Technique of pneumatic pest control

Winfried Schäfer, MTT Agricultural Engineering Research

03400 Vihti, Finland. E-mail: winfried.schafer@mtt.fi

Objectives: Pest control in organic production of berries, potatoes and vegetables usually employs spreading technique of registered phytopharmaceutical agents. This technique may be supported or even replaced by pneumatic pest control. Up to now there is no evaluation of pneumatic pest control available from agricultural engineering point of view. This paper concerns the following questions: Which techniques of pneumatic pest control are available and how may these techniques be improved in terms of technical and physical parameters?

Hypothesis: Analysis of pneumatic pest control techniques supports improvement of present available implements.

Method: Literature review, process analysis, and evaluation in respect of agricultural engineering parameters (airflow rate, air speed, working hours, energy input, process costs).

Results: Success of pneumatic pest control varies in a wide range, and the technique does not always grant satisfying results. Collection of eggs and larvae is more difficult than collection of adult insects. Usually weekly treatment is necessary. Frequent treatments may cause soil compaction. Pneumatic pest control may distribute fungal infection. Beneficial organisms may suffer from pneumatic techniques. Investment costs of pneumatic implements are high (ca. 5000-12000 €/row). Simultaneously blowing and sucking hoods work better than common suction hoods. Both the interrelationship and the control of physical parameters is almost not subject of research.

An analysis of physical parameters and their interrelationships reveals that airflow rate, working width, and travel speed can be comprised within the term air requirement, as shown in the following table:

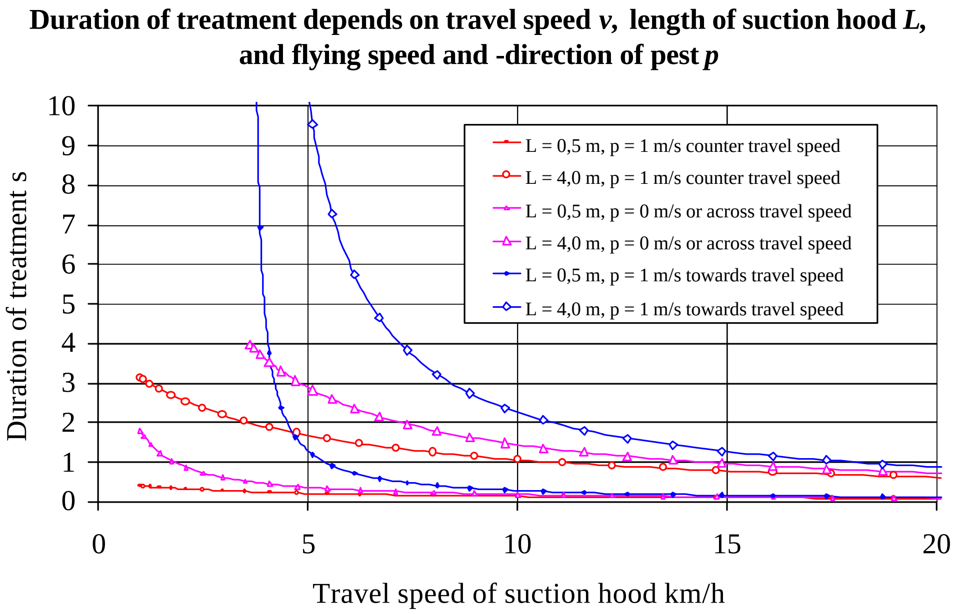
Parameter	$L = t_e * \dot{V}$	b^+	$t_e = \frac{10}{b*v}$	v_{max}	$\dot{V}$	v	Price €, number of rows		
Author unit	m^3/ha	m	h/ha	m/s	m^3/h	km/h	3*	2*	1*
Hellqvist, 1992/1995	15833 - 20353	1	6,67	21 - 27	2375 - 3053	1,5			x
Vincent&Lachance, 1993	6800	3	0,48	14,7	14280	7	x		
Pickel et al, 1994	1950 - 3900	1	1,25 - 2,5	4,7	1560	4 - 8			4.000,-
Pickel et al, 1994	1688 - 2250	2	0,63 - 0,83	8,2	2700	4 - 8		5.000,-	
Pickel et al, 1994	2125 - 4250	3	0,42 - 0,83	18,5	5100	4 - 8	60.000,-†		
Vincent&Chagnon, 2000	12780	1	2,5	30	5112	4			x
Tuovinen, 2000	10602 - 5903	1	1,67 - 2,5	25	6361	4 - 6			17.000,-

+ assumed row distance 1m — L airflow rate — t_e effective working time

* number of rows — $\dot{V}$ air stream — b working width

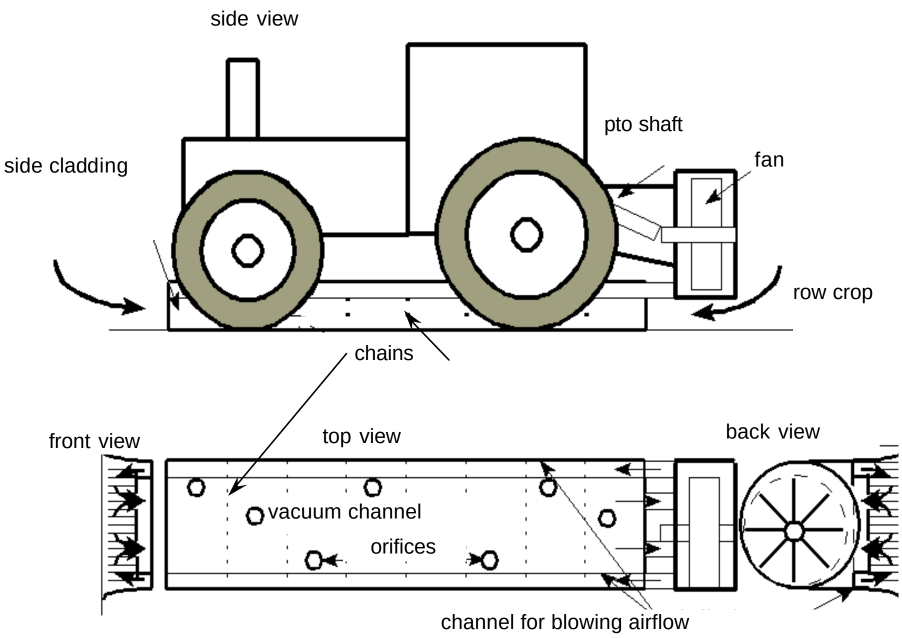
† inclusive modified tractor — v_{max} maximum airflow velocity — v travel speed

The air requirement correlates with the success of the treatment and is an objective evaluation criterion for the implement and its pneumatic efficiency. The latter may be improved by the following measures: 1) High travel speed prevents pests from escaping the suction hood. 2) Pests sitting upon the plant should start to fly before suction. This may be achieved pneumatically by blowing nozzles and/or mechanically by chains, brushes or similar devices. 3) A suction hood stretched in direction of travel may prolong the duration of pneumatic treatment to ensure successful control, see following chart:



To minimize the tractor power required the suction airflow velocity under the suction hood should be as low as possible. However, the suction airflow velocity must always be greater than the flying speed of the pest. Low airflow velocity may also contribute to go easy on useful insects.

The improvements proposed issue into a design proposal of a stretched hood mounted underneath the tractor. The hood is equipped with blowing and suction orifices and chains to drive the insects off the crop.



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