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Research Report 223

Windrowing with a Floating Cutterbar

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

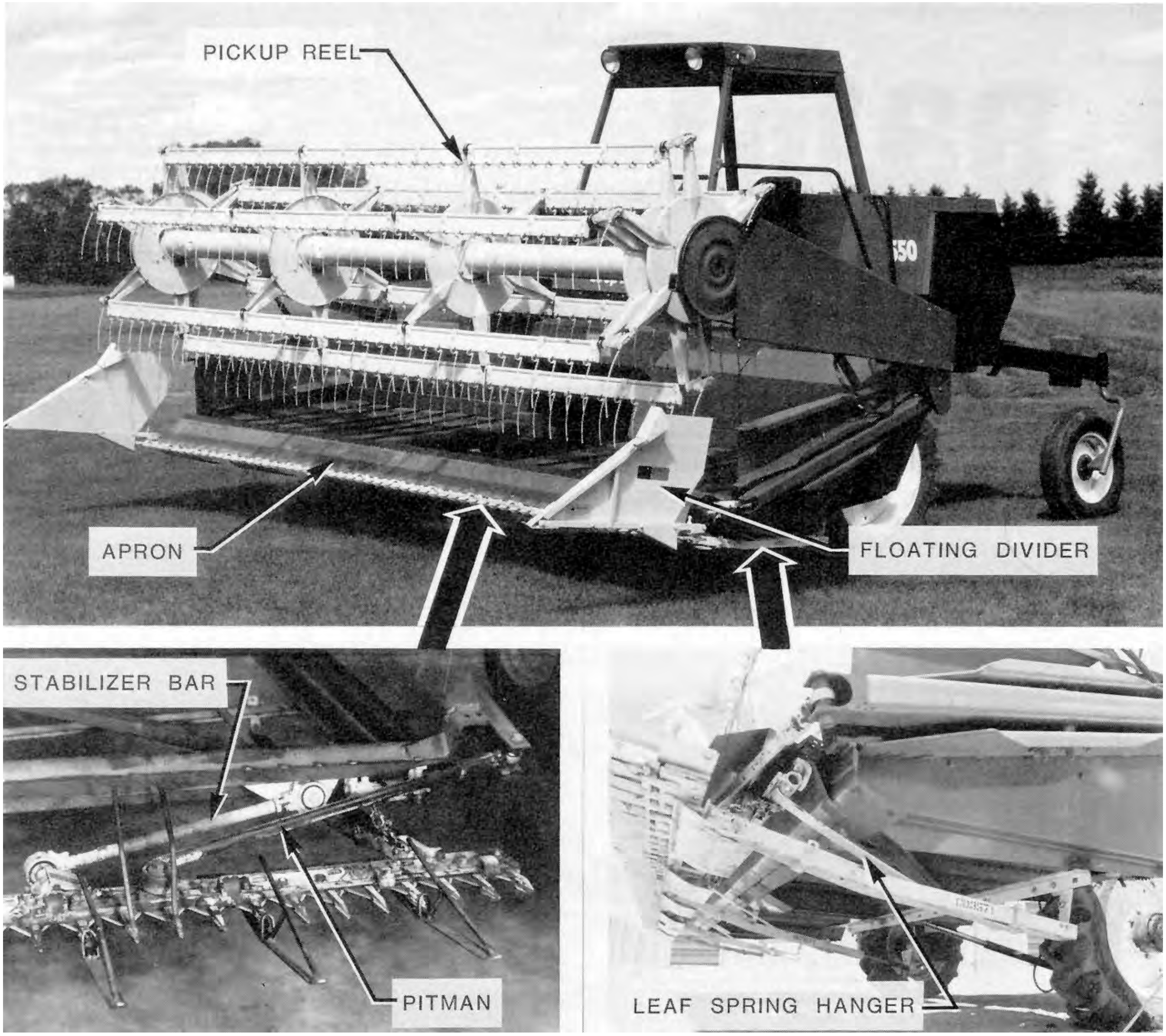

FIGURE 1. Floating Cutterbar Attachment.

SUMMARY AND CONCLUSIONS

Use of a floating cutterbar on a windrower reduced losses by 50%, in solid seeded soybeans and lentils, when compared to conventional windrowers. Functional performance was excellent in mature crops of lentils, peas and soybeans, as long as the soil was dry, however, performance was reduced in green crops. Weed infestations usually did not adversely affect the performance of the cutterbar.

Floatation was inadequate in wet soil. Two non-conventional lifter guard designs were fabricated to improve operation in problem crops and adverse conditions. The most effective, consistent and uniform lifting was obtained with the half moon lifters.

The floating crop divider was not effective in lentils and field peas. A specially fabricated rigid divider improved performance.

The pickup reel performed best when positioned directly above the apron. A considerable number of windrower modifications were necessary to permit proper attachment and operation of the cutterbar.

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ACKNOWLEDGEMENTS

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INTRODUCTION

The practical field application of a floating cutterbar mounted to a windrower, for harvesting certain problem crops, is investigated in this report. Only one model of floating cutterbar and windrower were used during the project, although others were available. The cutterbar is designed primarily for use in harvesting soybeans with combines. Summarized are results of two years of field studies to assess the performance and feasibility of the windrower/floating cutterbar combination along with a variety of lifter guards, to reduce field losses in a variety of solid seeded pulse crops, in addition to soybeans.

MACHINE DESCRIPTION

The Hart-Carter floating cutterbar (FIGURE 1) is a flexible combine harvester attachment designed to follow ground contours independently of the combine header. The cutterbar was adapted to mount to a Coop Implements 550 windrower[1] with 4.6 m (15 ft) draper header. The floating cutterbar was suspended, forward and below the conventional cutterbar location, by four leaf spring hangers spaced symmetrically about the windrow opening and attached below the draper header. A series of sheet metal aprons were hinged to the cutterbar to cover the gap between the flexible, floating cutterbar and the rigid draper header. The sickle was driven with a pitman connected to the windrower swaybar while a stabilizer bar, adjacent to the pitman, prevented the cutterbar from moving from side to side, with the sickle, during operation (FIGURE 1). A Hart-Carter (Hume) pickup reel replaced the conventional bat reel. Lifter guards, were used for most tests.

SCOPE OF TEST

The floating cutterbar and windrower were operated in the solid seeded crops shown in TABLE 1. Soil conditions varied from wet to very dry. Crop conditions varied greatly and included lodged and green crops, as well as crops with a high degree of weed infestation. The cutterbar/windrower arrangement was assessed for quality of work, operation and adjustment. Comparisons throughout the test were made to wind rowers with conventional rigid cutterbars, draper headers and pickup reels. Three separate machines, all of the same model, equipped with floating cutterbars were used during the testing.

TABLE 1. Operating Conditions

CROP	YIELD (t/ha)	CROP CONDITION	FIELD AREA (ha)
Field Peas	1.7 to 2.5	Wide range of maturity and moisture; solid seeded	33
Lentils	1.0 to 1.4	Wide range of maturity and moisture; solid seeded	28
Black Beans	0.9 to 1.3	Solid seeded	3
Soybeans	0.2 to 1.5	Solid seeded	32
Barley	4.8	Heavily lodged	8
Wheat	3.4	Partially lodged	3

QUALITY OF WORK

Losses: Crop losses with the floating cutterbar (FIGURE 2), are compared to those with windrowers, having conventional rigid cutterbars, in soybeans and lentils. In these tests, the windrower with the floating cutterbar was operated at three-quarter engine speed, with the reel positioned directly over the hinged apron. Lifter guards, spaced at 300 mm (12 in) were also used. The single lined shaded area represents the difference in crop losses, determined from seed counts, between the two windrowers. In soybeans, average total losses (for a 1.2 t/ha average yield) were reduced from 15% of yield to 8% by using the floating cutterbar. This represents average data derived from three separate fields. In lentils, the average cutterbar losses (for a crop of 1.3 t/ha average yield) were reduced from 6% to 3% by using the floating cutterbar (FIGURE 2, centre). In a second field of lentils with average yield of 2.2 t/ha the average losses were reduced from about 11% to 6% as shown in FIGURE 2 (top).

A portion of the crop loss was seeds and pods remaining on the plant stubble. This was reduced from 6% to 2% of yield due to the lower average cutting height of the floating cutterbar. Minimum cutting height for the rigid cutterbar was about 80 mm (3 in), in ideal conditions, while a minimum cutting height of 40 mm (1.5 in) was possible with the floating cutterbar. For both cutterbars, the loss in the plant stubble along the length of the cutterbar was evenly distributed and was about one-half of the total loss. The peak losses at the centre of the windrower, (FIGURE 2) are due to losses occurring above the drapers, which are transferred to the windrow opening.

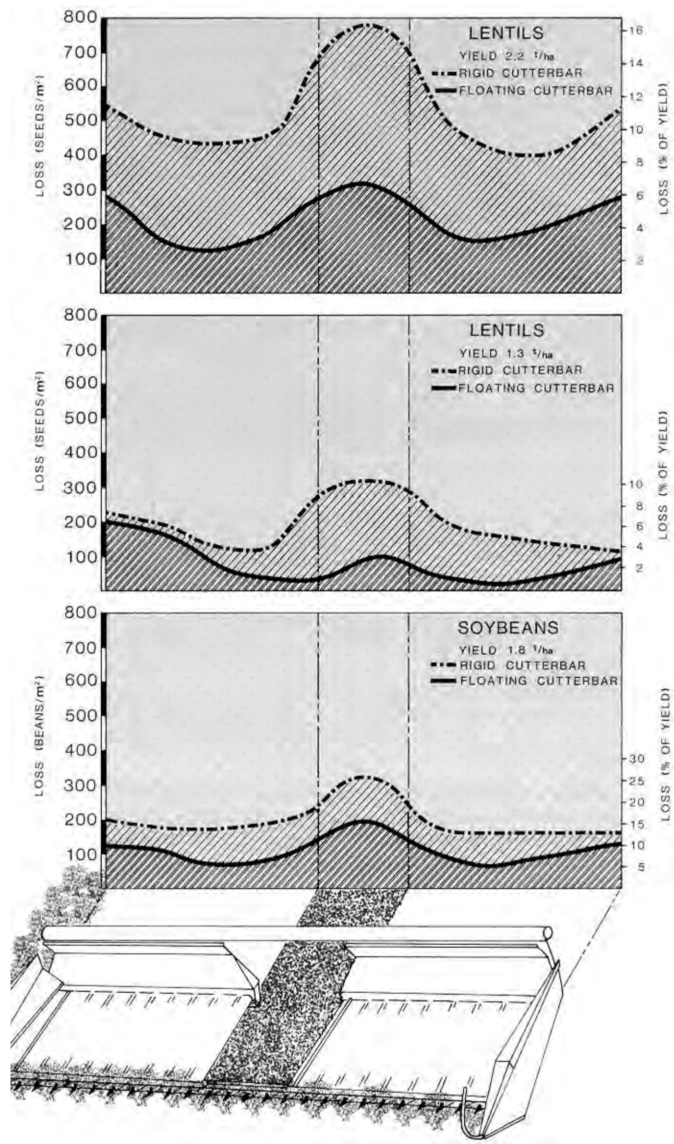


FIGURE 2. Seed Loss Distribution in Soybeans and Lentils.

The floating cutterbar was also used in field peas and black beans, however loss data were inconclusive in these crops. Lifter guards improved performance greatly, in peas, due to the vine-like nature of the haulm. Lifter guards, on the conventional cutterbar, produced comparable results provided the land was level. Results in solid seeded black beans were inconclusive due to the sparseness of the haulm and the proximity of the pods to the ground. Beans are generally row-cropped, in western Canada, and harvested with bean pullers or similar equipment.

Windrow Uniformity: Bunchy windrows were formed when the pickup reel was postioned ahead of the floating cutterbar. Windrow uniformity was improved when the pickup reel was positioned above the hinged apron with the reel index[2] set between 1.2 and 1.3. With this reel position, bunching was reduced at the cutterbar since the reel cleared the crop smoothly up the inclined, hinged apron.

In peas, windrow uniformity was excellent, particulary with the half-moon lifter guards. In lentils, lifter guards had a noticeable beneficial effect, especially in heavy crops. In most cases, heavy weed conditions did not reduce windrow uniformity and, in fact, often improved it in light crops.

In badly lodged barley and wheat, windrows were uniform. Losses were negligible ,in lodged cereal crops. Stubble height varied from 55 mm (2 in), when cutting opposite to the direction of crop lean, to 700 mm (28 in) when travelling in the direction of crop lean in badly lodged cereals of 1500 mm (45 in) stalk length.

[1]For an evaluation of the Coop Implements 550 Windrower, see PAMI Evaluation Report No. E1876A.

[2]Reel index is the ratio of reel tip speed to travel speed.

OPERATION AND ADJUSTMENT

Stubble Length: A cutting height as low as 40 mm (1.5 in) was possible in dry fields. In wet fields, performance was reduced by mud buildup under the cutterbar and ahead of the guards. This often led to jamming of the knife and eventual durability problems.

Rolling and undulating ground surfaces were negotiated easily provided the soil surface was not ridged or lumpy. Mole hills often caused plugging problems. In extreme mole infested areas, openings in the apron would allow the soil to fall through, while still permitting the crop to be conveyed to the drapers.

Floatation: Cutterbar floatation was provided by four support hangers, each equipped with an adjustable leaf spring located beneath the header (FIGURE 1). Operation in loose soils and mud was often difficult due to plugging. Floatation was adjusted by repositioning the rear leaf spring bracket on each hanger. This adjustment was not adequate, with Only four support hangers, to reduce soil buildup in mud. Floatation may have been improved by adding additional springs to each of the four spring hangers, or by adding another hanger on each side of the windrow opening. Although five hangers were supplied with the attachment, only four could be used as it was necessary to use an even number to permit symmetrical mounting about the centre windrow opening. Adjustment of flotation was convenient. The cutterbar rode easily over stones of moderate size provided, they were lodged in the ground. However, the header had to be raised over any large obstacles.

The cutterbar could also be locked rigid for the cutting of standing cereal crops. The could be useful when the changing of cutterbars, for limited cereal cutting, would not be practical or convenient.

Lifter Guards: A variety of lifter guards, all spaced at 300 mm (12 in), were used for most tests. Lifter guards were necessary in all fields of peas and lentils. Their effect was most beneficial in field peas. Since these crops grew close to the ground, the lifter guards helped to raise the vines from the ground and raise the pods hanging close to the ground. Since soybean pods are distributed along the length of the plant, lifter guards were not necessary in this crop. Three types of lifter guards were evaluated: the conventional lifter, the skid lifter and the half moon lifter (FIGURE 3). Lifter performance is detailed in TABLE 2 while specifications are included in APPENDIX I.

TABLE 2. Lifter Guard Performance in Field Peas and Lentils

OPERATING CONDITIONS	Conventional	Skid	Half Moon
Operation in Mature Dry Crops	good	very good	excellent
Operation in Green Crops	fair	good	excellent
Freedom from Hairpinning	poor	good	excellent
Operation in Dry Soil	very good	excellent	excellent
Operation in Wet Soil	poor	good	excellent
Resistance to Mud Buildup	fair	fair	very good
Freedom from Bunching at Cutterbar	poor	fair	excellent

The half moon lifters had excellent performance even in weeds and green crops. The narrow (6 mm) profile and rigid design of the guard permitted the point to operate below the soil and vegetation. The design of the lifter also minimized crop hairpinning and mud buildup. The most effective, consistent and uniform lifting action was obtained with the half moon lifter. The other lifters had considerable problems operating in wet soil.

The performance of the skid lifters was satisfactory in dry conditions despite some hairpinning in green peas and lentils.

Conventional lifters are manufactured by many companies; the Hume lifter, used in this test, is typical. Conventional lifters have a hinged leading section which is held down firmly on top of the soil by the spring mechanism. The conventional lifters tended to plow ground in both moist and dry conditions, and their wide profile often tended to hinder crop flow to the cutterbar even when their upper surfaces were polished.

(a) Half Moon Lifter Guards

(b) Skid Lifter Guards

(c) Conventional Lifter Guards

FIGURE 3. Lifter Guards

Dividers: The floating dividers (FIGURE 1) were generally not suitable for lentils and peas due to hairPinning and bunching at the ends of the cutterbar near the dividers. As well, the dividers tended to dig, particulary in wet soil. These dividers were later replaced with rigid dividers mounted to the floating cutterbar (FIGURE 4).

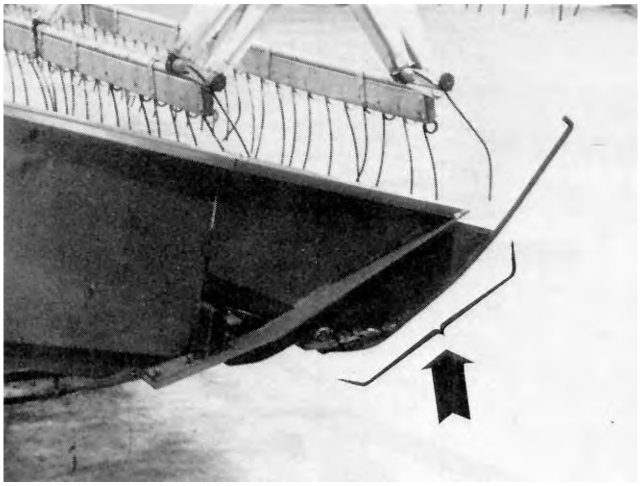


FIGURE 4. Rigid Crop Divider.

Tests done without dividers pointed out the necessity of using dividers to red uce bunching at the ends of the cutterbar. The rigid dividers worked very well in both wet and dry soil conditions.

Pickup Reel: Pickup reel performance was very good as long as the reel was not positioned ahead of the cutterbar. This was due to the steep angle of the hinged apron which hindered crop flow onto the windrower drapers. A pickup reel of large diameter could provide a greater sweep arc, to lift the crop and convey it onto the draper.

The pickup reel tooth angle was conveniently adjustable to suit the crop.

Steel pickup teeth were best suited for operating the reel near the ground. Plastic teeth used during part of the field test were less able to withstand ground contact, even in stonefree areas, which resulted in frequent failures.

INSTALLATION: It took two men about 16 hours to mount and adapt the cutterbar to the windrower. Supports were welded beneath the draper head to mount the four hangers (FIGURE 5).

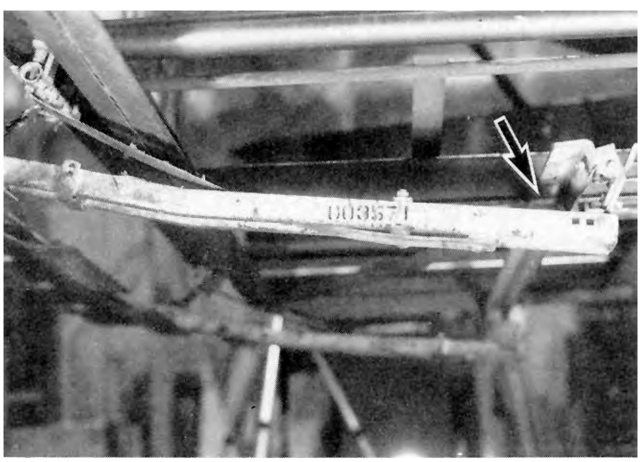


FIGURE 5. Cutterbar hanger support.

The added mass of the attachment made additional modifications to the windrower necessary. A nitrogen accumulator of greater capacity was used to increase header floatation, and the header hydraulic lift capacity was increased by raising the hydraulic pressure. The rear of the windrower was ballasted by adding 220 kg (480 lb) of mass (FIGURE 6) to counterbalance the additional mass of the cutterbar and pickup reel.

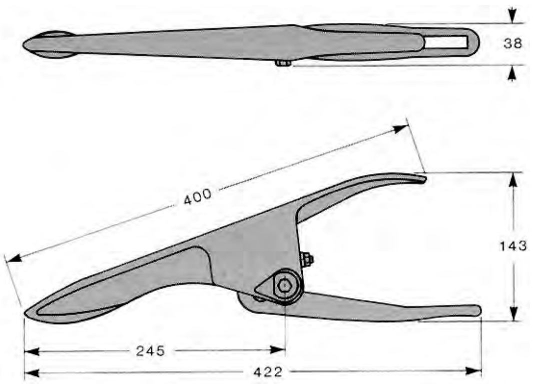
FIGURE 6. Rear ballast attachment.

Installation of the pickup reel made further modifications necessary. The reel arms were extended to correctly position the reel, and orifices were placed in the return lines of the hydraulic reel lift to reduce the lowering rate. The lift cylinders were repositioned to limit the downward travel to keep the pickup reel teeth from contacting the draper and cutterbar. A 200 mm (8 in) drive pulley was substituted for the adjustable pulley to prevent excessive belt slippage experienced during initial testing, especially in green, wet crop conditions.

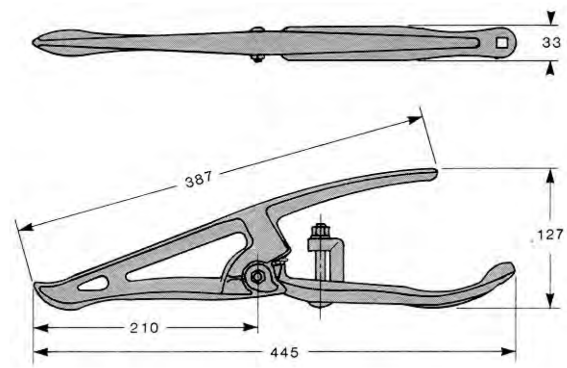
APPENDIX I

LIFTER GUARDS

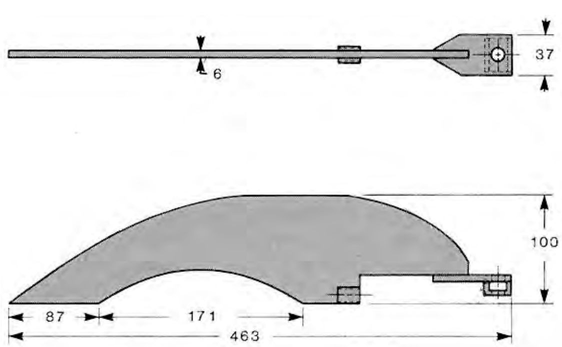
All dimensions are in mm



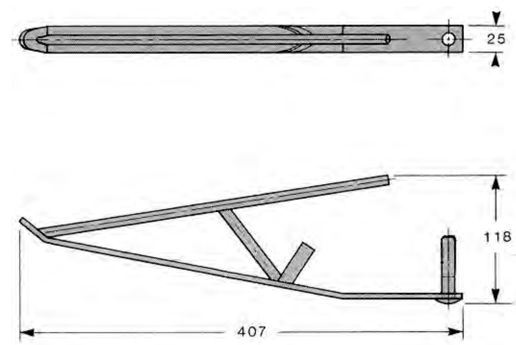
Conventional Lifter (Hume)



Conventional Lifter (Gaterman)



Half Moon Lifter*



Skid Lifter

***Available from Fred Staples Welding, P.O. Box 202, Oakville, Manitoba, R0H 0Y0.**

APPENDIX II

Conversion Table

1 tonne (t)	=	2200 pounds mass (lb)
1 kilogram (kg)	=	2.2 pounds mass (lb)
1 metre (m)	=	3.3 feet (ft)
1 millimetre (mm)	=	0.04 inches (in)
1 hectare (ha)	=	2.5 acres (ac)

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