed and Unsprayed Area of Sunflower	Nov. 1976-May 1977
3.23 Screening of Different Insecticides for the Control of the Major Insect Pests of Sunflower Under Laboratory and Field Conditions	Nov. 1978-June 1979
3.24 The Biology and Population Dynamics of the Major Insect Pests of Sunflower Under Central Luzon Conditions	1979
3.25 Survey and Identification of Sunflower Diseases in Sunflower	1979

5.2	Study on the Time of Harvesting As Affecting Seed Yield and Germination	1973
5.3	Design and Construction of a Self-Feeding Power Driven Sunflower Thresher	1973
5.4	Development for a Technology for Processing Sunflower Seeds As "Cracked Seeds."	1975

VI. Economics

6.1	Cost and Return Analysis Established that Sunflower can be Developed As One of the Major Cash Crop Which can Command Higher Returns Per Unit Area Per Unit Period of Time	1975
6.2	Establishment of the Profitability of Intercropping/Mixed Cropping Sunflower With Other Cash Crops	1976
6.3	Evaluating the Economic Feasibility of the Package of Technology on Sunflower Production Under Philippine Farm Conditions	1976
6.4	Cost and Returns Study of Sunflower Under Commercial Scale Operations	1976
6.5	Sunflower Production Under Different Levels of Input and Management	1979

B. Significant Accomplishments

1. Introduce sunflower in the stream of Philippine agriculture.
2. Developed a variety, CLSUN-1 which is comparable in yield to other foreign standard varieties; adopted to the country's agro-climatic conditions and relatively resistant to the major insect pests and diseases locally attacking sunflower.
3. Package of technology which is ready for adoption by farmers (Appendix A).
4. Identified the problems and constraints both technical and from the view point of economics.
5. Succeeded in developing a technology for utilization other than for oil. This is the product known as "Sunflower Crackseeds" which has been developed as a cottage-industry in some localities.

C. Problems/Constraints

1. The readiness among small farmers to adopt the sunflower production technology are constrained by:
   - 1.1 Ready market at a margin equal to other crops that the farmer grows.
   - 1.2 "The variability in yield (ranges from 750 kgs — 1,450 kgs) due to unreasonable use of insecticides for other crops. It is well to state that sunflower is a cross-pollinated crop which depends mainly on insects as pollinators. Indiscriminate use of insecticides in adjoining areas prejudices the yield of sunflower.
   - 1.3 There is need therefore to develop apiculture (bee-keeping) as an adjunct to sunflower production in order to insure high yields. However, apiculture is an added investment for a farmer which he might not be able to afford not to say that it needs less maintenance during off-production periods.
   - 1.4 Hidden apprehension among coconut producers that sunflower oil might compete with coconut oil.
   - 1.5 Availability of good-quality seeds for a relatively big area of production. There needs to encourage certified seeds producers to be involved in this concern.

D. Looking Forward

The CLSU sunflower researchers have now focused their attention to the following activities:

1. Pilot testing the package of technology in potential sunflower growing areas of the country.
2. Expand and continue research activities in varietal improvement, crop protection especially in screening pesticides which are effective but not detrimental to the beneficial insect pollinators.
3. Further refinement of the package of technology towards increasing yields to offset the increase in the cost of inputs.
4. Strengthen the research on cropping system as this is one method to increase farm income and also cushion the effect of crop loss.
5. Intensify research on apiculture as an adjunct to sunflower production.
6. Lobby to authorities concern for credit/market support for sunflower as part of the cropping system.

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To the Philippine Refining Company (PRC) for challenging CLSU to undertake research on sunflower and to my dear colleagues in CLSU for their untiring efforts and commitment to sunflower research.

APPENDIX "A"

Input-Output Analysis of Sunflower Seed Production for One Hectare as of July 1980

Item of Expenditure	*Man-Hr/Hrs.*	*Value (₱)*	*Percent*
I. Non-Cash Cost			
A. Land rental (3-month period)		210.95	6.94
B. Interest on operating capital investment[1]		87.22	2.87
II. Cash-Cost			
A. Labor[2]			
1. Land Preparation			
a. plowing & harrowing	120	225.00	7.41
b. furrowing	25	46.87	1.54
2. Field Labor			
a. planting	63	118.12	3.89
b. thinning & replanting	63	118.12	3.89
c. fertilization	59	110.62	3.64
d. irrigation (4x, 7 water tenders)	103	193.12	6.36
e. 2x cultivation & weeding	50	93.75	3.09
f. spraying (3 men, at most 4x)	96	180.00	5.93
g. harvesting & shelling	66	123.75	4.07
B. Use of Machineries (hrs.)			
1. Use of 6" water pump at ₱8.50/in/hr.	4.07[3]	207.57	6.84
2. Use of 4" water pump at ₱6.50/in/hr.	15.87[3]	412.62	13.58
C. Production Inputs			
1. 12 kg sunflower seeds at ₱4.00/kg		48.00	1.58
2. Fertilizer (Urea 45% N) ₱94.00/bag		501.02	16.50
3. Insecticides			
a. Sevin 85 WP (0.3 box at ₱27.27/box)		8.18	0.3

b. Azodrin 168 (1.6 quart at ₱58.00/qrt)	92.80	3.05
c. Thiodan (5.8 qrt. at ₱44.63/qrt)	258.85	8.52
TOTAL	₱3,036.56	100.00

III. Net Returns

1,300 kgs. of seeds at ₱4.00/kg	₱5,200.00
Total cost of production	3,036.56
Net returns	₱2,163.44

IV. Net Return Per Peso Invested ₱ 0.79

Net income	2163.44
Cash expenses	2738.39

V. Net Return on Investment (ROI) Includes Non-Cash Costs ₱ 0.71

Net income	2163.44
Total expenses	3036.56

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[1]Computed at 12% per annum straight-line interest

[2]₱15.00 per 8-hr/day

[3]Computed based on 1977 figures:
a) Use of 6" water pump at ₱6.00/in/hr. at ₱146.66
b) Use of 4" water pump at ₱4.00/in/hr. at ₱254.00

Eduvigis Pantastico, Ph.D., Discussant

Thank you Dr. Velasquez and of hand I would like to congratulate the speaker, a former colleague in the Department of Botany at UP Los Baños.

I have three points to talk about the paper, I would like to look at sunflower as an example of the "brand" of CLSU. Second, I would like to take the sunflower as a biological material and therefore I'll talk about the physiological requirement. Thirdly, I look at the sunflower as discussed, that is, as a tool for development.

As a "brand" of CLSU I think this is one commodity among the others, we used to hear before of cotton, from CLSU. They did a lot of studies about cotton and now it is taken in by a corporation and it is an ongoing business in the country. Another is probably you have heard of rice-fish culture at CLSU and is being adopted again by the ministries and by other regions of the country, CLSU the rice-fish culture, inland fisheries and so on.

As a brand of CLSU, this crop commodity among others can be identified only with that University. The University tends to select only few commodities to study and making good at them. For example, their researchers have specialized in cotton, carabeef, rice-fish culture and inland fisheries. This kind of specialization may lead to agro-climatic zonification of growing crops in the country, if only other agricultural universities and research agencies will follow the same type of approach.

Sunflower as a biological material. Sunflower belongs to the C_3 — pathway of photosynthesis and two groups are known to exist: one, requiring low temperature (15-20°C) for maximum photosynthesis and the second, requiring high temperature (25-30°C) for maximum photosynthesis. For our purpose, the high temperature requiring varieties of sunflower should be preferred, particularly in the breeding program. Besides, the high temperature requiring varieties can also convert higher amounts of CO_2 into dry matter than the low temperature requiring ones.

Sunflower as a tool for development. As yet, sunflower industry is not existing in the country. But we can consider this crop

as one with potential, in similar category as winged bean and apple. All these crops can be the future tools for economic development.

I would like to cite at this point what happened in cotton. CLSU did a lot of studies in cotton and now cotton production is an ongoing industry in the country. Whether or not the same will happen to sunflower, I don't know. It may be used as feeds, oil for industry or for its aesthetic value but one thing is sure, it is a potential tool for development.

Juan Carlos, Jr. Ph.D. Discussant

I would like to congratulate CLSU with Dr. Campos for the leadership having pioneered in this project and they have completed about 103 experiments in five years and by one agency and that I think it deserves a very good commendation. Another thing is that I notice in your analysis that they're getting about 79% return on investment. This is not bad. In fact, this is even higher than rice if you are not getting about 90 cavans/per hectare these days — even better than corn. So it may not really be that preferential treatment if the market is there and the market problem is I think a very serious one. And because of this then, the classifical uses of sunflower in the Philippines may not be that strong yet. Probably, one direction of research that you may want to take at this point, is the development of other users than what is now practically known. This is one way. The other is probably there are actual big users locally who are still importing. That we don't know. And some can produce this now in the Philippines. The Central Luzon Sun No. 1 is a big achievement. I'm just wondering whether this is a selection or a hybrid. If it is a selection then probably, it is now stable and probably ready for mass production. We have solved one problem with it but it is still needed to produce a few more varieties because it is dangerous to maintain one variety for any commodity because once we are hit by one problem then we are hit one hundred percent (100%). Maybe another problem is on seed technology. I didn't see any of your experiments geared towards the production of quality seed and probably this is one research direction that you can take in the future. Once the pilot, with this experiences and the time that you had put on to the project I think you have to be encouraged by everyone to go on the pilot. It may not be that expensive but I wonder what the Philippine Refining Company would say after having catapulted the CLSU to go into this. Maybe we can ask the PCARR, the NSDB or private agencies to help us in this direction.

Cesar Bautista, Discussant

Although I have a science orientation, both academically and professionally, I would like to comment this afternoon on the business side of the paper.

As the managing director of the Philippine Refining Company I have the happy association with Dr. Campos of CLSU on this project. Because we are all anxious to partake of the salted "bungang araw" I will make this comment short and sweet.

Our interest of course here stems from the fact that sunflower seeds produce oil and that is what you call soft quality oil. In the country today there are only three crops that give commercial oil, namely coconut, palm and corn. Soft oil is only available from corn. And corn is, in fact, in very limited supply. This is mainly used more as feeding stuff directly for either human consumption or for animals. You are aware of the relationship between fat consumption, quality of the fat with cardio-vascular diseases. Recent newspaper reports say that reduced calorie intake together with the high polyunsaturates will reduce blood cholesterol level which reduce the risk of cardiovascular diseases notwithstanding the stand of thousands of research institutions.

Now sunflower is a major source of soft oil internationally. Corn oil is not, in fact, as good as sunflower in the supply of linoleic. For example we know that corn oil has only 40% linoleic while sunflower has got 78%. Some pragmatics among us will say who cares about the linoleic when the Philippines' problems is lack of food. This is where we talk now about international situation because in the world market, sunflower oil commands a premium price over all the other kinds of oil. I don't think we have to be parochial about any of our research activities. One must look not in the country as the market, but in the world in general. This happily enough is getting to be an official statement from the Philippines as well — that export of Philippine products must be a primary issue in any of our undertakings. Now, our main mother company which is Unilever in fact has got research laboratories and they have had similar projects in Turkey and Mexico and some of the African countries.

Therefore we thought sunflower development was a relevant situation for the Philippines as well. With this in mind, we knew that CLSU was going to be the right agency to interest the growers to take sunflower production as part of their projects. The techni-

cal details of course will be competently handled by Dr. Campos and her staff, supply her with research information and some seeds. And we bought from the complete production from her 50 hectare lot and we helped in gathering growers' conferences so that they can exchange views and ask questions. I'm happy to say a general interest has been stimulated by the work and from the results of her discussion we feel and we agree that sunflower production for a farmer is in fact very profitable. You will notice that this conclusion is valid inspite of the fact that the price she quoted was a bit lower when you talk about the world market price. The economics of fats and oils is really quite difficult to finalize because if the discrepancy between local prices and the world market i.e. coconut oil which is currently depressed but local corn oil is artificially expensive here.

On the other hand, the meal that you get out of this will be compared and in fact should be better than the meal that one gets from other sources because of the higher protein content. In fact I don't think it was brought out by anyone before that the protein content of sunflower meal after removing the oil in the factory is 40% and it has a very high level of essential amino acid which meets in fact the minimum standard for human consumption, 48% of the total protein is essential amino acid. Having said that therefore one can feel optimistic about the technical aspect and the business aspect of sunflower seed growing. It will be a case of selling the idea to farmers so that one can consider a big scale undertaking to merit an equivalent action from the industry. With that I hope that the future projects of CLSU on sunflower will continue and continued success will be achieved.