ration given the restrictions and feed prices. The total cost of the least-cost ration is $90.56. If feed ingredients of levels of the restrictions are changed, the least-cost combination of nutrient sources is likely to change. For instance, if instead of 8% fiber, the requirement was that there could not be more than 7% fiber in the ration, this would increase the cost of the ration by 85c. However, on the other hand if the fiber requirement was changed to say at least 9% instead of 8% fiber, this would decrease the cost by 85c. Likewise, if the requirement for protein had been 34% instead of 35%, the ration could have been decreased by 69c. Or, if the requirement had been 36% instead of 35% protein, the ration cost would have been increased by 69c.

This is some of the additional information furnished by a linear programming solution. These values allow one to evaluate the economic consequences that would result from changes in requirements for a feed mix. Since minimum and maximum requirement for certain rations are constantly being re-evaluated in this age of changing technology, linear programming could be a useful guide for showing the economic consequences of changing critical requirements. Likewise, price mapping can be used to determine how sensitive or how rapid the least-cost ration changes due to changes in prices of certain ingredients.

In conclusion, I would like to stress that even though the technique of linear programming is useful in giving answers to practical problems, it also may be used in certain cases as a guide for general direction of adjustment in the agricultural industry. One of the limitations of linear programming in solving actual problems is the limitations in the data required by linear programming. Therefore, I would stress that perhaps in some ways that our mathematical and computer techniques are ahead of the actual data that we have. This places greater strain on the importance of keeping good records.

TABLE 1.

Basic Data Required for a Least-cost Feed Mix Problem

Nutrient Source	Nutrient Requirements	Feed Ingredients			
		Alfalfa Meal	Distillers Solubles	Fish Meal	Soybean Meal
Fiber	3	25	3	1	6.5
Protein	35	17	25	60	45.0
Fat	1.5	2	5	7	.5
Cost per ton		$66	$92	$156	$95

TABLE 2.

A Least-cost Solution to the Feed Mix Problem

Nutrient Source	Amount of Nutrient (lbs.)	Cost per ton	Total Feed Cost
Alf. meal	280	$66.00	$ 9.24
Dist.. Sol.	620	92.00	28.52
Soy. Meal	1100	96.00	52.80
Total	2000		$90.56

Junior Colleges . . .

H. M. McKenzie, Editor

A Study of the Status and Role of the Junior Colleges in Providing Non-Transfer Agricultural Education in California

Ralph M. Vorhies

The major purpose of this study was to determine the past, present, and possible future of the California junior colleges in providing non-transfer agricultural education. An attempt was made to learn how extensive this type of training is in the junior colleges in the state. Information secured from the colleges and the former students included: (1) the number and type of courses offered, (2) the student's educational background, and (3) the employment record of the former students. Students who entered the program in 1959 were used for the study. Whenever the former students gave permission employers were asked to give their opinion of the employee and his training.

1. SUMMARY OF THE DATA

History

Agriculture has been taught in the junior colleges of California from the very beginning of the system. In 1910 when the Fresno School District established the first public junior college, agriculture was in the curriculum.

The number of junior colleges offering agriculture courses has declined somewhat in recent years, and at present only 19 are offering agriculture. These colleges are widely scattered in all of the agricultural areas of the state, but the greatest number are located in the Los Angeles area and in the San Joaquin Valley.

Enrollments in agriculture are increasing slowly, but not as rapidly as the total college enrollment.

The Extent of the Non-transfer Program

Many of the junior colleges in California that offer agriculture teach only transfer courses which are planned to parallel the courses of the four-year agricultural college to which most of their students transfer.

Some junior colleges have special non-transfer courses in English and mathematics for terminal students, but few offer separate courses in agriculture designed to fit the needs of the non-transfer student.

Recently at least two of the junior colleges, Modesto Junior College and Mount San Antonio College, have begun to offer special terminal curricula for training agricultural technicians. The surveys made by these colleges and reviewed in Chapter II have demonstrated a need for such training.

Most of the junior colleges studied had adequate facilities for offering non-transfer courses in agriculture that would fit students for work in the related agriculture field.

The staff in agriculture at the 10 junior colleges varied from two to 11 with an average of 4.4 instructors. Nearly all of the full-time instructors had the master's degree, and they had considerable experience as teachers of vocational agriculture in high school or as workers in production or related agricultural fields.

* Unpublished Doctoral dissertation, University of Missouri, Columbia, 1964

The enrollment in the non-transfer program was diffcult to determine since accounting practices differ at the different colleges. Some of the larger junior colleges had over 200 students in agriculture, and in some cases at least one-half of them were considered to be non-transfer students.

Nearly all of the junior colleges in the survey had school farms. Some of the colleges provided work experience courses, and students were encouraged to carry out productive projects either on the school farm or on the student's own farm. One college required such projects of all their agriculture students since the college received part of its support from federal funds that required such projects.

Students' Background and Objectives

The study revealed that 78 per cent of the students surveyed had a rural background. Approximately one-half of the students had taken courses in vocational agriculture in high school. The proportion that had vocational agriculture in high school varied depending on the location of the junior college. Those in the Los Angeles area reported only 10 to 20 per cent as having such course, while one San Joaquin Valley college estimated that 75 per cent of their students had such courses. Very few students had courses in general agriculture in high school.

It has been reported many times that two-thirds of the students entering junior college expect to transfer to a four-year college, but only one-third of the students do transfer. The findings of this study are in line with this statement. Forty per cent expected to finish a four-year course, and another 50 per cent expected to finish the two-year course when they entered junior college. Actually only about 25 per cent finished the two-year course.

Drop-out is high from this program. Nearly one-fourth of the students did not finish even one year at the junior college. The major reason for dropping out was given as financial. Thirty-two per cent of the drop-outs gave this reason, although some of the agricultural teachers and counselors doubted that it was the real reason in many cases.

Community Influence on Course Content

The courses in agriculture often reflect little of the agriculture of the community. This is due to the need of the majority of the students for specific courses that will transfer to a four-year agriculture college.

The non-transfer courses and especially the agricultural technician training programs should reflect the agricultural needs of the community. Most of the graduates of the non-transfer program who enter agriculture remain in the service area of the college. This seems to have been considered in setting up the existing technician training programs. These curricula and the course content have in most cases been based on community surveys, and have been selected with the aid of advisory committees from the related agricultural industries of the community.

It has also been recognized that the transfer courses presently being taught in the junior colleges are not suitable to meet the specialized needs of students training to become agricultural technicians.

Placement History

The junior college placement services are confined largely to locating part-time jobs for present students. They have done very little placement of drop-out or terminal agricultural students. Placement of these students has been left to the agricultural department personnel, and even they do not usually have an organized method of bringing the students and the employers together. Replies from 50 former non-transfer students regarding initial job placement revealed that 35 per cent went into production agriculture. Another 35 per cent entered jobs not related to agriculture at all, and about 30 per cent entered related agriculture employment.

A study of present employment showed that 23 per cent were self-employed. Of the 37 not self-employed five were in on-the-farm agricultural jobs and 13 were in off-the-farm related agricultural jobs. The 19 students who did not go into agricultural work are employed in a wide variety of jobs.

Information was sought regarding the number of job changes made since leaving college. Less than one-half of the former students had changed jobs at all, and of those who changed, 50 per cent had only changed once.

The mean monthly salary on the first job after leaving college was $328.51. The mean salary for the present job at the time the former student began to work at it was $352.16, and the present monthly salary for all former students not self-employed was $413.63. The salary range for present jobs was from $175 to over $600.

As a group the junior college students earn about $50 a month less than the two-year technical graduates from the state college agricultural programs. However, the junior college students as a group had much less college training than the state college graduates.

Most of the former students felt that their junior college work had helped them to advance faster and farther than they could have done without it. This was especially true of the technical agricultural courses they had taken. However about one-half of the former junior college students felt that a four-year course in their field would have helped them even more.

Employer's Opinions

The results of the employer opinion survey indicated that in general the employers were fairly well satisfied with the former non-transfer students as employees. Sixty-nine per cent said that they would hire more students from such programs. About one-half of the students had been hired primarily because of their college training. A little more than one-half of the employers felt that a four-year degree would have made the employees more successful on the job.

The technical agricultural courses seemed to be the part of the employees' training that contributed most to the job. There was no well defined recommendations regarding areas of deficiency in the college training program that the employers felt should be corrected.

The Program at Four-year Colleges

Terminal agricultural training at other colleges in California was found at only three of the state colleges. These colleges are Fresno State College, Chico State College, and California State Polytechnic College at the San Luis Obispo campus.

Two of these colleges have a two-year program, and one has a three-year vocational program. California Polytechnic College has the most extensive program with 13 fields of specialization, and about 380 students enrolled in 1963. Animal husbandry is the most popular major, and in some colleges accounts for over one-half of the enrollment.

One of the three colleges offers special courses in English, biological science, political science, and agriculture for the two-year students.

Admission into the two-year program in agriculture is more difficult at the state colleges than it is at the junior colleges. Increasing entrance requirements and rising costs are turning some prospective students away from the state college program.

The demand for graduates of the two-year programs is good, but not as good as for the four-year graduates.

Very few courses designed especially to train agricultural technicians are being taught at the state colleges.

II. CONCLUSIONS

1. Agricultural education in California junior colleges has been quite

successful in the area of transfer education for students going on to four-year colleges, but in general the non-transfer students have been neglected.

2. Courses in technical agriculture have been of value to former non-transfer students and were recognized as valuable by the students and employers alike. This is indicated by the employer's willingness to hire students from the program and to advance them.

3. The placement and follow-up of non-transfer students in agriculture has been given minimal attention. A need also exists for some curricular changes to better fit these students for agricultural jobs where their rural background and training would be fully utilized.

4. Agricultural technician training program similar to those recently started at Modesto Junior College and Mount San Antonio College have much value. They are based on and meet local agricultural needs of the community. These programs also fulfill important needs for junior college agricultural students not planning to transfer to a four-year college.

5. There seems to be little duplication of effort between the junior college and state college programs of terminal agricultural education.

III. IMPLICATIONS

Some of the possible implications that may be drawn from this study of the non-transfer agricultural program in the California junior colleges are now presented.

This study seems to point to a continued demand for well-trained agricultural workers both in production agriculture and in related agricultural occupations. There needs to be greater stress on training for related agricultural occupations since it is in this field that most of the job openings exist.

The investigation also indicates that the junior college agricultural programs now in existence have an important role to play in the training of these workers. However, before the junior colleges can become fully effective in this training they must greatly expand their placement and follow-up work with the non-transfer students in agriculture. There seems to be considerable need for better communications between the junior colleges and related agricultural industry.

It appears that the training program for agricultural technicians has made a good start in California junior colleges and may well become a major part of their offering in agriculture.

The stiffening entrance requirements and the increasing cost of attending the university and the state colleges may lead to even larger gains in enrollment in the agricultural program at the California junior colleges.

Soils . . .

C. G. Hobgood, Editor

Comments on Foliar and Plant Tissue Test As A Guide to Plant Needs

C. G. Hobgood
La. Tech

Since man is so dependent upon plants, he has searched for more accurate methods of increasing yields by various chemical methods for approximately 300 years, or since the famous experiment of the willow tree conducted by von Helmont in which he concluded that water was the only factor of plant growth. One hundred and fifty years later Jethro Tull declared earth to be the substance of plants; but, it was not until Justus von Liebig published a series of lectures in 1840 that the problem of plant nutrition began to come into focus. Useful interpretations of plant nutrition have progressed from that time by the aid of such men as Laws and Gilbert of Rothamsted, Winogradsky and Beijerinck with their work on nitrogen fixation and Dyer who supplied information on availability of nutrient elements in the soil. Later in the United States two men decided to break away from the European methods and attack the problem on what they believed to be a more fundamental basis. C. G. Hopkins worked on the theory of total content of nutrient elements in the soil and plants, while Milton Whitney thought that the productive capacities of soil were to be found in the natural soil solution. It is meaningless to say wherein these men were right or wrong because both contributed much to scientific agriculture and both contributed greatly toward stimulating workers in experiment stations all over the country to attack the plant nutrition problem.

Peech (7) points out the limitations of the classical methods for adequately characterizing a fraction of the total supply of a given plant nutrient element in the soil that is equal or at least proportional to the amount of the element that the plant can utilize during its growing period; and that the total supply of a given nutrient element as determined by chemical analysis is no measure of the amount of that element that is at the disposal of the plant. "As empirical as such chemical methods for assessing soil fertility may be, they provide, nevertheless, one of the useful tools for ascertaining the most profitable returns from fertilizers and for diagnosing causes of crop failures. Their successful use depends to a very large degree upon careful calibration of the results of the chemical test with responses of different crops to application of fertilizers on different soils (7)".

Scarseth (10) and others (6) have reported that many fertility experiments have been handicapped or have failed to give true information because it was assumed that the growing crop was adequately supplied with a particular nutrient element.

The mere addition of an element to the soil is no assurance that the nu-