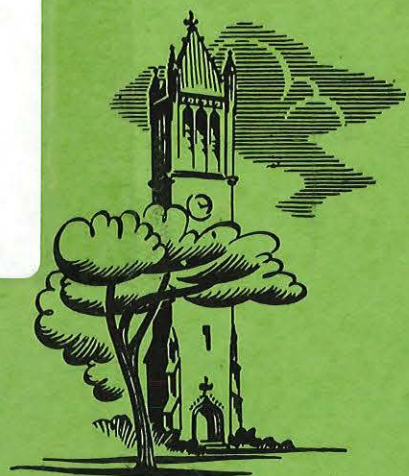


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**COMPETENCIES IN FARM MACHINERY MAINTENANCE  
NEEDED BY FARMERS**

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and

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3-365

*This is an abstract of a thesis submitted to Iowa State University of Science and Technology by Norman Lyle Robinson in partial fulfillment of the requirements for the degree of Master of Science in August of 1964.*

*The study is one of a series conducted by the Department of Education of Iowa State University of Science and Technology with the assistance of graduate students in agricultural education in cooperation with the Iowa Agriculture and Home Economics Experiment Station and the Vocational Agriculture Section, Division of Vocational Education, State Department of Public Instruction.*

*This abstract was prepared by Norman L. Robinson with the assistance of Alan A. Kahler and Roy D. Hickman, research assistants for the Iowa Agriculture and Home Economics Experiment Station Project 1253, under the direction of Dr. Duane L. Blake.*

# COMPETENCIES IN FARM MACHINERY MAINTENANCE

## NEEDED BY FARMERS

by

Norman Lyle Robinson

### Purpose of the Study

The purpose of this study was to determine some of the competencies in farm machinery maintenance, repair and adjustment needed by present and prospective farmers.

### Method of Procedure

Key farmers, those classified as outstanding in the use of farm machinery, prepared the original list of competencies for 12 farm machines. Professional agricultural engineering personnel assisted with the final wording of the competencies. These competencies so identified are presented in Table 1.

Two separate groups were used as samples for this study. One group consisted of 300 farmers who had been graduated from high school from 1950-1954. These farmers had either studied vocational agriculture in high school or their fathers were farming on the date of their high school graduation. The other group of 300 farmers consisted of recommended outstanding machinery using farmers well scattered throughout Iowa.

Of the original 12 farm machines selected, competencies pertaining to tractors, plows, corn planters and mowers were put into questionnaire form along with selected control items and then mailed to the selected farmers. The farmers evaluated the degree each competency was needed in order to properly maintain, repair and adjust these farm machines. They also evaluated the degree each competency was possessed. The first 200 usable questionnaires received from each sample group were used as data for the study.

### Findings

When both groups of farmers were considered together, it was found that those who had not studied vocational agriculture were farming on a larger scale than those who had studied vocational agriculture. Forty-three percent of those who had studied vocational agriculture one year or more operated 300 acres or less as compared to 28 percent of those in the nonvocational agriculture group. Only 17 percent of the vocational agriculture group operated farms with over 500 acres compared to 27 percent of the nonvocational agriculture group. Since only 39 percent of the outstanding farmers had studied vocational agriculture compared to 90 percent of the 1950-1954 graduates, the investigator did not attribute the smaller operations to vocational agriculture.

Table 1. Competencies identified

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 Farm machinery areas and competencies
 

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TRACTORS

Replace radiator thermostat  
 Adjust fan belt  
 Repair and adjust wheel bearings  
 Replace and adjust breaker  
   points  
 Replace and adjust spark plugs  
 Adjust and overhaul carburetor  
 Adjust hydraulic system  
 Perform complete overhaul  
 Adjust clutch  
 Adjust and replace brake  
   equipment  
 Adjust valves  
 Replace and adjust generator  
   brushes  
 Clean air cleaner  
 Replace oil filter  
 Provide battery maintenance  
 Add fluid to tires

PLOWS

Adjust colters  
 Adjust horizontal hitch  
 Replace shares  
 Weld new points and edges on  
   shares  
 Hammer out worn shares  
 Hardsurface shares  
 Sharpen shares  
 Check for sprung condition  
 Adjust tail wheel  
 Adjust special covering devices  
 Adjust vertical hitch

GRAIN AND FERTILIZER DRILLS

Weld broken parts  
 Calibrate grain drill and  
   fertilizer attachments

MOWERS

Adjust lead  
 Sharpen sickle  
 Replace ledger plates  
 Tighten belts  
 Lubricate  
 Replace sections  
 Replace and adjust wearing  
   plates  
 Replace and adjust hold  
   down clips  
 Adjust register  
 Adjust pitman tension

CULTIVATORS

Adjust shovel angle  
 Adjust shovel trip  
 Adjust gauge wheels  
 Level the frame  
 Adjust tilt of front rigs  
 Replace all parts

HAY RAKES

Adjust tooth pitch  
 Replace teeth  
 Care for pitch control  
 Replace and adjust chains

MANURE SPREADERS

Steam clean  
 Paint  
 Replace dogs and clutches

HAY CONDITIONERS

Adjust roll tension  
 Check bearings for wear and  
   lubrication  
 Adjust rollers even all way  
   across

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Table 1. (Continued)

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 Farm machinery areas and competencies
 

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CORN PLANTERS

Adjust planting method - drill,  
     hill drop or check  
 Replace shoe bottoms  
 Replace kernel knockout dog  
 Adjust planting rate  
 Adjust planting depth  
 Check valves in shoe  
 Correct run of the shoes  
 Select and replace planter  
     plates  
 Replace worn parts  
 Correct all clutch problems

CORN PICKERS

Adjust for different picking  
     conditions  
 Adjust snapping roller  
     bearings - upper and lower  
 Replace and adjust gathering  
     chains  
 Check bearings for wear  
 See that all zerk fittings  
     take grease  
 Adjust all slip clutches  
 Adjust snapping roll speed

COMBINES

Adjust cylinder speed  
 Adjust cylinder clearance  
 Adjust ground travel speed  
 Adjust sieves  
 Adjust fan speed  
 Adjust grain cleaning  
 Adjust air flow  
 Replace bearings and shafts  
 Replace and adjust knife  
     assemblies and replace  
     sickle sections

BALERS

Repair and adjust knotter  
 Adjust plunger knives  
 Adjust plunger for smooth  
     operation  
 Adjust bale size  
 Replace bale chamber knives  
 Set timing on the baler

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There were twice as many renters in the group of 1950-1954 graduates as there were in the group of outstanding farmers. Seventy-five percent of the graduates were classed as renters compared to 37.5 percent of the outstanding farmers. More owners, both among the outstanding farmers and the 1950-1954 graduates, were observed in the 301-400 acres farmed range than were found in any other range. That category accounted for 51 of the 400 farmers. Fifty-three percent of the respondents were shown to be farming between 200 and 400 acres.

This study did not reveal any outstanding farmers who indicated less than 7-9 years of schooling. There were nearly twice as many, 30, outstanding farmers with 16 or more years of schooling as opposed to 16 of the 1950-1954 graduates. When all school level classifications were considered, it was noted that the largest percent, 35.5, of the 1950-1954 graduates operated from 201-300 acres. Of those with 16 or more years of education, the largest number of respondents were operating 401-500 acre farms.

No relationship was found between additional years of farming experience and total number of acres operated by either the 1950-1954 graduates or the outstanding farmers. Twenty-one of the graduates had farmed for five years or less and 54 had farmed for 11 years or more. Only 40 of the outstanding farmers had farmed 10 years or less, compared to 146 of the graduates. Over 50 percent of the outstanding farmers had farming experience of 11-25 years.

Comparison of level of education with annual gross income revealed that 61 percent of the graduates indicating 10-12 years of schooling were in the \$1-20,000 income range, whereas 50 percent of those with 13-15 years of school and 37.5 percent of those with 16 and over years were in that range. There were 26 percent of the outstanding farmers in the first increment range of \$1-20,000. Twenty-four outstanding farmers indicated over \$100,000 annual gross income compared to one of the 1950-1954 graduates.

When the size of farming unit was compared to annual gross income, 83 percent of the 1950-1954 graduates operating 200 acres or less reported less than \$20,001 gross income, whereas 63 percent of those operating 201-400 acres, 47 percent of those operating 401-700 acres and 36 percent of those operating over 700 acres reported in that income range. Eighty-two percent of the outstanding farmers operating 300 acres or less reported in the \$1-40,000 range compared to 50.5 percent of those operating 301-600 acres and 31 percent operating over 600 acres.

Mean scores for degree competency needed and possessed are presented in Table 2. Both groups indicated they needed the most competency in tractor overhaul, adjusting tractor hydraulic systems and adjusting and overhauling tractor carburetors, in that order. The mean needed scores for the same competencies ranged from 6.85 to 7.87 for the outstanding farmers and 6.76 to 7.78 for the graduates on a one-to-nine point rating scale.

Rated lowest by the outstanding farmers on the basis of competence needed were lubricating the mower (3.11); cleaning the tractor air cleaner (3.13); and replacing the tractor oil filter (3.14). Competencies rated lowest by the graduates were cleaning the tractor air cleaner (3.05); replacing the tractor oil filter (3.08); and replacing plow shares (3.16).

Table 2. Relationship of mean farm machinery competency scores needed and possessed by outstanding farmers and 1950-1954 graduates

Competency	Outstanding farmers				1950-1954 graduates			
	Mean needed scores <sup>a</sup>	Rank	Mean pos- sessed scores <sup>b</sup>	Rank	Mean needed scores	Rank	Mean pos- sessed scores	Rank
Perform complete tractor overhaul	7.87	1	3.56	45	7.78	1	4.35	42
Adjust tractor hydraulic system	6.86	2	4.06	42	6.97	2	4.30	43
Adjust and overhaul tractor carburetor	6.85	3	4.32	40	6.76	3	4.63	39
Hardsurface plow shares	6.63	4	2.99	46	6.53	5	3.09	46
Hammer out worn plow shares	6.62	5	2.68	47	6.47	7	2.68	47
Adjust tractor valves	6.52	6	4.31	41	6.52	6	4.65	38
Correct all corn planter clutch problems	6.46	7	5.05	34	6.19	8	5.33	35
Weld new points and edges on plow shares	6.40	8	3.64	44	6.68	4	3.65	45
Replace and adjust tractor generator brushes	6.06	9	4.32	39	5.80	10	4.54	40
Check plow for sprung condition	6.06	10	4.73	37	5.86	9	4.77	37
Replace and adjust tractor breaker points	5.90	11	4.98	36	5.72	11	5.63	27
Adjust tractor clutch	5.73	12	5.03	35	5.61	14	5.38	34
Sharpen plow shares	5.72	13	3.66	43	5.65	13	3.76	44
Adjust and replace tractor brake equipment	5.56	14	5.18	33	5.65	12	5.46	33
Adjust plow vertical hitch	5.45	15	5.39	31	5.15	17	5.56	30
Adjust plow tail wheel	5.44	16	5.42	30	5.19	16	5.52	32
Adjust corn planting method	5.31	17	5.95	19	5.22	15	5.85	22
Adjust plow horizontal hitch	5.27	18	5.71	24	5.12	18	5.89	20
Correct run of planter shoes	5.23	19	5.72	23	5.07	19	5.63	26
Adjust mower lead	5.23	20	5.52	27	4.96	21	5.75	25
Adjust plow special covering devices	5.18	21	5.29	32	4.95	22	5.12	36
Adjust mower register	5.10	22	5.49	28	4.91	24	5.57	29
Repair and adjust tractor wheel bearings	5.06	23	5.78	22	4.89	25	5.98	17
Replace corn planter worn parts	5.05	24	6.08	9	4.96	20	6.28	10

<sup>a</sup>1, no competency needed; 2-3, little competency needed; 4-5, some competency needed; 6-7, much competency needed; 8-9, very much competency needed

<sup>b</sup>1, no competency possessed; 2-3, little competency possessed; 4-5, some competency possessed; 6-7, much competency possessed; 8-9, very much competency possessed

Table 2. (Continued)

Competency	Outstanding farmers				1950-1954 graduates			
	Mean needed scores	Rank	Mean pos- sessed scores	Rank	Mean needed scores	Rank	Mean pos- sessed scores	Rank
Check valves in planter shoe	5.00	25	5.87	21	4.88	26	5.77	24
Adjust mower pitman tension	4.99	26	5.45	29	4.93	23	5.60	28
Adjust corn planting rate	4.99	27	6.46	2	4.69	28	6.37	7
Adjust plow colters	4.85	28	6.00	12	4.69	27	5.94	19
Select and replace corn planter plates	4.62	29	6.23	7	4.34	33	6.50	4
Replace mower ledger plates	4.53	30	5.93	20	4.35	32	6.11	16
Sharpen mower sickle	4.52	31	5.67	25	4.56	29	5.82	23
Adjust corn planting depth	4.48	32	6.31	4	4.29	34	6.31	9
Replace and adjust mower wearing plates	4.47	33	6.02	10	4.43	31	6.18	13
Replace corn planter kernel knockout dogs	4.46	34	5.96	17	4.55	30	5.88	21
Add fluid to tractor tires	4.34	35	4.55	38	3.83	39	4.39	41
Replace and adjust mower hold down clips	4.33	36	5.95	18	4.19	35	6.13	14
Replace tractor radiator thermostat	4.28	37	5.56	26	4.02	38	5.55	31
Replace and adjust tractor spark plugs	4.19	38	5.97	14	4.09	37	6.22	12
Replace corn planter shoe bottoms	3.99	39	5.96	16	4.09	36	5.97	18
Tighten mower belts	3.71	40	6.01	11	3.51	42	6.31	8
Replace mower sections	3.71	41	6.24	6	3.69	40	6.49	6
Adjust tractor fan belt	3.70	42	5.97	15	3.52	41	6.23	11
Provide tractor battery maintenance	3.38	43	6.34	3	3.33	43	6.59	3
Replace plow shares	3.30	44	5.98	13	3.16	45	6.11	15
Replace tractor oil filter	3.14	45	6.46	1	3.08	46	6.81	1
Clean tractor oil cleaner	3.13	46	6.27	5	3.05	47	6.80	2
Lubricate the mower	3.11	47	6.18	8	3.29	44	6.50	5



There was a high correlation observed between the ratings given by the outstanding farmers and the 1950-1954 graduates on all of the competencies studied. The graduates tended to indicate a lower degree of competence needed in order to effectively perform the maintenance jobs.

The outstanding farmers indicated they possessed the most competence in replacing tractor oil filters (6.46); adjusting corn planting rates (6.46); and providing tractor battery maintenance (6.34). The 1950-1954 graduates reported the most competence possessed in replacing the tractor oil filter (6.81); cleaning the tractor air cleaner (6.81); and providing battery maintenance (6.59).

The outstanding farmers indicated they possessed the least competence for hammering out worn plow shares (2.68); hardsurfacing plow shares (2.99); and completely overhauling a tractor (3.56). There was a high correlation observed between the competency possessed ratings given by the outstanding farmers and the 1950-1954 graduates, but the correlations were not as high as was revealed between the ratings given for competence needed. The graduates indicated they needed less competence and possessed more competence.

A need for more competence than they possessed was indicated by the outstanding farmers for 16 of the 47 competencies, and for 14 of the 47 by the 1950-1954 graduates. It was noted, however, that training is necessary in all the competencies since 3.05 was the lowest mean score needed, and any rating over one indicated some need.

In the areas where the outstanding farmers felt a need for more competence than they possessed, two cases showing the greatest differences were: performing a complete tractor overhaul, 7.87 needed, 3.56 possessed; and hammering out worn plow shares, 6.62 needed, 2.68 possessed. The greatest difference for the 1950-1954 graduates occurred for hammering out worn plow shares, 6.47 needed, 2.68 possessed; and hardsurfacing plow shares, 6.53 needed, 3.09 possessed.

Where the outstanding farmers felt they possessed more competence than they needed, areas showing the greatest differences were: replacing the tractor oil filter, 6.46 possessed, 3.14 needed; and cleaning the tractor air cleaner, 6.27 possessed, 3.13 needed. The greatest differences for the 1950-1954 graduates occurred for: replacing the tractor oil filter, 6.81 possessed, 3.08 needed; and providing tractor battery maintenance, 6.59 possessed, 3.33 needed.

The Spearman rank order coefficient of correlation was used to analyze the relationship of the mean competency needed scores of the two groups of farmers. A correlation of .993 was obtained, indicating a strong tendency for the outstanding farmers and the 1950-1954 graduates to rate the machinery competencies needed very similarly.

Pearson product moment coefficients of correlation were used to determine the extent to which changes in ratings of one machine competency being studied were accompanied by equal changes in another competency. When the degree competency was needed scores were analyzed, the highest correlations for the two groups of farmers were between replacing and adjusting mower wearing plates and replacing and adjusting mower hold down clips, outstanding farmers .884,

graduates .902: cleaning the tractor air cleaner and replacing the oil filter, outstanding farmers .877, graduates, .913; and between replacing the tractor oil filter and providing battery maintenance, .847 for the outstanding farmers and .858 for the graduates.

The scores for degree competency was possessed were also analyzed by correlation methods. The highest correlations for the two groups of farmers were between cleaning the tractor air cleaner and replacing the oil filter, outstanding farmers .940, graduates .925; and between replacing the tractor oil filter and providing battery maintenance, outstanding farmers .940, graduates .870.

The ten most important machinery competencies, as rated on the basis of competence needed by the outstanding farmers, were identified, and the highest mean value was tested for significant differences against each of the other nine means by use of the t-test. Performing a complete tractor overhaul was the most needed competency. The computed t-values revealed five combinations to be significant at the one percent level for the outstanding farmers and three combinations for the graduates. There were eight combinations significant at the five percent level for both groups. No significant difference was revealed for either group of farmers between the mean scores found for the highest rated competency and adjusting the tractor hydraulic system.

### Implications

Future programs in agricultural education should provide some instruction in all competencies identified in the study, with more intensive training being provided for those competencies receiving higher degree needed scores.

The need for training in farm machinery competencies by the two groups of farmers studied may imply an even greater need by the average and below average farmers and by those farmers who did not have vocational agriculture in high school.

Since the outstanding farmers and the 1950-1954 graduates differed somewhat in regard to the extent that specific competencies were needed and possessed, it may be desirable to design separate instructional programs for the two groups.

Curriculum changes in teacher education programs may be necessary to provide an adequate supply of instructors who are competent in farm machinery maintenance and repair. In addition, greatly improved agricultural mechanics shop facilities will be needed if the educational needs of farmers are to be met.

