

Optimisation of cultural practices for organic potato :

Effect of irrigation regimes on the development of late blight, crop yield and quality





INTRODUCTION :

- potato : temperate crop
- 85% of the root length in the upper 0,3 m soil layer
- water stress :
 - Before tuber initiation : reduces nb of tubers
 - After tuber initiation : reduces size of tubers
- water excess :
 - N leaching
 - Phytosanitary problems :
scarred and hollow heart, bacterial incidence
Late blight : stimulation of oospores production



AIM OF THE TRIAL :

- evaluate, under organic rules, how much the yield is increased by using top irrigation
- find if an optimized irrigation is sufficient to obtain a reasonable yield, in order to preserve the water resource
- evaluate if irrigation increases phytosanitary problems on foliage and on harvest, without any use of copper to control diseases such as late blight



EXPERIMENTAL DESIGN :

- in 2002 and 2003
2002 : near Avignon (no late blight)
2003 : near la Rochelle (Poitou-Charentes) presented today
- According to organic production rules (45 000 plants/ha, organic seeds, fertilisation, crop protection...)
- No copper applied !
- Planted on 3rd April 2003 ; harvested on 6th August 2003



EXPERIMENTAL DESIGN :

- split plot design - 4 repetitions
- 2 factors => 6 treatments
 - 3 irrigation regimes (main plots) : no irrigation + standard practices + optimised irrigation based on the observation of soil humidity sensors
 - 2 varieties (subplots) : one susceptible (Charlotte) + one moderately resistant (Santé)
- experimental plot : 6 m (8 rows) x 15 m
- each plot is bordered by 2 rows of Bintje (to obtain an uniform spread of late blight)



RECORDINGS :

Late blight recording : foliage checked weekly

2 central rows, 13 meters

- incidence : number of plants attacked by late blight / number of plants on the two central rows.
- severity : percentage of foliar surface diseased by late blight, for each plant out of twenty on the two central rows (key of James)

Harvest recording :

- 2 central rows, 13 meters => total yield.
- on a representative sample (30-50 kg) : proportion of tubers within usable size classes, proportion of diseased tubers.



RESULTS

- Total rain falls during the growing season : 232 mm
- Aspersions : irrigation doses
 - 167 mm (in 12 times between 3rd June 2003 and 25th August 2003) for the plots concerned by usual practices
 - 67 mm (in 6 times between 3rd June 2003 and 11th July 2003) for the plots concerned by optimized irrigation

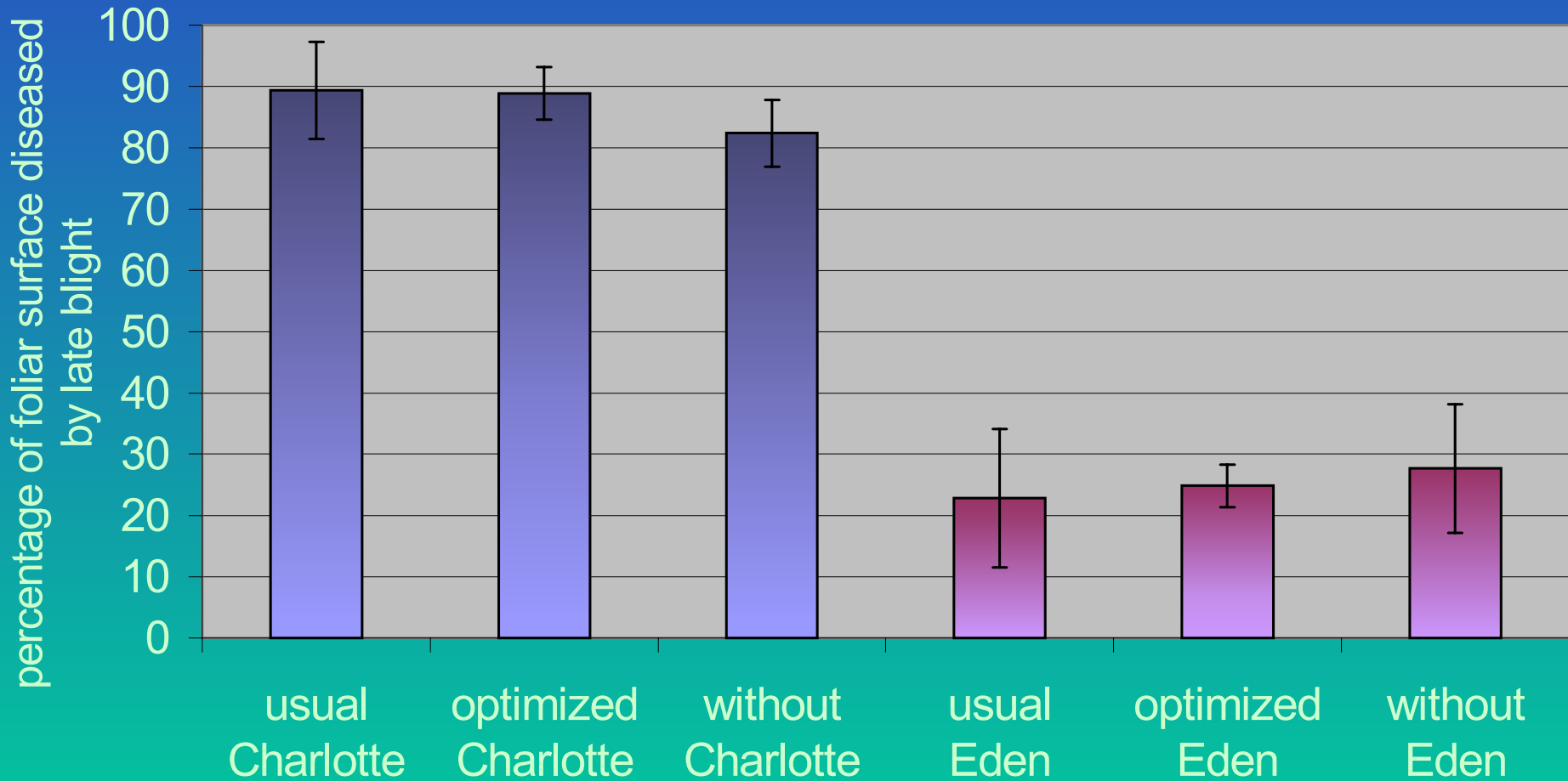


Average incidence noted I
(% of plants diseased by late blight)
and average severity noted S
(% of the foliar surface diseased by late blight)

Variety	irrigation	date							
		17/06/2003		23/06/2003		01/07/2003		17/07/2003	
		I	S	I	S	I	S	I	S
Charlotte	without	32,5	0,28	87,5	0,56	98,75	1,13	100	82,38
	optimized	50	0,44	97,5	0,7	100	1,59	100	88,88
	usual practices	40	0,28	96,25	0,81	98,75	1,54	100	89,38
Eden	without	26,25	0,2	90	0,66	87,5	0,62	100	27,63
	optimized	11,25	0,06	57,5	0,36	80	0,59	100	24,81
	usual practices	18,75	0,1	78,75	0,52	81,25	0,58	100	22,81



Average severity (percentage of foliar surface diseased by late blight) on 17th July 2003





Average severity on 17th July 2003

Charlotte : severity of about 90% (susceptible)

Eden : severity of about 20% (resistant)

No significant effect of irrigation regime on foliar late blight



Comparison of tuber yield and tuber quality average per variety and average per irrigation regime

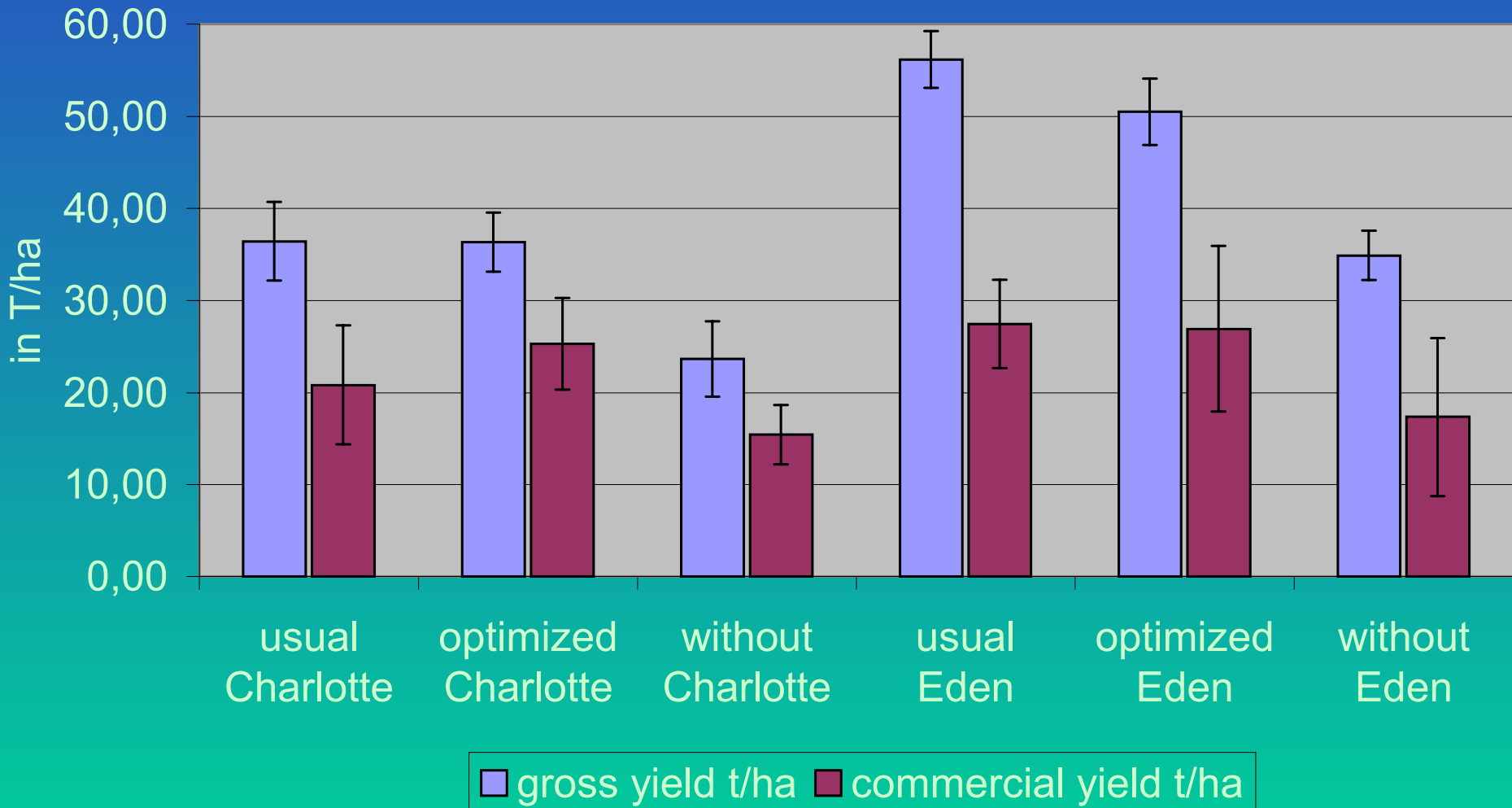
	total yield	commercial yield	tubers distribution (in % of harvested weight)					
	t.ha-1	t.ha-1	<35 mm %	35-50 mm %	>50 mm %	diseased %	with late blight %	out of shape %
Irrigation								
none	29,29a	16,36a	11,96a	40,26	5,72a	37,32	0,95	3,79a
optimized	43,43b	26,12b	4,52b	42,44	15,01b	29,41	1	7,61a
usual practice	46,29b	24,15b	3,32b	34,44	14,85b	30,52	0,9	15,96b
Variety								
Charlotte	32,15	20,51	10,14	44,99	8,81	28,98	1,41	5,67
Eden	47,19	23,91	3,07	33,1	14,91	35,85	0,49	12,58
Analysis of variance								
source of variation								
Irrigation (I)	**	*	**	NS	*	NS	NS	*
Variety (V)	**	NS	**	*	0,05	NS	*	*
I x V	0,07	NS	**	NS	NS	NS	NS	NS

*, ** significant at the 0,05 and 0,01 probability levels, respectively

where significant irrigation effects were detected by the analysis of variance, column means followed by the same letter are not sig



Total and commercial yield for the two varieties and the three irrigation regimes





Total and commercial yield for the two varieties and the three irrigation regimes

Total yield :

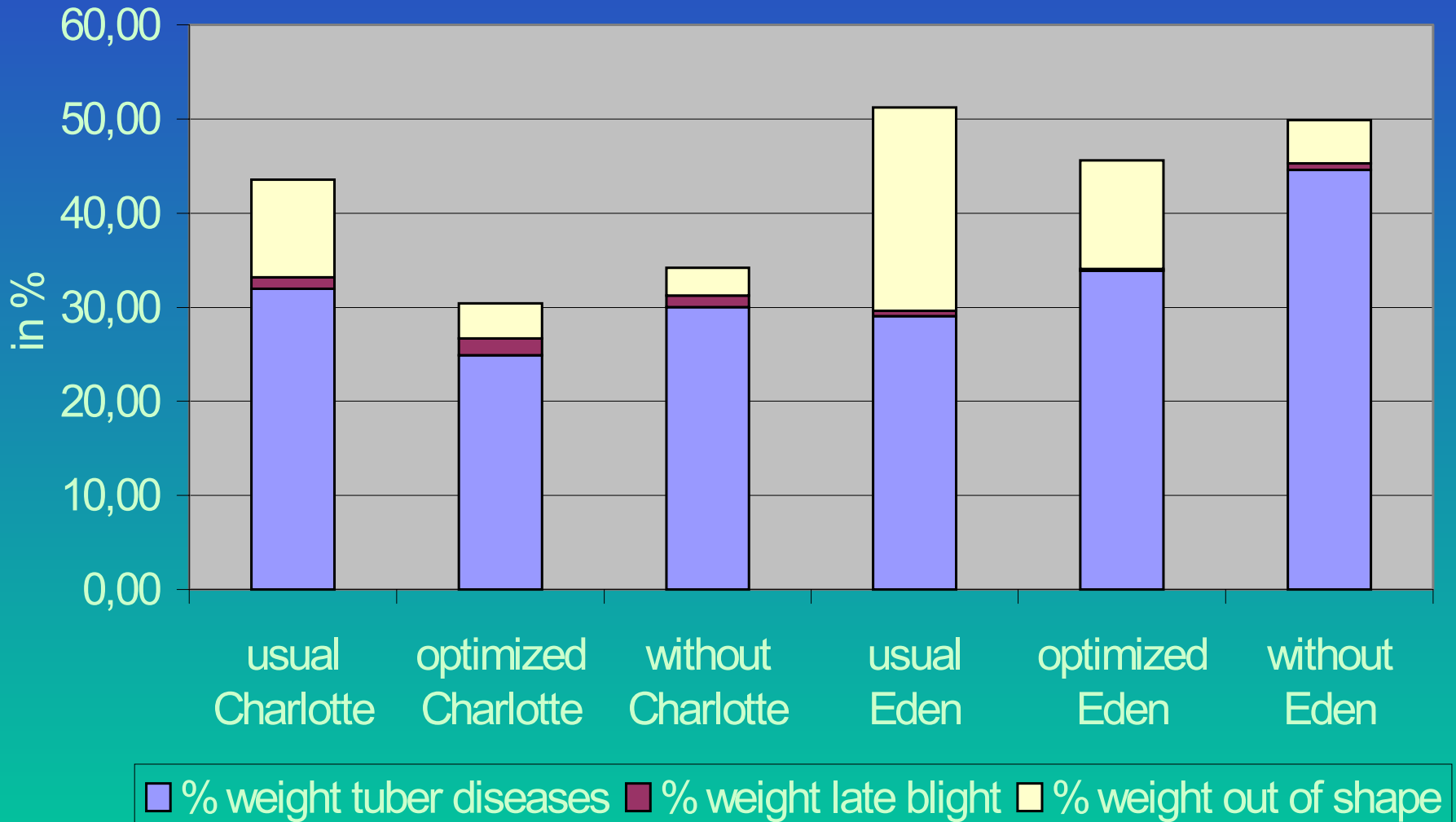
- Significantly higher for Eden (/ varietal susceptibility of Charlotte)
- The more the potato is irrigated, the higher the total yield (statistically : Usual & Optimized different from No irrigation)
- Eden more susceptible to lower irrigation

Commercial yield :

- Statistically : Usual & Optimized higher than No irrigation
 - Proportion of waste higher for Eden
- =>No difference between Eden and Charlotte



Proportion of different types of waste in percentage of total yield



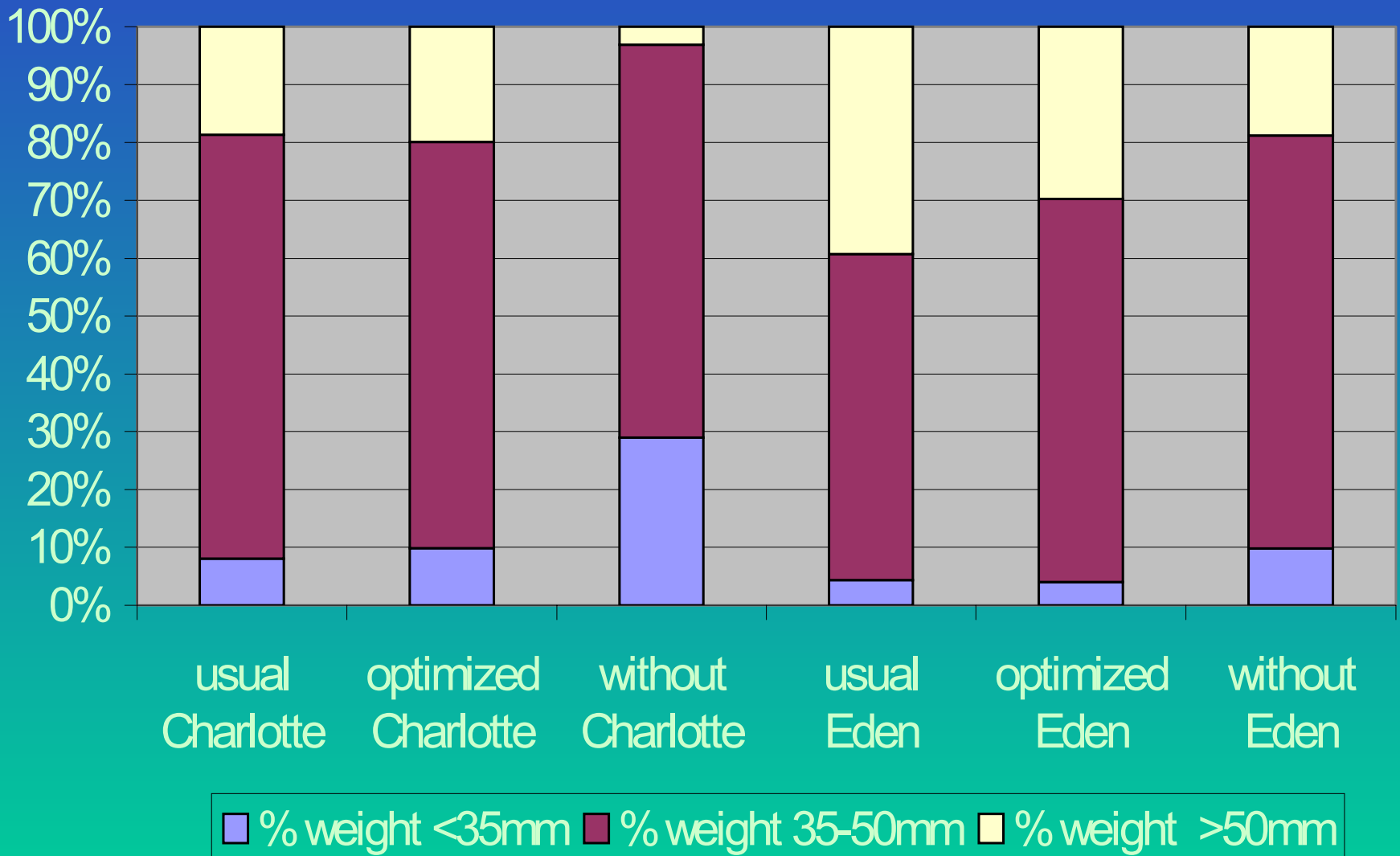


Proportion of different types of waste in percentage of total yield

- High proportion of waste (30% and 50%)
- Mainly due to black scurf (*Rhizoctonia*) and silver scab (*Helminthosporium*)
- A very few tubers with late blight (and no statistical difference between irrigation regimes)



Proportion of the different size classes, in percentage of the commercial yield





Proportion of the different size classes, in percentage of the commercial yield

- Tubers are bigger for Eden (longer period of growth and maturation of tubers)
- Statistical effect on little and big tubers : optimized and usual practices different from no irrigation



DISCUSSION AND CONCLUSIONS

- **reduced irrigation** : no effect on foliar late blight, no effect on tuber blight
- **reduced irrigation** :
 - effect on total yield (**almost for Eden**)
 - no major effect on commercial yield and size classes
- **Irrigation remains indispensable in this region**
- **Watermarks** : simple and cheap material
- **Possible to save the water resource**