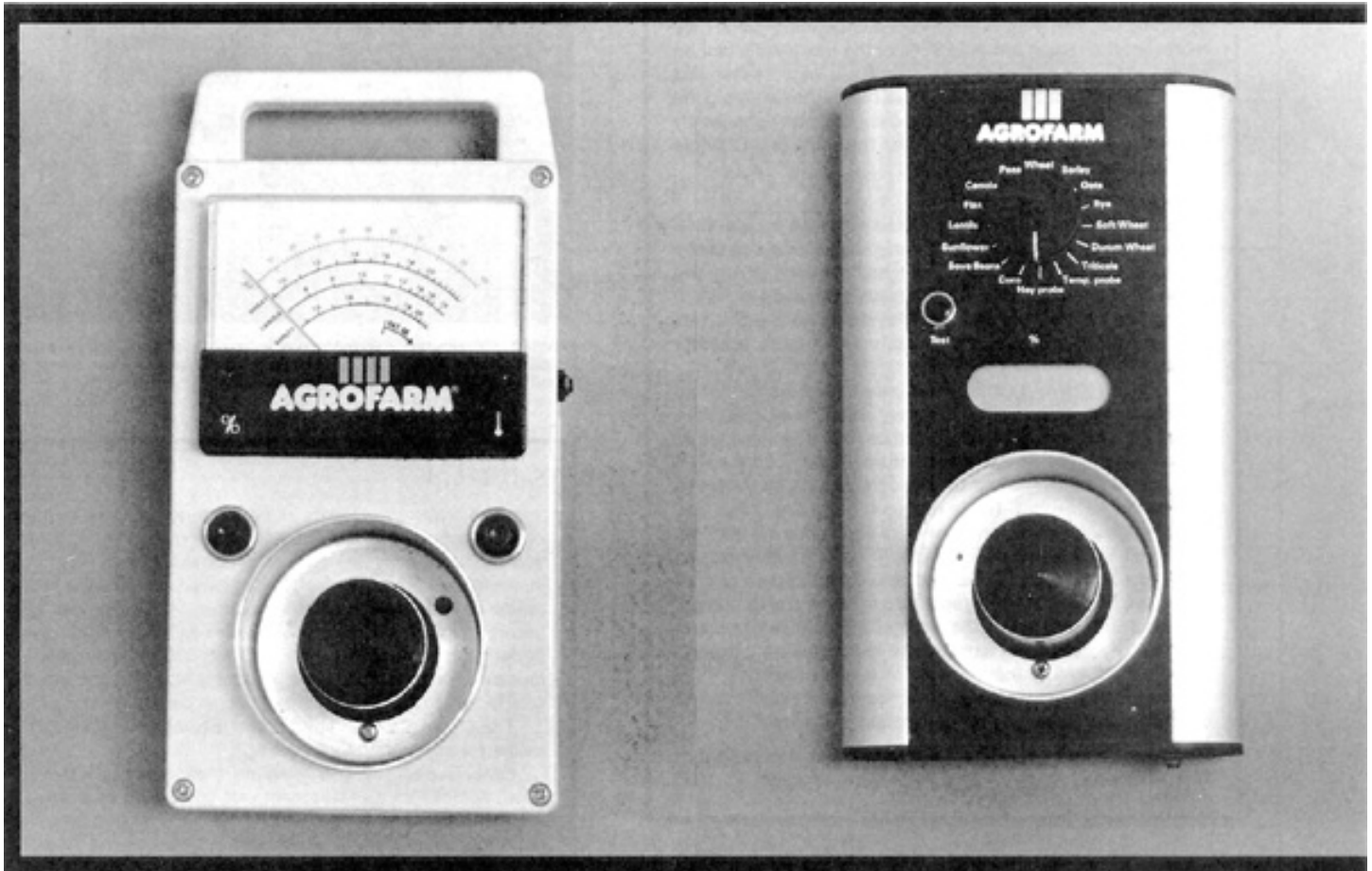


Evaluation Report

659



Agrofarm Analog and Digital Grain Moisture Meters

A Co-operative Program Between



INTRODUCTION TO REPORT

CROP VARIABLES

The electrical properties of grain vary with grain variety, kernel size, maturity, weathering, artificial or natural drying and tempering (rewetting of grain). A grain moisture meter is an attempt to accurately represent the average properties for one or several grain varieties. To accurately predict the dielectric properties and corresponding calibration charts of all varieties of grain grown in the Prairies is very difficult. Therefore, the owner should annually check results of his moisture meter against a calibrated moisture meter as used at the local elevator. Several samples should be compared to ensure correct meter readings.

METER PERFORMANCE

To assess meter performance, three factors; accuracy, uncertainty and repeatability, are considered. Accuracy indicates how close the average meter reading is to true moisture content. Uncertainty is a measure of scatter over the range of moisture contents measured, or how close the readings follow a "best-fit" line. The shaded belts (APPENDIX II) can be used as a measure of meter uncertainty since they represent the region in which 95% of the test results can be expected to occur. A wide belt indicates a wide scatter and measurement uncertainty, whereas a narrow belt shows good meter certainty. Repeatability is a measure of how consistently a meter gives the same reading when the same grain sample is tested several times.

SCOPE OF TEST

Each moisture meter was operated in the lab to determine moisture contents of wheat, barley and canola. Meter readings were compared to moisture contents obtained using the American Association of Cereal Chemists oven method. Before testing, the meters were calibrated for each type of grain. This was recommended by the manufacturer for more accurate results.

For each grain, artificially tempered samples (dry grain which was moistened in the laboratory and allowed to stabilize before moisture measurement) were used to determine meter performance. The range of moisture content of greatest concern was between 9 and 18% for cereal grains and between 7 and 15% for canola. These ranges include dry, tough and damp stages. The moisture content of each grain sample was measured five times with each meter. All samples were allowed to stabilize in the sample chamber before the moisture content was taken. All results in the report are expressed on a percent wet-basis. The accuracy of the external temperature probe was evaluated by comparing temperature readings from 0 to 50°C to that of a mercury thermometer in a water bath.

The meters were evaluated for quality of work, ease of operation and suitability of the operator's manual.

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AGROFARM ANALOG GRAIN MOISTURE TESTER

Manufacturer:

Agrofarm
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Denmark

Distributor:

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Red Deer, Alberta
T4N 5E3
PH. (403) 343-6222

Retail Price: \$324.00 (August 1991, Lethbridge Alberta)

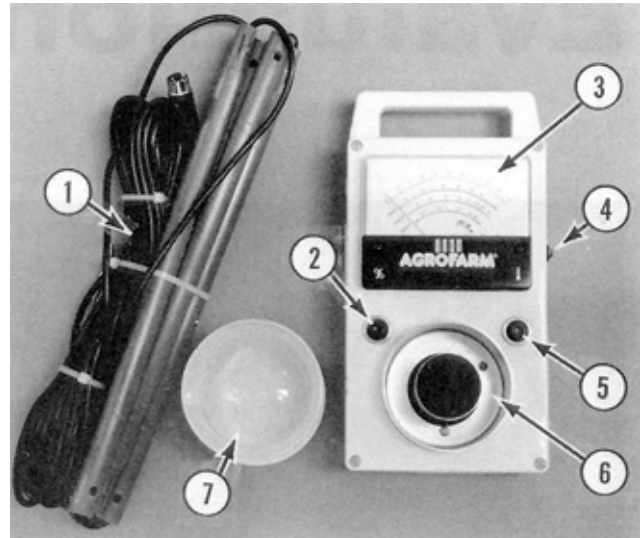


FIGURE 1. Agrofarm Analog Grain Moisture Tester: 1) Temperature Probe and Cable, 2) Moisture Button, 3) Moisture and Temperature Scale, 4) Adjusting Screw, 5) Temperature Button, 6) Sample Chamber, 7) Sample Container.

SUMMARY

The Agrofarm Analog meter performance in wheat was fair over the entire range of moisture contents measured. Accuracy was fair, uncertainty was good and repeatability was very good in wheat. Meter performance in barley was fair over the entire range of moisture contents measured. Accuracy was fair, uncertainty was good and repeatability was fair in barley. Meter performance in canola was fair over the entire range of moisture contents measured. Accuracy was fair, uncertainty was fair and repeatability was good in canola.

The external temperature probe readings averaged 7.5°C below actual temperature readings.

Ease of performing a moisture measurement was very good. A moisture measurement was completed in less than a minute. Scale divisions were to the nearest one requiring estimation of intermediate values. container eliminated the need to weigh out

Ease of performing a temperature measurement was very good.

Portability of the meter was very good. The unit was light, durable and self-contained in a plastic case.

The operating instructions were clear and easy to understand.

GENERAL DESCRIPTION

The Agrofarm Analog grain moisture tester is a portable moisture meter suitable for testing the moisture content of various grains, oil-seeds and grasses.

The meter indicates moisture content directly on three analog scales for wheat, barley and canola. The chart on the back of the meter indicates conversions to determine moisture contents for eight different grains.

The sample container is used to pour material into the sample chamber until the centre cone is covered. Temperature compensation is performed automatically.

The meter operates on a 9-volt alkaline battery. The test switches are spring-loaded. The meter is self-contained in a plastic case.

An optional external temperature probe, complete with a 15 ft (4.6 m) cable for use in grain bins, is supplied. Temperature from 0 to 100°C is indicated on the analog scale.

Detailed specifications are found in APPENDIX I, while FIGURE 1 shows the major components.

RESULTS AND DISCUSSION

QUALITY OF WORK

Meter Performance: The Agrofarm Analog meter performance in wheat was fair over the entire range of moisture contents. Accuracy was fair over the moisture content range. At 14.5% moisture content, the upper limit for dry wheat, the average meter reading was 1.8% high. Uncertainty was good, while repeatability was very good over the moisture content range.

The Agrofarm Analog meter performance in barley was fair over the entire range of moisture contents. Accuracy was fair over the moisture content range. At 14.8% moisture content, the upper limit for dry barley, the average meter reading was 1.1% high. Uncertainty was good, while repeatability was fair over the moisture content range.

The Agrofarm Analog meter performance in canola was fair over the entire range of moisture contents. Accuracy was fair over the moisture content range. At 10.5% moisture content, the upper limit for dry canola, the average meter reading was 1.6% high.

Uncertainty was fair, while repeatability was good over the moisture content range.

Sample Measurement: The scales on the Agrofarm Analog meter indicated moisture contents ranging from 9 to 26% in wheat, 11 to 23% in barley and 7 to 18% in canola. The Agrofarm Analog was evaluated with samples ranging from 9.4 to 23.9% in wheat, 8.9 to 23.6% in barley and 7.0 to 16.8% in canola.

The sample container was used to pour grain into the sample chamber until the grain covered the centre cone. Tapping the meter to compact the sample resulted in 0.3% increase in the moisture content readings. Care should be taken to avoid tapping the meter. The automatic temperature compensation was effective in the critical range near the upper limit for dry grain. When a sample was varied 9°C temperature compensation was accurate to within 0.2% moisture content.

Temperature Accuracy: The external temperature probe readings averaged 7.5° C below temperature readings obtained with a mercury thermometer.

EASE OF OPERATION

Moisture Measurement: Ease of performing a moisture measurement was very good. A moisture measurement was easily completed in less than a minute. The supplied sample container eliminated the need to weigh out a sample. The sample filled the sample chamber until the centre cone was covered. The volume of the sample chamber was 5.5 fl oz (155 mL) of grain. The average sample weight for wheat was 6.2 oz (176 g).

When the test switch was depressed, the analog scale displayed moisture content on three scales; for wheat, barley and canola. Scale divisions were to the nearest one percent, requiring estimation of intermediate values.

The meter remained "off" unless the spring-loaded "moisture content" button or the "temperature" button was depressed. This reduced the risk of premature battery failure. No warm-up period was required.

The 9-volt alkaline battery was replaced by removing the top cover of the meter, held in place by four screws.

Temperature Measurement: Ease of performing a temperature measurement was very good. The Agrofarm Analog meter was used as a temperature meter by plugging in the temperature probe. The temperature scale was in increments of 2°C.

Portability: Portability of the Agrofarm Analog was very good. The unit was light, durable and self-contained in a plastic case, complete with handle for convenient field use.

MECHANICAL HISTORY

There were no operational problems encountered during the evaluation.

OPERATOR'S MANUAL

The operating instructions were contained on a single sheet. Additional instructions were supplied by the distributor. The instructions were clear and easy to understand.

AGROFARM DIGITAL GRAIN TESTER

Manufacturer:

Agrofarm
Monten 7
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Denmark

Distributor:

Dani Farm Supply Ltd.
R.R. #3, Site 4, Box 32
Red Deer, Alberta
T4N 5E3
PH. (403) 343-6222

Retail Price: \$395.00 (August 1991, Lethbridge Alberta)

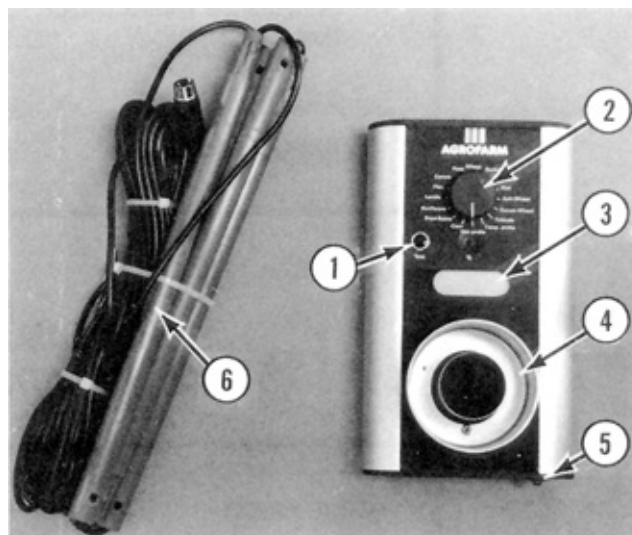


FIGURE 2. Agrofarm Digital Grain Tester: 1) Test Button, 2) Grain Selection Dial, 3) Digital Display, 4) Sample Chamber, 5) Adjusting Screw, 6) Temperature Probe and Cable.

SUMMARY

The Agrofarm Digital meter performance in wheat was fair over the entire range of moisture contents measured. Accuracy and uncertainty were fair, while repeatability was good in wheat. Meter performance in barley was poor over the entire range of moisture contents measured. Accuracy was unsatisfactory, uncertainty was very good and repeatability was fair in barley. Meter performance in canola was very good over the entire range of moisture contents measured. Accuracy was very good, uncertainty was very good and repeatability was excellent in canola.

The external temperature probe readings varied from -5 to +11°C from actual temperature readings.

Ease of performing a moisture measurement was very good. A moisture measurement was completed in less than a minute. The digital display showed the moisture content of the grain to the nearest 0.1%. Sample weighing was not required.

Ease of performing a temperature measurement was very good.

Portability of the meter was very good. The unit was light, durable and self-contained in an alu-housing case.

The operating instructions were clear and easy to understand.

GENERAL DESCRIPTION

The Agrofarm Digital grain moisture tester is a portable moisture meter suitable for testing the moisture content of various grains, oil-seeds and grasses.

The grain selection dial is used to select one of the sixteen available functions. The digital display indicates the moisture content of the crop in the sample chamber. The chart on the back of the meter shows the operating instructions and the moisture scale range for each function.

A sample is poured into the sample chamber until covering the centre cone with a half inch of material. Temperature compensation is performed automatically.

The meter operates on a 9-volt alkaline battery. The test switch is spring-loaded and the meter is self-contained in an alu-housing case.

An optional external temperature probe, complete with a 15 ft (4.6 m) cable for use in grain bins, is supplied. Temperature from -5.0 to +90°C is indicated on the digital display. A hay/straw probe is available as optional equipment.

Detailed specifications are found in APPENDIX I, while FIGURE 1 shows the major components.

RESULTS AND DISCUSSION

QUALITY OF WORK

Meter Performance: The Agrofarm Digital meter performance in wheat was fair over the entire range of moisture contents. Accuracy was fair over the moisture content range. At 14.5% moisture content, the upper limit for dry wheat, the average meter reading was 2.3% high. Uncertainty was fair, while repeatability was good over the moisture content range.

The Agrofarm Digital meter performance in barley was poor over the entire range of moisture contents. Accuracy was unsatisfactory over the moisture content range. At 14.8% moisture content, the upper limit for dry barley, the average meter reading was 1.8% high. Uncertainty was very good, while repeatability was fair over the moisture content range.

The Agrofarm Digital meter performance in canola was very good over the entire range of moisture contents. Accuracy was very good over the moisture content range. At 10.5% moisture content, the upper limit for dry canola, the average meter reading was 0.5% high. Uncertainty was very good, while repeatability was excellent over the moisture content range.

Sample Measurement: The scales on the Agrofarm Digital meter indicated moisture contents ranging from 10.0 to 27.0% in wheat, 11.5 to 24.5% in barley and 7.0 to 16.5% in canola. The Agrofarm Digital was evaluated with samples ranging from 9.4 to 23.9% in wheat, 8.9 to 23.6% in barley and 7.0 to 16.8% in canola.

The grain sample was poured into the sample chamber until the centre cone was covered. Tapping the meter to compact the sample resulted in 0.3 to 1.1% increase in the moisture content readings. Care should be taken to avoid tapping the meter.

The automatic temperature compensation was effective in the critical range near the upper limit for dry grain. When a sample was varied 9°C, temperature compensation was accurate to within 0.5% moisture content.

Temperature Accuracy: The external temperature probe readings varied from -5 to +11°C from the temperature readings obtained with a mercury thermometer.

EASE OF OPERATION

Moisture Measurement: Ease of performing a moisture measurement was very good. A moisture measurement was easily completed in less than a minute. The grain sample was poured into the sample chamber until the centre cone was covered by a half inch of grain. The volume of the sample chamber was 5.5 fl oz (155 mL) of grain. The average sample weight for wheat was 6.2 oz (176 g).

When the test switch was depressed, the digital display showed the moisture content to the nearest 0.1% for the selected crop.

The meter remained "off" unless the spring-loaded "test" switch was depressed. This reduced the risk of premature battery failure. No warm-up period was required.

The 9-volt alkaline battery was replaced by removing the top cover of the meter, held in place by one screw.

Temperature Measurement: Ease of performing a temperature measurement was very good. The Agrofarm Digital meter was used

as a temperature meter by plugging in the temperature probe. The temperature digital display was in increments of 0.1°C.

Portability: Portability of the Agrofarm Digital was very good. The unit was light, durable and self-contained in an alu-housing case convenient for field use.

MECHANICAL HISTORY

There was no operational problems encountered during the evaluation.

OPERATOR'S MANUAL

The operating instructions were contained on a single sheet. Summarized operating instructions were listed on the back of the meter. Additional instructions were supplied by the distributor. The instructions were clear and easy to understand.

APPENDIX I SPECIFICATIONS

| | |
|------------------------------------|---|
| MAKE: | Agrofarm |
| MODEL: | Analog Grain Tester |
| SERIAL NUMBER: | 0367 |
| MANUFACTURER: | Agrofarm 6064 Jordrup Denmark |
| ELECTRICAL POWER EQUIPMENT: | One 9-volt Alkaline Battery |
| OVERALL HEIGHT: | 2.8 in (71 mm) |
| OVERALL WIDTH: | 4.9 in (125.0 mm) |
| OVERALL LENGTH: | 9.1 in (231 mm) |
| TOTAL WEIGHT: | 23.3 oz (661 g) |
| PRINCIPLE OF OPERATION: | Capacitance |
| MOISTURE SCALES: | Wheat, Barley, Canola, Corn, Rye, Mustard, Peas, Timothy, Sorghum, Soya Beans, Oats and Sunflowers. |
| CONTAINER SIZE: | 7.6 fl oz (215 mL) |
| SAMPLE SIZE: | 5.5 fl oz (155 ml) |
| OPTIONS: | Temperature Probe |

| | |
|------------------------------------|---|
| MAKE: | Agrofarm |
| MODEL: | Digital Grain Tester |
| MANUFACTURER: | Agrofarm Monten 7 6000 Kolding Denmark |
| ELECTRICAL POWER EQUIPMENT: | One 9-volt Alkaline Battery |
| OVERALL HEIGHT: | 2.9 in (74 mm) |
| OVERALL WIDTH: | 5.0 in (127 mm) |
| OVERALL LENGTH: | 8.5 in (216 mm) |
| TOTAL WEIGHT: | 24.4 oz (692 g) |
| PRINCIPLE OF OPERATION: | Capacitance |
| MOISTURE SCALES: | Wheat, Barley, Oats, Rye, Soft Wheat, Durum Wheat, Triticale, Corn, Soya Beans, Sunflowers, Lentils, Flax, Canola and Peas. |
| SAMPLE SIZE: | 5.5 fl oz (155 mL) |
| OPTIONS: | Temperature Probe, Hay/Straw Probe |

APPENDIX II

STATISTICAL SIGNIFICANCE OF MOISTURE METER RESULTS

The following data presented illustrates the statistical significance of the Agrofarm Analog meter results shown in FIGURES 2 to 4, and the Agrofarm Digital meter results shown in FIGURES 5 to 7.

In the tables, M = the reading of the meter in percent moisture, wet basis, while T = the moisture content of the sample in percent moisture, wet basis, as determined by the American Association of Cereal Chemists' oven method. Sample size refers to the number of grain samples used. Each meter sample represents the average of five meter readings on that sample.

AGROFARM ANALOG GRAIN MOISTURE TESTER

| GRAIN SAMPLE | FIGURE NO. | REGRESSION FORMULA | CORRELATION COEFFICIENT | STD. ERROR OF ESTIMATE | SAMPLE SIZE | SAMPLE MEAN |
|--------------|------------|--------------------|-------------------------|------------------------|-------------|-------------|
| WHEAT | 2 | $M=0.94T+3.23$ | 0.90 | 0.67 | 30 | 15.2 |
| BARLEY | 3 | $M=0.86T+3.18$ | 0.97 | 0.65 | 31 | 15.4 |
| CANOLA | 4 | $M=0.88T+2.90$ | 0.93 | 0.98 | 31 | 14.1 |

AGROFARM DIGITAL GRAIN MOISTURE TESTER

| GRAIN SAMPLE | FIGURE NO. | REGRESSION FORMULA | CORRELATION COEFFICIENT | STD. ERROR OF ESTIMATE | SAMPLE SIZE | SAMPLE MEAN |
|--------------|------------|--------------------|-------------------------|------------------------|-------------|-------------|
| WHEAT | 5 | $M=1.29T+1.07$ | 0.96 | 0.93 | 32 | 16.4 |
| BARLEY | 6 | $M=5.14T+1.47$ | 0.98 | 0.53 | 25 | 16.0 |
| CANOLA | 7 | $M=0.54T+1.00$ | 0.98 | 0.38 | 20 | 12.1 |

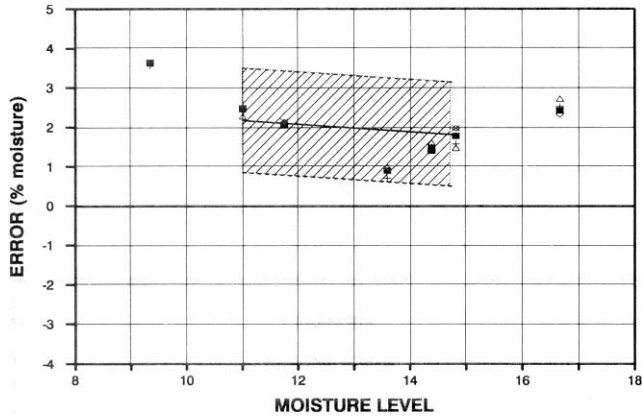


FIGURE 3. Analog Meter Performance in Wheat.

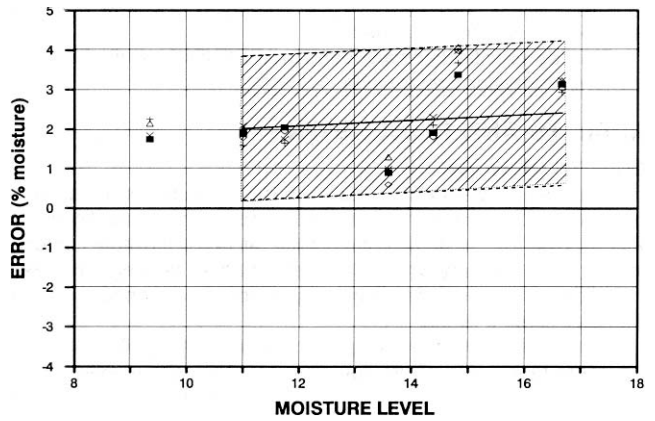


FIGURE 6. Digital Meter Performance in Wheat.

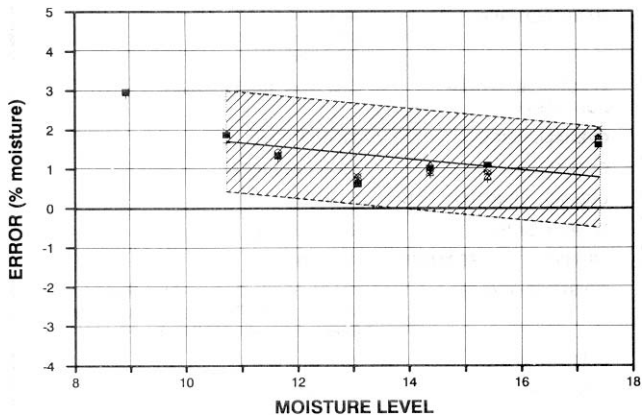


FIGURE 4. Analog Meter Performance in Barley.

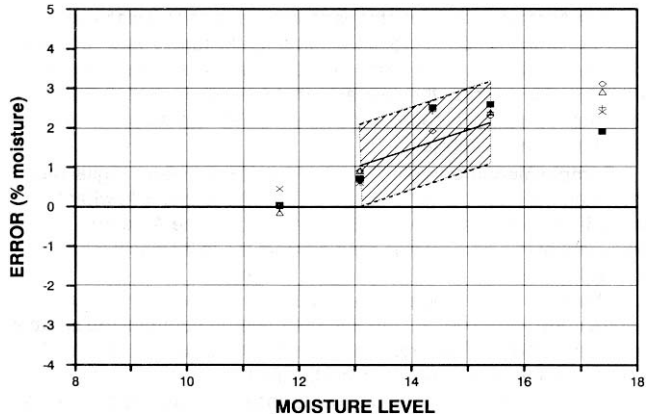


FIGURE 7. Digital Meter Performance in Barley.

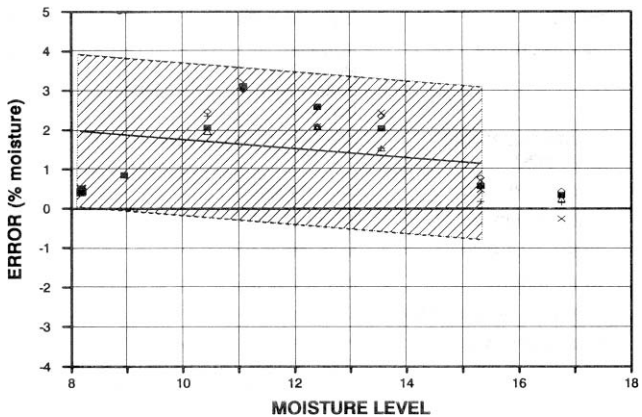


FIGURE 5. Analog Meter Performance in Canola.

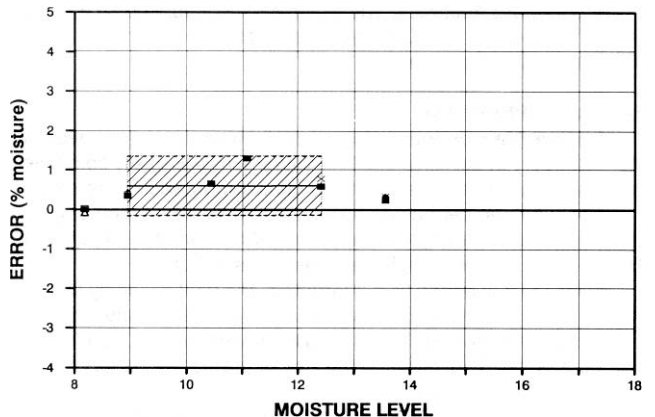


FIGURE 8. Digital Meter Performance in Canola.

SUMMARY CHART

AGROFARM ANALOG GRAIN MOISTURE METER

| | |
|---------------------------------|--|
| RETAIL PRICE: | \$324.00 (August 1991, Lethbridge, Alberta) |
| QUALITY OF WORK: | |
| Meter Performance | Fair in wheat; Fair in barley; Fair in canola |
| Temperature Accuracy: | Averaged 7.5°C below actual readings |
| EASE OF OPERATION: | |
| Moisture Measurement: | Very Good ; completed in less than a minute |
| Temperature Measurement: | Very Good |
| Portability: | Very Good ; self-contained in a plastic case |
| MECHANICAL HISTORY: | No problems with meter operation |
| OPERATOR'S MANUAL: | Clear and easy to understand |

AGROFARM DIGITAL GRAIN TESTER

| | |
|---------------------------------|---|
| RETAIL PRICE: | \$395.00 (August 1991, Lethbridge, Alberta) |
| QUALITY OF WORK: | |
| Meter Performance: | Fair in wheat; Poor in barley; Very Good in canola |
| Temperature Accuracy: | Varied from -5 to +11°C below actual readings |
| EASE OF OPERATION: | |
| Moisture Measurement: | Very Good ; completed in less than a minute |
| Temperature Measurement: | Very Good |
| Portability: | Very Good ; self-contained in a alu-housing case |
| MECHANICAL HISTORY: | No problems with meter operation |
| OPERATOR'S MANUAL: | Clear and easy to understand |



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