Final report:

British Beet Research Organisation Project 05/26

Performance evaluation of precision sugar beet drills

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SUMMARY

This evaluation tested seven drills at two speeds and on two soil types. Drill performance was measured by uniformity of seed spacing. There was variability in the way drills were worked and the accuracy of operation. The importance of operating in line with manufacturers specifications was noted. All drills produced good plant populations

Keywords: precision sugar beet drill

INTRODUCTION

Performance tests of precision sugar beet drills were last conducted in 1998, since when the drill market has changed considerably; a number of new drills, and new versions of well-proven ones have been introduced. Technology has also moved on; more drills are now being offered with electronic drive, allowing computer controlled, 'on the move adjustment' of seed spacing, variable positioning of tramlines and ability to link into GPS (Global Positioning Systems).

Recent BBRO-funded Growers' Open Days identified plant establishment as a key target area for improvement, and the seed distribution performance of drills is crucial to the achievement of optimal plant stands. Non-uniform crops resulting from poorly placed seeds produce poorer plant stands and ultimately poorer crops in terms of yield and root quality. Seeds need to be placed at an even depth and spacing in the row to give rapid and maximum plant emergence and establishment. This exercise evaluated the abilities of the various models of drills now being marketed to achieve this. It also provided a subjective assessment of others aspects of the practical operation of these machines such as type of coulter; range of seed spacing available; ease of adjusting drilling depth; ease and completeness of emptying seed hoppers; ease of use etc.

OBJECTIVE

1. To evaluate the performance of the current market range of drills in terms of their ability to produce rapid seedling emergence and optimal plant establishment.

2. To assess the ease of setting up and operating these drills.

APPROACH

Two fields, of different soil types, a sandy loam and a heavy clay loam and in close proximity to one another, were selected on a commercial farm at Langtoft, near Market Deeping in Lincolnshire, to conduct this evaluation.

A target date the 23 March 2005 for conducting the performance tests was circulated to all entrants in advance. Final cultivations to prepare the seed beds for drilling were completed on the day of the trials. These were one pass of a power harrow on the light land site, and two passes for the heavier soil type. The weather conditions on the day were good despite a period of unsettled weather in the previous few days.

The entrants made their own preparations to meet the specification required for the tests, providing their own tractor and driver to set up the drill, and operate the actual test runs. All participants were asked to drill one pass (6 or 12 rows depending on the

size of the drill) at two test speeds 4.0kph and 6.5kph. During the test runs, each drill was timed over 50m to check the actual forward speed operated at.
Row width was 50cm; target seed spacing 17 - 17.5 cm and seed depth was 2.5cm (or into moisture). Each entrant was supplied with the same variety of sugar beet seed, Dominika, which had been Gaucho Advantage treated. All manufacturers were allowed a preparation area to set up the drills prior to the evaluation runs.
Prior to the tests each drill was examined for particular features facilitating ease of use. Measurements were made of plant populations at 50% and 75% seedling emergence and final plant establishment at the six-leaf stage on 2 rows x 20m replicated 4 times on each treatment. The accuracy of seed spacing was assessed by measuring the distance between plant stations on two rows. This was done using a wheel mounted laser pointer attached to a data logger, with one person pushing the logger and two people operating recording switches to mark the position of the beet as the logger passed over every plant in a 20 metre length of row (see photograph 1).

All companies who manufacture, or are UK agents for, precision sugar beet drills were invited to take part in the evaluation, seven accepted, each entering one precision drill for the test (Table 1).

Table 1 - ***Sugar beet drills entered for the 2005 tests***

Manufacturer	Agent / Supplier	Model
Herriau, France	Standen Reflex	Herriau Turbosem
Kongskilde, Germany	Kongskilde UK	Becker Centra 2000
Kuhn, France	Kuhn Farm Machinery UK	KNM
Kverneland Group, Germany	Kverneland UK	Accord Monopill SE
Kverneland Group, Germany	Vicon Rau	Kliene Unicorn Synchro
Ribouleau Monosem	Toucan Farm Machinery	Monosem Mecca 3
Stanhay Webb Ltd	Stanhay Webb	Webb Seven

The model of drill entered for testing from each manufacturer, the type of metering system and target seed spacing selected for the evaluation is shown in Table 2.

Table 2 - ***Characteristics and seed spacing of drills under test***

Model	Mechanism	Seed Spacing CM (target 17- 17.5 cms)
Herriau Turbosem	Pneumatic	17.3
Becker Centra 2000	Mechanical cell wheel drive	17.0
KNM	Mechanical cell wheel drive	17.1
Accord Monopill SE	Mechanical electronic cell wheel drive	17.3
Kliene Unicorn Synchro	Mechanical electronic cell wheel drive	17.3
Monosem Mecca 3	Mechanical cell wheel drive	17.5
Webb Seven	Mechanical cell wheel drive	16.9

As the specification was the same for all, any observed differences could be attributed to the performance of the drill rather than variations in the drill set-up.

RESULTS

Results of the examination of each drill for particular features facilitating ease of use are shown in Table 3. Scores on a scale of 1 – 10 (1=poor, 10=good) were awarded for each specified feature.

Table 3 ***Specification assessments***

	Herriau	Kleine	Kongskilde Becker	Khun KNM	Monopil	Monosem	Webb
Feature	Scores 1 – 10 (10 = Good) or Yes/No						
Coulter type	Metal	Metal	Metal	Metal	Metal	Metal	Ceramic
Multi crop options	Yes	No	No	No	No	No	Yes
Electronic drive options	No	Yes*	No	No	Yes*	Yes	No
Clod pusher options	No	Yes	Yes	Yes	Yes	Yes	Yes
Seed coverer options	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disc coulter option	Yes	Yes	No	No	Yes **	Yes	No
Tramline options	Yes	Yes	Yes	No	Yes	Yes	Yes
Wheel options	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Row width options	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hydraulic marker options	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ceramic coulter options	No	No	No	No	No	No	Yes
Spacing choice	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reversible coulters	No	No	No	No	No	No	Yes
Monitor availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spares availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ease of attachment	7	8	8	8	5	7	7
Ease of unit removal	8	7	6	6	5	8	6
Ease of gear change	8	9	8	9	9	8	5
Ease of depth setting	6	8	8	7	8	7	7
Ease of emptying	9	8	8	7	7	8	4
Ease of maintenance	8	8	8	7	8	7	7
Ease of cleaning	9	7	7	7	7	7	7
Ease of transport	7	8	7	8	8	8	7
General build quality	7	9	7	8	9	8	7

* Electronic version used
** Fitted to test drill.

Generally all drills had good levels of build quality and were relatively easy to arrange for transport. However they did differ in the ease of attachment to a tractor. The Monopill being the most closely coupled, was also the most difficult to remove individual seeding units from, for examination or maintenance. The Webb drill proved to be difficult to empty surplus seed from, and also the most difficult to change seed spacing. Depth setting was identified to be more difficult on the Herriau due to its design, compared to the other traditionally designed drills. Some drill also had the option of disc coulters allowing them to operate in conditions with more straw and trash such as with cover crops and non-inversion tillage.

Results of actual forward speed compared to target speed are shown in Table 4.

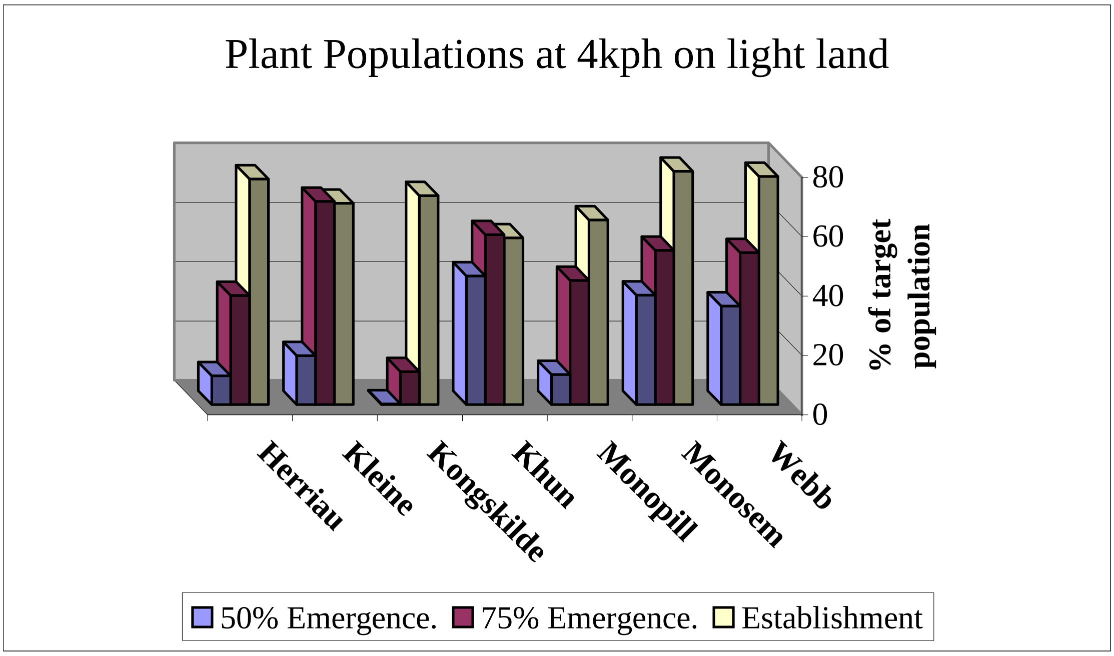
Table 4 ***Actual forward speed versus target (kph)***

Drill	**Herriau**		**Kleine**		**Kongskilde Becker**		**Khun KNM**		**Monopill**		**Monosem**		**Webb**	
Target speed kph	**4.0**	**6.5**	**4.0**	**6.5**	**4.0**	**6.5**	**4.0**	**6.5**	**4.0**	**6.5**	**4.0**	**6.5**	**4.0**	**6.5**
Actual speed Light field	3.7	6.5	4.0	6.5	4.2	6.6	4.0	6.4	4.5	6.1	3.7	6.0	4.0	6.0
Actual speed Heavy field	4.1	6.2	3.9	6.4	4.1	6.6	3.9	6.4	4.1	6.5	4.3	6.2	4.0	6.0

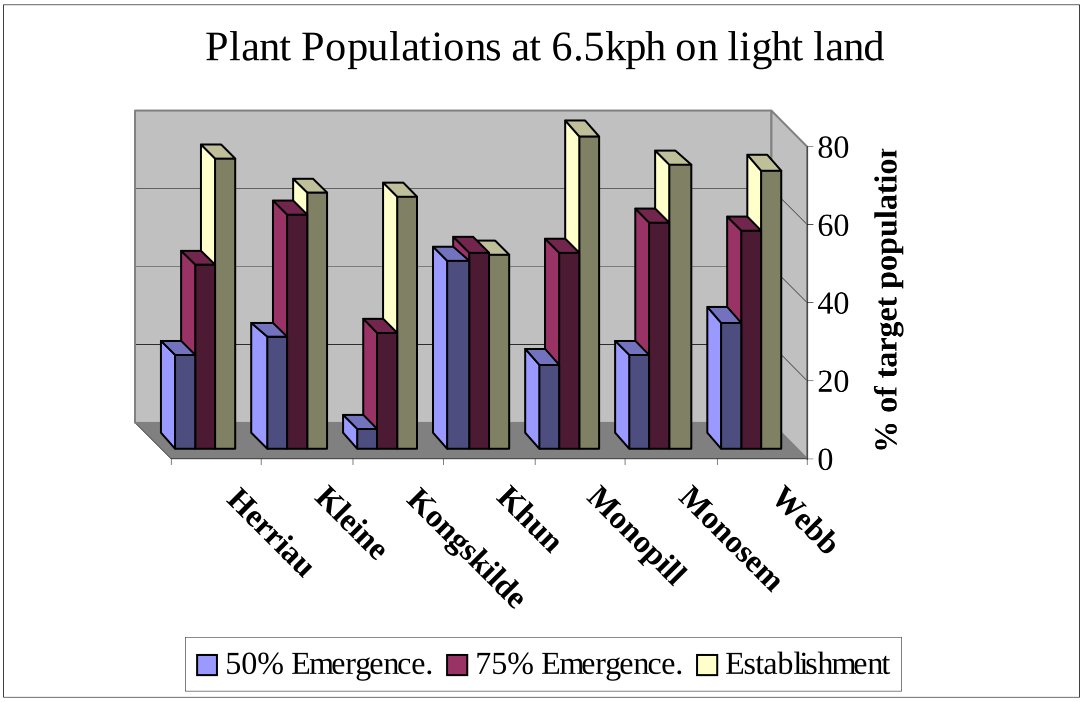
Most drills were operated close to the target speed

The results of plant emergence and final establishment are shown in graphs 1, 2, 3 and 4.

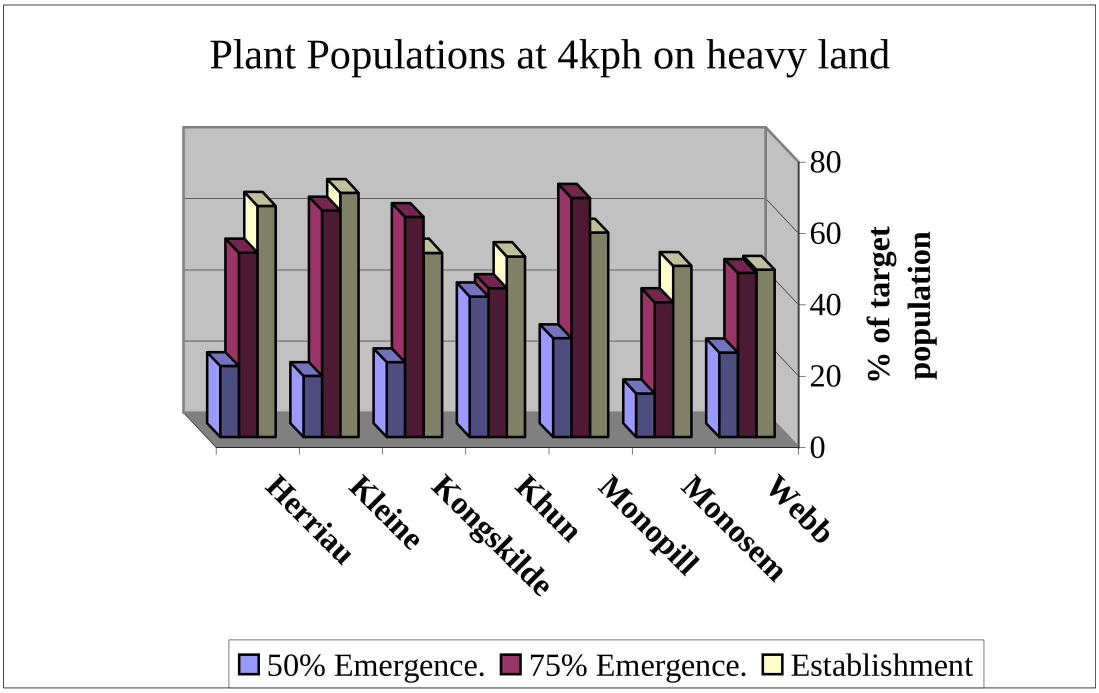
Graph 1 ***Plant population at 4 kph light field***



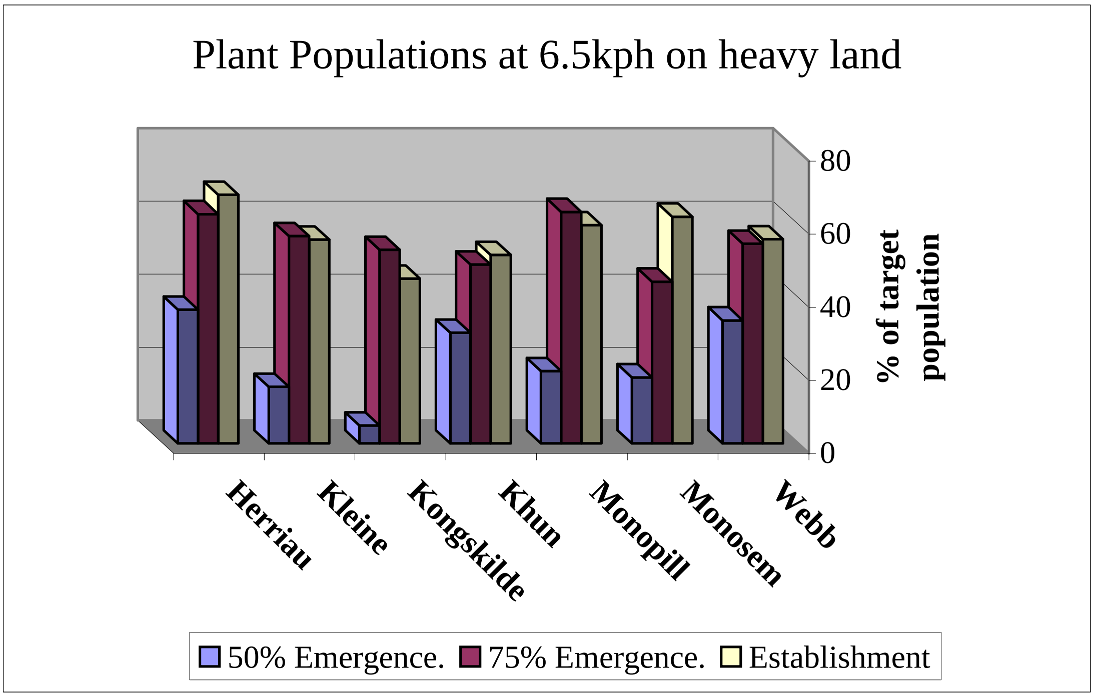
Graph 2 ***Plant populations at 6.5 kph light field***



Graph 3 ***Plant populations at 4 kph heavy field***



Graph 4 ***Plant populations at 6.5 kph heavy field***



The weather following drilling was cool and wet; the first beet emerged after 13 days. On the day there was some variability in the way the drills were set up for the prevailing conditions and differences in emergence were apparent between drills which were a result of drilling depth. The Kuhn drill produced the most rapid emergence, its drilling depth was quite shallow. However on the heavier field this resulted in some mouse damage (between 6 and 7% of the seeds eaten). The operator of the Monosem drill felt he operated with the drilling depth too shallow on the 4.0kph run on the heavy field; subsequently mice ate 14% of the seeds. On the other hand the Kongskilde drill was set quite deep on both fields and the seedlings were the slowest to emerge. The cool growing conditions during April and early May slowed crop growth and prolonged the period when the crop was susceptible to grazing by rabbits, hares and birds.

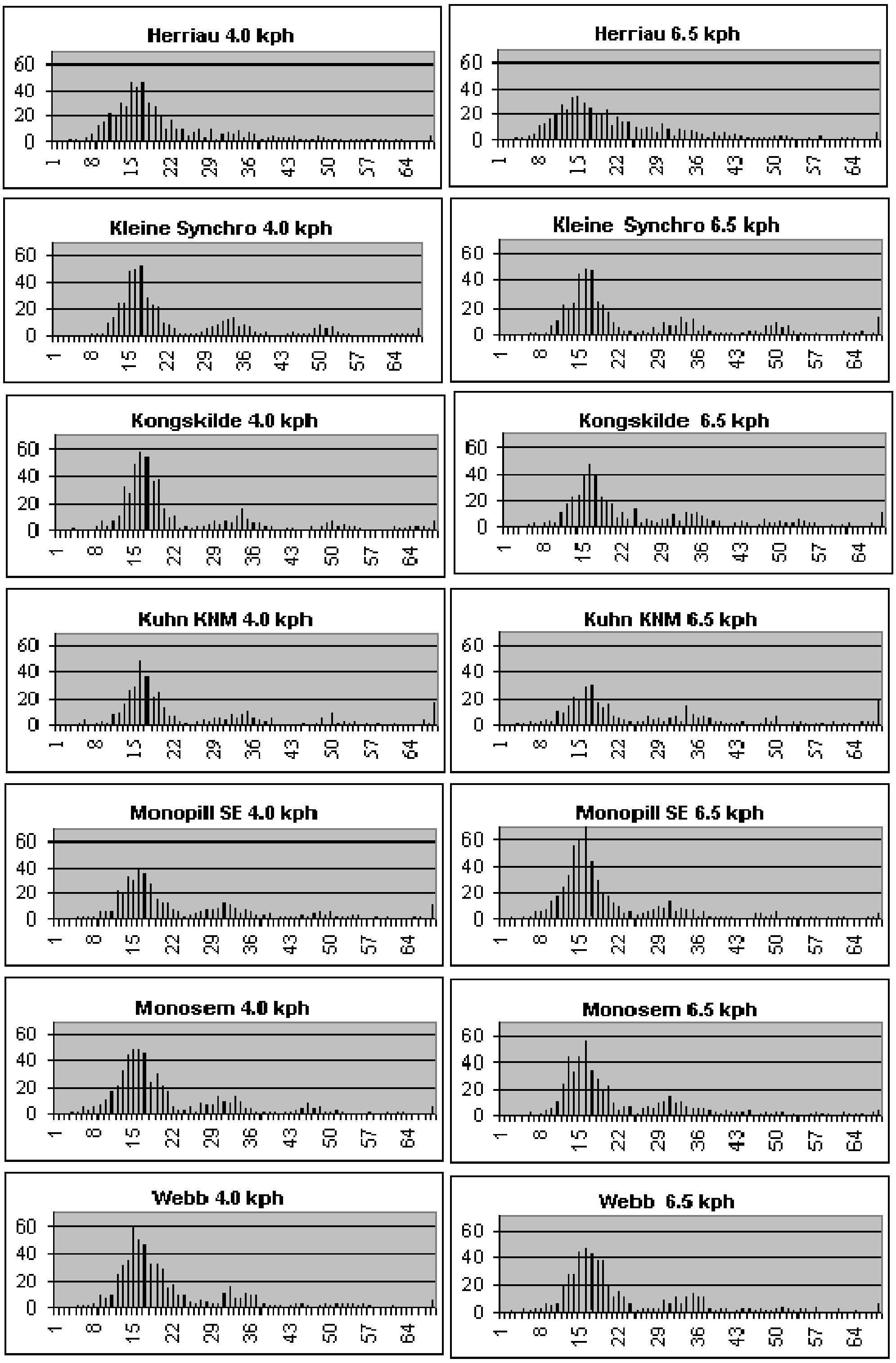
Establishment from the best drills was around 75%. The lowest establishment on the lighter field at both speeds was from the Kuhn drill and was probably a result of the shallow drilling depth. The Monopill produced the highest establishment at 6.5kph but establishment was only average at 4.0 kph. Overall the level of establishment from the Herriau, Monosem and Webb was similar at both speeds.

On the heavier field overall establishment was much lower with establishment of the best drills at just over 60%. The Herriau and Kleine performed best at 4.0 kph with the Herriau and Monosem also achieving similar levels of emergence at 6.5 kph. The effect of plant loss at establishment can be seen on a number of drills, with counts lower than those recorded at 75% emergence**.**

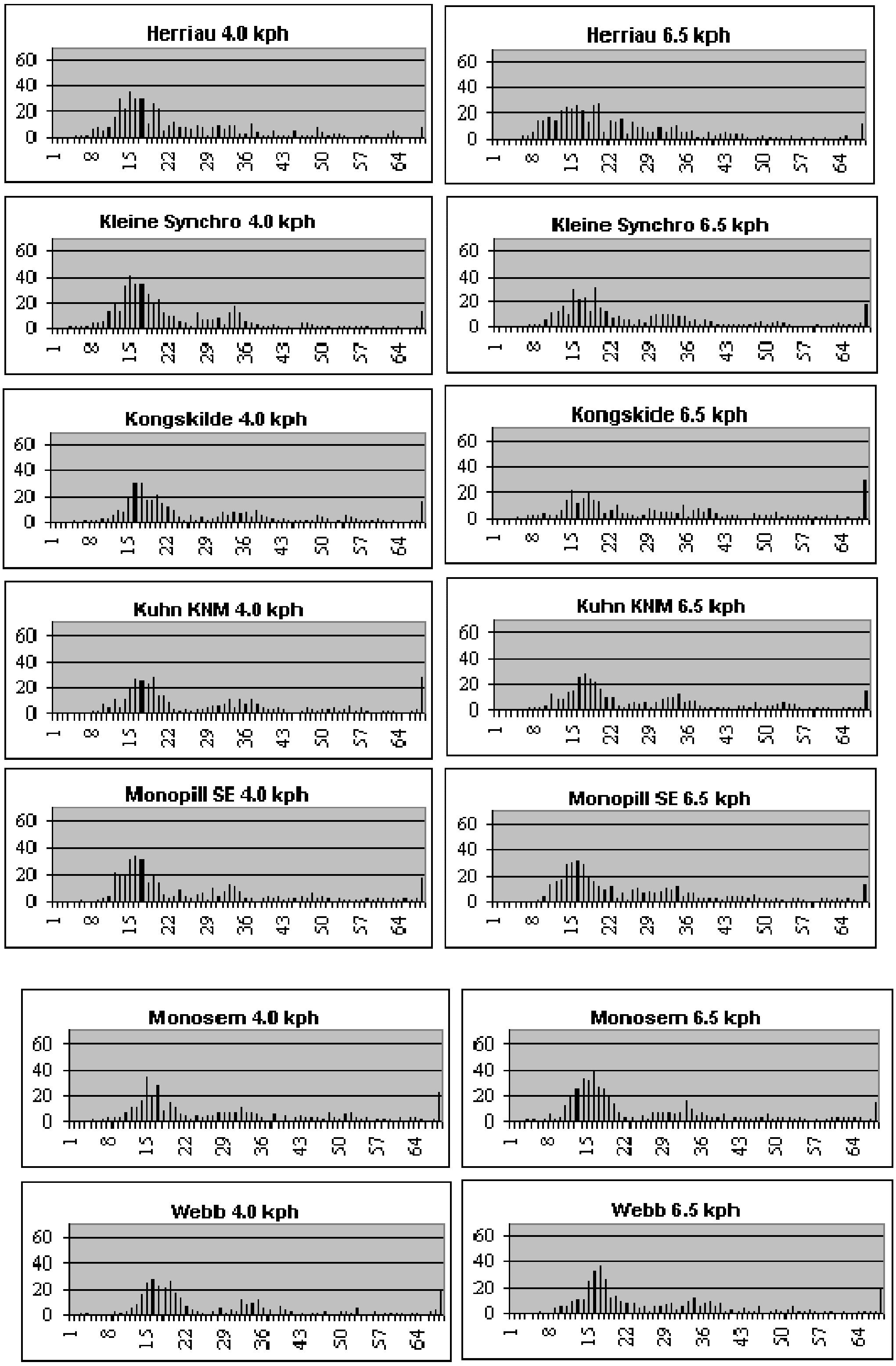
The accuracy of seed spacing at establishment is depicted as frequency histograms for each drill type at 4.0kph and 6.5kph on both the light soil and heavy soil type and is shown in graphs 5 and 6.

Optimum drill spacing appears in each figure as a single peak at the set distance for each drill, with smaller peaks at multiples of that setting, resulting from gaps where seeds may have failed to be sown or seedlings may have failed to establish. Distribution of bars on either side of these peaks represent less than optimum spacing being achieved.

Graph 5 ***Frequency histogram of spacing of individual drills on the light field at 4kph and 6.5kph***



Graph 6 ***Frequency histogram of spacing of individual drills on heavy field at 4kph and 6.5kph***



DISCUSSION

The Herriau turbosem 12M drill used was a heavy-duty minimum tillage model, different from the standard model used for sugarbeet. It differs in its metering mechanism from all the other drills tested; seeds are selected from a central hopper pneumatically and blown at high pressure down a tube to each coulter. In this exercise this approach appears to have produce a poorer plant distribution around the target, on both soil types and at both speeds.

The Kleine worked well at both speeds producing a well-defined peak around the target spacing, it also performed satisfactorily on the heavier field.

The Kongskilde performed better at the slower speed in both situations.

The Kuhn drill performed better at the slower speed, however shallow drilling may have led to more extensive mouse damage on the heavier field.

The Monopill is designed to operate at higher speeds and its performance is seen to be better at the faster of the two operating speeds.

The Monosem performed equally well at both speeds on the lighter soils however on the heavier soil results were poorer at 4.0kph as a result of the mouse damage due to shallow seed placement.

The Webb worked better at the slower speed on the lighter field. However, it did work satisfactorily on the heavier field.

The results of this evaluation highlight how important it is to set the drill to the correct drilling depth for the prevailing conditions. The test also highlighted how important it is to operate the drills at the optimum forward speed, ie that for the Monopill is 7.0kph, faster than either test speed. Ultimately the performance of the drill depends on the skill and judgement of the operator on the day.

All drills evaluated did successfully place the seed accurately, with the possible exception of the Herriau. Although even here the total plants established was good. What effect the larger variability around the target spacing from this drill, had on final yield and harvestability was not established. The design of drill does have an advantage in that with one central hopper down time is reduced in filling, resulting in a capacity to drill 40 ha before refilling is required. The heavier weight and design of coulter of the Herriau did allow it to place the seed on the heavier site at a constant depth and achieve the highest establishment at the faster speed. Some drills also operate more successfully at higher forward speeds than others and the ease of use of the drills do vary. For contractors and farmers drilling large areas these differences may add up to a considerable time saving during a drilling season, and may ultimately allow more timely drilling or a larger area of crop to be drilled.

Photograph 1 Measuring plant spacing.