

Table 1. Colorimetric classification of the parameters for the design of a hand-rake sweeper.

	<p>FIXED PARAMETERS: fundamentally, they depend on the type of fruit to be swept. They are set at the beginning of the design and are not modified. For example, “total rake width”, that is, the length to be swept per sweep.</p>
	<p>MODIFIABLE PARAMETERS WITH NO REPERCUSSION IN THE STRUCTURAL OPTIMISATION OF THE MODEL: these parameters do not influence the optimisation of the design. For example, “tooth radius” and “draft angle”.</p>
	<p>STUDY PARAMETERS: these must be modified to influence the optimisation of the design.</p>

Table 2. Design parameters and their initial values.

Variable	Description	Type	Initial value	Units
Thickness	Thickness		2.5	mm
Stick Diameter	Handle diameter		25	mm
L_H_1	Horizontal L of the first side		82	mm
Angle_L2	Angle of the second side		15	°
a_0	Vertical L between the start of the handle and the start of the body		60	mm
L_H_2	Horizontal L of the second side		150	mm
a3_	L up to the end of the body		755	mm
A_L3	Angle of the third side		65.0	°
r_1_Handle	Radius of the contour of the handle where it is anchored with the body		20.0	mm
R_L1-L2	Radius between the first and second sides		12.0	mm
R_L2_L3	Radius between the second and third sides		7.5	mm
d_1_Plane	Reference plane to make the teeth		70.0	mm
s_1_plastic	Horizontal distance of each tooth in the reference plane (d_1_Plane)		12.0	mm
S2_hole	Horizontal distance of each space between teeth in the reference plane (d_1_Plane)		7.0	mm
d2_level_Plane	Start of the teeth		80.0	mm
R_Arc_Lower	Radius of the lower arch where the teeth end		2560.0	mm
Dis_Arc_Lower	Distance over the symmetry axis from the handle to the end of the teeth		330.0	mm
R_Nerve_1	Radius of the upper tooth		1120.0	mm
W_Nerve_1	Width of the upper tooth		32.0	mm
D_Nerve_1	Distance over the symmetry axis from the handle to the axis of tooth 1		200.0	mm
D_Nerve_2	Distance over the symmetry axis from the handle to the axis of tooth 2		260.0	mm
R_Nerve_2	Radius of the lower tooth		2780.0	mm
W_Nerve_2	Width of the lower tooth		27.0	mm
L_Teeth	Length of the teeth		87.9	mm
Up_Thickness_Teeth	Excess thickness of the teeth		0.0	mm
R_Teeth	Radius of the teeth		35.0	mm
R_Up_Teeth	Increase of the radius of the teeth		0.0	mm
R_General	General radius		1.0	mm
R_2_Handle	Radius of the corner between the handle and the body		23.0	mm
R_General_Corner	General radius of the corners between teeth		3.0	mm
R_End_Teeth	Radius of the end of the teeth		2.0	mm
R_Var_Handle	Variable radius of the corner between the handle and the body		3.	mm
L_Handle	Handle length		100.0	mm
L_Screw_Handle	Distance from the holding point of the handle to the body of the rake		27.0	mm
D_Screw_Handle	Diameter of the handle screw		1.5	mm
Teeth_Drafting	Drafting of the teeth		25.0	°
Handle_Drafting	Drafting of the inside of the handle		3.0	°
General_Drafting	General drafting		1.5	°

Table 3. Design parameters of the rake. Modified values.

Parameter	No. tests	Description	Type	Initial value (mm)	Modified value (mm)
Thickness	6	Thickness		2.5	1.8
r_1_Handle	2	Radius of the contour of the handle where it is anchored to the body		20.0	40.0
R_L1-L2	2	Radius between the first and second sides		12.0	20.0
R_L2_L3	2	Radius between the second and third sides		7.5	20.0
W_Nerve_2	3	Width of the bottom spike		27.0	40.0
L_Teeth	4	Tooth length		87.9	30.0
R_Up_Teeth	4	Increase of tooth radius		0.0	3.0
R_End_Teeth	6	Final tooth radius		2.0	1.5

Table 4. Rake design modified parameters (test 2).

Parameter	Initial value (mm)	Modified value (mm)
r_1_Handle	20.0	40.0
R_L1-L2	12.0	20.0
R_L2_L3	7.5	20.0

Table 5. Modified rake design parameter (test 3).

Parameter	Initial value (mm)	Modified value (mm)
W_Nerve_2	27.0	40.0

Table 6. Modified rake design parameters (test 4).

Parameter	Initial value (mm)	Modified value (mm)
L_Teeth	87.9	30.0
R_Up_Teeth	0.0	3.0

Table 7. Rake design parameters to modify in future research lines for its optimisation.

Parameter	Initial value (mm)	Modified value (mm)
Thickness	2.5	1.8
R_End_Teeth	2.0	1.5