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Non-selective mechanical harvesting of white asparagus

The asparagus harvest begins mid-April and ends in the last third of June. At a fresh yield of between 7 and 12 t/ha between 140 and 180 kg/d can be harvested over something like 60 days. The daily yield is, however, very dependent of weather and this leads to yield peaks when the climate is favourable resulting not only to difficulties in labour planning but also to sinking of prices below break-even in oversupply periods. Non-selective mechanical harvesting offers a solution for relieving the problem of these short spells of oversupply. Hand harvesting could then be reapplied when prices justified this.

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Keywords

White asparagus, harvest, harvester

Appreciation

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Over the last 10 years in Germany asparagus production area has doubled to over 14000 ha. Asparagus production is very labour-intensive whereby 90% of labour time is involved in harvesting, preparation and marketing. Harvest costs represent around 37% of total production costs.

Knowledge level

Investigations into non-selective harvesting of white asparagus have been conducted since 1950 in the USA [1]. Around half the spears could be harvested longer than 17 cm [4]. In the following years many investigations into non-selective and selective harvesting were conducted. The trials were repeatedly stopped because of the high losses involved [2]. A comprehensive overview of this theme is available [3].

Trial harvester

In 1998, together with Geisenheim Research Institute, preliminary trials were conducted with a root vegetable lifter-windrower [5] and a trial machine designed to allow the carrying out of crop experiments with subsequent increase in technical experience.

Drill cutting and soil uptake

The tackle for „cutting" into the drill caused difficulties. Uptake proved impossible with a solidly-fixed share. The soil piled-up in front of the machine. The band saw as used in the USA [1] couldn't be applied on the on the sandy soil with scattered individual stones because of the resultant limited working periods. Good results were shown by a vibrating flat share or the double knife of an asparagus foliage cutter. Without further technological aids the entire soil drill was uplifted by the sieve webbing as described in [1].

Sieve procedure

The sieve webbing separated soil and spears. The gap width, sieve area, length of time involved, frequency and amplitude influenced sieve performance, losses through the gaps and proportion of damaged spears. Selected for the prototype was sieve webbing with flat steel slats (gap width 25.8 mm) and a sieve area of 2 m^2. Webbing speed, frequency and amplitude were adjustable. The lighter and drier the soil, the faster it could be separated. The sieve performance improved with increasing frequency and stroke but in line with this the number of broken spears and losses also increased. Very light soil was separated within the first third of the sieve belt length. The spears revolved on the bare sieve and fell through the gaps. Webbing with different slat gaps should be available and the frequency parameters should be adjustable as with potato harvester webbing.

After sieving of soil the spears were then deposited on the soil surface (windrowed).

Fig. 1: Prototyp asparagus harvester

Result of the cropping investigation

It is possible to harvest spears in a quality suitable for the fresh market Asparagus plant crowns uncovered by hand indicated no visible damage

Displayed in *figures 2 and 3* trial are results from 1998 and 2000 from areas on the Geisenheim Research Institute. A control area for comparison was harvested by hand, the other areas mechanically harvested at periods of five to eight days (five times in 1998, three times in 2000). Before and after, the crops were manually harvested.

The yield in spears/ha (growth dynamic of the asparagus plant) depended on the harvesting system. An alteration in rhythm of spear development could not be observed within the trial period and reflected results recorded in 1969 [4]. After completing a part-mechanised harvest, manual harvesting can take-over without any problems.

As expected, total yield (dt/ha) was reduced by more than 30% because of the many short spears (*fig. 3*).

Table 1 shows the results of sorting into five length classifications and non-usable spears (broken or thinner than 10 mm).

On a weight basis, around 25% of the spears could be harvested longer than 22 cm. 40% of the spears were longer than 17 cm. 30% were short spears. Breakage losses would have to be greatly reduced in a commercial machine. In this case, the respective results from [1] (42 to 75% over 11 cm for the conserving industry) should be aimed for. The highest yields of long spears were achieved when the stalks were cut as closely as possible over the crown and the drills were high, although this meant that the periods between harvesting operations were then longer [1].

The drills were covered with black plastic sheeting in example c. For trial-related reasons, only a slightly higher yield was achieved in this case. Covering the drills with plastic can also increase the yield of longer spears because the spears can grow through to slightly above the drill surface.

Depending on weather and growth conditions, harvesting can occur every five to eight days. Yield can be increased through adjusting mechanical harvesting operations to fit with weather conditions.

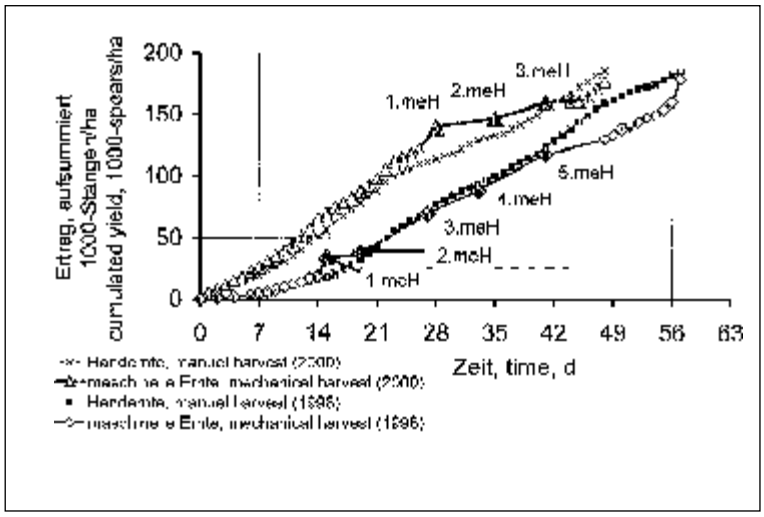

Fig. 3: Asparagus yield in weight in 1998 and 2000 for hand cutting and non-selective harvest

Discussion

In the first place, the reduction in yield speaks against mechanical harvesting. The method can be evaluated as economical when the reduced labour input is considered and the results can be further improved if it proves possible to sell the tips for at a relatively high price.

Labour reduction is a plus point for mechanical harvesting A medium sized farm in Germany with 50 ha asparagus employs around 200 people during the season, including 150 for the harvesting alone. Organising such a large force is complicated. The labour capacity must be matched to highest yield conditions.

Additionally the regulations related to employing non-EU workers have been further tightened, even although EU workers are hardly available. Operating at 5 km/h with 2 m between the drills, a single row harvesting machine can lift around 0.6 ha/h with four people (tractor driver and three sorters). A single machine can thus tackle 7 ha in a 12-hour day and 35 ha in a five-day harvesting period.

The final ground in favour of the method is the long-term continued reduction in asparagus price through increasing growing area. With this in mind complete mechanisation of harvesting can be considered, especially where plastic mulching is used.

Conclusion

There are many reasons for considering non-selective harvesting of asparagus. The method must be further optimised and proportion of losses reduced. A harvesting machine should be fitted with additional equipment for lifting and replacing plastic mulch and reforming the drill. Another sensible addition would then be mechanical grading of the spears.

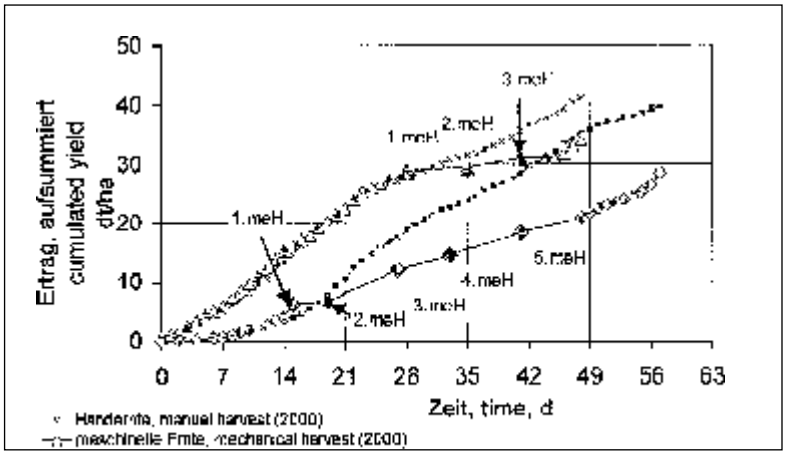

Fig. 2: Asparagus yield in number of spears in 1998 and 2000 for hand cutting and non-selective harvest

	1	2	3	4	5	6	
	Diameter D ≥ 10mm Length, cm					D < 10mm, and broken spears without tips	Total
	3 - 7	7 - 12	12 - 17	17 - 22	≥22		
	short spears with tips			**Trading ware**			
	Mass %						
a	1,6	12,2	18,6	14,7	**24,1**	28,8	100
b	5,5	15,6	17,6	13,9	**24,2**	23,2	100
c	1,8	8,0	15,6	14,4	**25,5**	34,8	100

Table 1: Grading of asparagus spears from single experiments with non-selective harvester in 2000 (a, b) and 2001 (c)

Literature

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