

**New potato cultivar
evaluation for McCain Foods
(Aust) Pty Ltd**

David Ryan
McCain Foods (Aust) Pty Ltd

Project Number: PT07021

PT07021

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**New Potato Cultivar Evaluation for
McCain Foods (Aust) Pty Ltd
Safries Pty Ltd**

David Ryan

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McCain Foods (Aust) Pty Ltd &
Safries Pty Ltd

August 2008

Final Report HAL Project

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Purpose of Report: This report provides the final report on this project in which new French fry potato cultivars have been evaluated in 3 regional trials and one seed multiplication plot during 2007-2008.

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3. The numerous potato growers and research facilities that have contributed to the work, in time and resources over the past twelve months.

Date: August 2008

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Media Summary

The evaluation and identification of new French fry cultivars with improved processing and agronomic characteristics adapted to different production regions of Australia is essential for the French fry Potato Industry to remain competitive, profitable and sustainable.

New Varieties need to have yield and French fry processing parameters equal to or greater than existing processing varieties. Cultivar selection requires the variety to have improved specific French fry quality parameters and show stable high yields. Varieties need to be efficient or require reduced inputs such as chemical and fertilisers to have minimum impact on the environment and reduce the costs of production.

McCain Foods (Aust) Pty Ltd and Safries Pty Ltd in partnership with the McCain growers groups in Victoria, New South Wales and Tasmania and the Safries grower group in South Australia along with matching funds from HAL have tested potential new potato lines for the French fry industry over the past twelve months. Trials were conducted in Ballarat (Victoria), Forthside (Tasmania) and Penola (South Australia).

This project has evaluated and identified potential new varieties for the French fry Industry. Under previous evaluation projects some varieties were selected as potential replacements and these continue to be evaluated.

Further evaluation of breeding lines across production environments is needed to determine their potential for commercialisation. It is planned that this project is continued next season to carry out further evaluation of some highly potential varieties. Assessments of advanced cultivars are showing very good results and the likely chance of a replacement cultivar is high, with one Australian breed cultivar in early stages of commercialisation.

Due to unforeseen climatic conditions the South Australian trial was abandoned in December. Shortly after planting an extreme rain event saturated the trial site causing wide spread seed piece breakdown. With less than 5% of the trial and surrounding crop emerging it was decided to discard the entire pivot site.

Historically we have had a replicated trial site in N.S.W at Berrigan, assessing early delivery schedule cultivars. However during season 2007 - 2008 water allocations in the Riverina were minimal therefore our early delivery crops were not planted taking away the opportunity for a trial site.

Technical Summary

Potato genotypes introduced from the Potato Breeding program at Toolangi were evaluated in field experiments in 3 major potato growing regions of South Eastern Australia. In the 3 trial sites new cultivars were grown in randomised block experiments, with 3 replicates per entry, 2 trials were located within commercial crops and compared against current French fry commercial cultivars and the Tasmanian trial was located on the Forthside research facility. All cultivars that are included in the program are maintained at the Toolangi research farm as seed for future variety work. Also as part of the project there was a seed multiplication observational plot at Forthside.

The project identified new varieties with potential French fry processing capabilities. Promising newly bred lines were identified at each trial site and further evaluation will be required before possible commercial release. Cultivars will be tested over a number of seasons to determine if they are consistent in results. The cultivars that will be evaluated further include Cultivar 22, Cultivar 53, Cultivar 95, Cultivar 99 and Cultivar 137 (Ballarat) and Cultivar 53, Cultivar 87, and Cultivar 111 (Tas).

The promising new varieties in this project are not yet in commercial production so it is not possible to accurately estimate the improved financial gain, estimate market share, costs of growing new lines, reduced chemical inputs and financial gains at present. However, the high potential yields and reduced input costs of new varieties will result in future substantial financial gains.

McCain Australia has progressed one variety, Cultivar 53, into the commercialisation program. The company will process a reasonable volume of trial material in 2009 enabling accurate data to assist with the future direction of Cultivar 53.

Introduction

New Potato varieties with improved French fry characteristics are required to help maintain and increase the competitive position of French fry potato growers and to improve the processing recovery rates of French fry processing plants. Such improved varieties must meet the demands of the processing potato grower and the processor at the same time, with high yield, reduced cost of growing and excellent processing attributes.

Existing varieties are not ideally suited to all Australian production areas and systems. Common problems with current French fry processing varieties include: susceptibility to physiological disorders such as misshapen tubers, second growth and hollow heart (mainly Russet Burbank), susceptibility to disease's such as Target Spot, Common Scab, Powdery Scab, Pink Rot, Rhizoctonia and Late Blight and susceptibility to Virus's such as Potato Leaf Roll and Tomato Spotted Wilt Virus (mainly Shepody). Other problems include geographical constraints with environmental conditions limiting varietal options available to growers and processors.

In partnership with grower groups from each major potato growing area, McCain Foods (Aust) Pty Ltd has undertaken this variety development program with high importance. As a research priority McCain Foods has given variety breeding, selection and development it's highest level of commitment and we believe that the potential for a positive result is very likely.

Methods

Experimental design

Crossbred lines and new or check varieties used in this project have been either bred in Australia or introduced under private arrangements by McCain Foods (Aust) Pty Ltd or commercial partners. The Department of Primary Industries, Toolangi, Victoria carried out the breeding. Each of these new lines were grown from botanical seed in a glasshouse and after 3 field generations, during which time selection begins and seed is multiplied, clones are then selected to be entered into district variety trails. All trials were planted with seed produced, harvested and stored under the same conditions to obtain seed of the same physiological age for valid comparisons.

Field experiments were conducted using a randomised block design replicated in each of the 3 blocks. 2 of the 3 experiments were grown within commercial crops with the Tasmanian replicated trial and seed multiplication plot being grown at the Forthside research facility. Within each experiment the common commercial variety for the particular time of delivery and district was used as standard controls. Individual plots were either 4 or 5 metres long (depending upon trial site) with 2 rows per plot. Coloured marker plants (Ruby Lou) were planted at the beginning and end of each plot in a one-metre strip to prevent mixing of varieties at planting and harvest. During the growing season, plots were assessed for emergence, vigour, maturity and pest and disease susceptibility. At harvest plots were assessed for tuber characteristics including colour, texture, shape, distortion, eye characteristics, size and evenness. Each plot was yield graded by size's specific to processing parameters for French fry processing.

Samples from each plot were removed after grading, with one sample from each plot assessed at McCain Foods (Aust) Pty Ltd testing facilities for Dry Matter content and cooking ability. Also removed from each plot (Tasmanian seed multiplication plot not included) was a storage sample which is held in commercial storage facilities by McCain and at 3 staggered intervals during the next 7 months one replicate of samples will be removed and tested for processing attributes again.

Field experiments were conducted at Dunnstown near Ballarat – Victoria (32 entries), Mingbool near Penola – S.A. (12 entries) trial abandoned and Forthside Research Farm – Tasmania (8 entries). The Victorian trial was planted in mid November and harvested in late April and the Tasmanian trial was planted in late October and lifted in late April. Ballarat and Forthside soil types are similar Krasnozem.

Data was analysed by standard analyses of variance procedures. Least significant differences (LSD) among treatment means were expressed at the probability of 5%. This means that the calculated LSD between treatment means is 95% due to the treatment per se (in this case the genotype) and only 5% due to chance or random effects such as irrigation or soil variations between plots (Williams 2004).

Results and Discussion

Complete results from harvest and processing assessments for the two experiments are included in Appendix 1 along with written assessment of the Tasmanian seed multiplication plot.

Table M1 below gives a comparison of selected French fry cultivars from the 2 field trials during the 2007-2008 growing season. Fry grade yield is expressed as tonnes per hectare and fry colour as a percentage.

Table M1.

Fry grade yield (t/ha) (fry colour in parentheses)		
Entry	Vic ϕ	Tas+
Cultivar 5	60.1 (96)	45.9 (100)
Cultivar 6		53.4 (100)
Cultivar 22	59.7 (100)	
Cultivar 53	72.1 (90)	
Cultivar 87		57.2 (100)
Cultivar 95	62.7 (99)	
Cultivar 99		
Cultivar 108	70.7 (100)	
Cultivar 111		54.5 (100)
Cultivar 137	69.0 (100)	
LSD* P=0.05	8.8 (11.6)	6.7 (NS)

Fry colour was assessed by the USDA chip colour chart. The zero category % fry colour is shown in brackets.

ϕ Fry grade yield is > 75grams

+ Fry grade yield is > 100grams

* LSD = Least significant difference.

Cultivar 5

Cultivar 5 is the main French fry processing variety that is grown in Australia, therefore it was used as a check variety in the Victorian, South Australian and Tasmanian trials and the Tasmanian seed multiplication plots. Cultivar 5 is a long maturing variety that requires significant inputs during the season. It requires certain environmental conditions to be in its favour to reduce the pest and disease incidence. Cultivar 5 has the ability to be stored for an extended period of time and still retain its processing attributes.

Cultivar 6

Cultivar 6 is the main early to mid variety used for French fry production in Australia. It has a medium length maturity, which enables it to be used for December, January, and February processing. Cultivar 6 is not stored by McCain Foods (Aust). Cultivar 6 sets only average tubers per plant and can produce larger size tubers, which are undesirable for processing.

Cultivar 22

Cultivar 22 Late maturing variety with high tuber numbers this past season, this is a reversal from last season. Yield was only marginal (Table M1), with tubers needing some bulking up. There was some slight common scab but only minimal. We will continue with it in trials increasing spacing to establish if it increases tuber size. We have some minitubers ordered for this variety and we will look at bulking up a small volume and assessing it in the factory over the next few years.

Cultivar 53

Cultivar 53 has shown us that it has potential to be a very good variety. In Ballarat there was some slight powdery scab again. Tuber shape was good again with some pairing but overall tuber shape and size was good, reflecting in this cultivar being the 2nd highest yielding entry (Table M1). Tasmanian trial was not replicated but yields and quality was good. Both trial sites and bulk trials as well as commercial seed showed some signs of cracking in the tuber from handling. This is something we will be watching carefully.

We have processed the first commercial volume this past season and it has performed well. The problems of cracking in the tubers was not a problem for direct delivery tubers, this may be revised after storage. Next season we will have a large volume of commercial potatoes for the plant. McCain Australia has exclusive rights to this cultivar and has entered into an agreement on worldwide exclusivity.

Cultivar 87

Cultivar 87 was the highest yielding variety in the Tasmanian trial with a high % of tubers in the 75-170 gram range. It has good tuber numbers and shape and a shorter maturity than Russet. We will continue with this cultivar into bulk plots for next season.

Cultivar 95

Was one of the stand out tuber shape varieties in the Ballarat trial. Yield was in the middle of the range in the Ballarat trial and good in Tasmania. Results in Tasmania showed good shape and good tuber numbers but some hollow did present itself. We have found that this cultivar will crack from very minimal impact and something that we need to consider carefully before we continue any further. It is a very attractive tuber type and has the potential to yield so we will continue for one more season and monitor the few problems outlined above.

Cultivar 99

Cultivar 99 was only included in the Tasmanian trials last season. This variety has had very good tuber shape in the past 3 seasons in Tasmania. Tuber shape can be slightly broad at times with tuber fry grade size just below that of standard's. However it had a high yield in the 100 – 170 gram range indicating potential bulking up potential. It did have some hollow in a bulk trial in Tasmania, something to be mindful of in future assessments. It has a very attractive tuber shape and will be included in the small bulk trial next season.

Cultivar 108

Wedge type replacement, Cultivar 108 is an Australian breed variety and released in W.A some years ago as a crisping variety. We are revisiting it as a potential wedge cultivar and it has performed very well. It showed some slight powdery and common scab infection in the Ballarat trial this season. Cultivar 108 has had consistent high yields in variety trials and shape has been slightly oblong at times tending to get length which may distract as an attractive wedge only type. We have had some hollow showing up in trials, but not enough to discard it at this stage.

Cultivar 111

Cultivar 111 has had variable performance in the past with it being discarded from mainland trials due to low yield. Last season in the Tasmanian replicated trial this variety performed well with adequate yield results and good tuber shape characteristics. There was some indication of slight distortion when large but not significant enough to discard from continuing in bulk plots next season but something that needs to be watched closely.

Cultivar 137

Cultivar 137 is a late maturing variety with a high yield potential. There was some hollow heart in the sample cut in Ballarat, so we need to monitor for any major problems. Cultivar 137 has an attractive tube, which we should continue with mindful of its maturity and hollow heart susceptibility. Tasmanian seed plots showed some shape variation with roundish tubers, which I would assume could improve with some increase with spacing.

Technology Transfer

A Field day was conducted during the harvest of the Victorian trial with members of the McCain Grower Group invited to attend, along with Department of Primary Industries (Vic) representatives and production personnel from McCain Food processing plant in Ballarat. Attendance and interest in the trial was satisfactory considering the trial was harvested in one of the busiest times for the growers. Ballarat's local growers were also welcome to inspect the trial site during the season.

Confidential results from all trial sites will be presented to each grower group and also to the McCain Foods Variety evaluation committee. A public version of the results is available by contacting HAL.

Recommendations

Further evaluation and development of new French fry varieties is required prior to the commercialisation of any cultivar. The past five seasons have shown, that with the industry groups taking a far greater ownership in variety evaluation and commercialisation of new cultivars, interest in the variety trials conducted under this project has been very high. Industry groups are anticipating return on their investment into research and development and a superior variety to current varieties will achieve this. Over the past few seasons we have included 3 varieties into tissue culture that have shown potential. These cultivars will be bulked up over the next few seasons during which we need to further develop agronomy programs for each specific cultivar. Currently this work is funded privately.

In further advanced commercialisation trials Cultivar 53 was trialled last season and a small quantity of potatoes were processed at Ballarat. Initial results are reasonable with some problems with disease susceptibility and damage issues being assessed prior to any further expansion of volumes take place. The plan is to conduct commercial trials as planned in 2009 and assess after processing. A commercial quantity of seed has been funded by McCain Foods (Aust) Pty Ltd.

This project will continue next season (VC Project funding pending) in a similar capacity as season 2007-2008. Small plot trials give industry personnel a scientific result, with definitive answers arrived upon, making the selection process a constant variable from year to year. The size of the project over four states (water permitting) is also allowing for variability in cultivar performance due to environmental conditions to be evaluated, this is very important when the French fry processor is sourcing it's raw product from many different districts with different climatic constraints.

References

Williams, C. (2004) Evaluation and development of new potato genotypes in South Australia. Final Report HAL Project No. PT 02009.

Appendix 1.

Victorian variety evaluation trial 2007-2008. Ballarat (Dunnstown) is the main delivery and storage district for McCain Foods Ballarat processing plant. Planted in mid November, the trial was lifted on the 24th April 2007.

Table 1.

Ballarat trial comparison of potato lines for different tuber yield weight grades, tubers per plant and processing parameters.

Entry	Spacing in Rows cm	Yield, Tonnes per Hectare					Rank by Fry Grade	Tuber No. Per Plant	Quality							
		Chats	Small	Large	Over Size	Fry Grade			Dry Matter %	Fry Colour *						
		0-75g	75-170g	170-340g	>340g	>75g				0	1	2	3	4	Ends	
Cultivar 5	38.4	2.0	9.7	29.3	21.1	60.1	22	9.4	20.8	96	4					
Cultivar 20	28.0	0.6	5.9	29.5	28.8	64.2	14	5.7	22.0	98.8	1.2					
Cultivar 22	35.7	2.4	16.2	34.3	9.2	59.7	24	11.4	22.8	100						
Cultivar 53	33.4	1.1	7.4	37.8	26.9	72.1	2	8.3	22.4	89.2	10.8					
Cultivar 61	31.2	2.1	14.3	41.9	11.1	67.3	8	9.9	21.2	98.8	1.2					
Cultivar 92	38.4	2.0	12.2	36.4	6.7	55.3	30	11.6	19.6	100						1.2
Cultivar 93	33.4	0.6	8.1	36.4	14.4	58.9	26	7.1	21.7	100						
Cultivar 95	33.4	2.0	12.7	34.7	15.3	62.7	17	9.3	20.5	98.8	1.2					
Cultivar 108	25.0	1.8	14.3	44.1	12.3	70.7	4	8.3	24.7	100						
Cultivar 110	33.4	0.8	11.6	37.8	11.1	60.5	21	8.8	22.5	100						
Cultivar 112	33.4	0.6	6.7	39.9	13.3	59.9	23	7.1	24.1	100						
Cultivar 114	35.7	1.7	16.8	39.3	9.9	66.0	11	12.2	24.7	100						
Cultivar 119	38.4	2.7	16.1	35.9	8.8	60.8	20	13.0	23.0	98.8	1.2					
Cultivar 121	33.4	3.8	21.0	23.8	0.8	45.6	32	11.2	22.9	100						
Cultivar 123	35.7	1.4	10.8	35.7	17.1	63.6	16	9.7	22.3	94.8	4	1.2				
Cultivar 124	31.2	0.6	6.4	29.3	25.2	60.9	19	6.2	21.3	100						
Cultivar 125	31.2	3.9	29.1	30.8	2.1	62.0	18	11.7	20.5	100						
Cultivar 127	31.2	1.5	6.6	29.1	21.7	57.4	27	6.5	23.2	100						
Cultivar 128	33.4	1.5	10.9	37.7	17.6	66.2	10	9.3	22.3	96	4					
Cultivar 129	31.2	1.8	12.1	30.1	24.2	66.4	9	8.7	24.1	98.8	1.2					
Cultivar 130	31.2	2.0	10.2	35.3	23.9	69.4	6	8.4	21.1	93.2	5.2	1.2				
Cultivar 131	31.2	1.0	4.6	22.3	44.9	71.8	3	6.3	21.3	92	8					
Cultivar 132	31.2	3.5	12.3	30.2	7.0	49.5	31	9.8	23.5	57.2	37.4	5.4				
Cultivar 133	31.2	0.8	3.8	23.4	54.3	81.5	1	6.1	20.0	70.8	24	5.2				
Cultivar 134	31.2	1.4	8.3	29.0	27.0	64.3	13	7.5	21.5	100						
Cultivar 135	33.4	1.0	8.4	27.7	21.0	57.1	28	7.2	21.1	100						
Cultivar 136	35.7	2.1	15.3	34.4	9.9	59.6	25	11.2	22.7	98.8	1.2					
Cultivar 137	31.2	1.1	11.3	41.9	15.8	69.0	7	8.6	22.0	100						
Cultivar 138	31.2	2.0	13.3	37.8	12.7	63.8	15	9.3	23.9	100						
Cultivar 139	31.2	1.3	12.9	33.7	8.8	55.4	29	8.1	21.6	100						
Cultivar 140	33.4	2.1	16.1	45.2	4.5	65.8	12	11.6	22.6	100						
Cultivar 141	31.2	3.1	24.6	39.2	5.9	69.7	5	12.3	22.4	100						1.2
LSD [P=0.05]		1.0	3.9	7.2	7.0	8.8			0.6	11.6						
LSD [P=0.01]		1.4	5.0	9.4	9.1	12.3			0.8	14.8						

* Fry Colour at harvest (USDA colour chart)

Table 2.

Tasmanian seed multiplication bulk trial evaluation 2007-2008

Devonport district (Forthside) is one of the main delivery and storage district for McCain Foods Smithton processing plant. Planted in late October, the trial was lifted mid April 2008. No yield comparisons were taken, as it was not a replicated trial site. A replicated trial will be undertaken next season on cultivars that are retained.

Observation notes from Forthside seed multiplication plots.

<i>Harvest Comments Forthside Seed Multiplication Plots</i>			
Variety	Comments	L/W Ratio	Days to Maturity
Cultivar 2	small sample (smaller than RB), very even shape & size	1.68	120
Cultivar 5	very good, even sample for RB	1.75	139
Cultivar 6	mishapes & variable shape, scab!	1.65	128
Cultivar 126	even, roundish sample but scab!	1.41	155
Cultivar 127	smalls tend to be roundish, scab, large are good shape, size variation?	1.45	155
Cultivar 128	roundish?, odd mishape, even shape & size	1.26	162
Cultivar 129	size & shape variation?, scab!	1.59	148
Cultivar 130	pears/pinching - too many of them?	1.77	139
Cultivar 131	eyebrows, odd mishape	1.53	148
Cultivar 132	knobs - distortion!, smallish, thinnish tubers?	1.85	155
Cultivar 133	few tubers?, scab!, size variation, odd mishape = X	2.18	139
Cultivar 134	scab!, large are slightly lumpy	1.69	139
Cultivar 135	long thin tubers, tuber number?, size variation	1.81	128
Cultivar 136	too small? variable shape, pitted scab	1.61	139
Cultivar 137	shape variation (roundish?)	1.49	155
Cultivar 138	even shape but smallish	1.69	148
Cultivar 139	too small? Scab!	1.56	120
Cultivar 140	pitted scab lesions (common?), crisper?, very even shape & size	1.09	155
Cultivar 141	roundish, scab!, smallish - suitable for wedging?	1.26	128

Tasmanian variety evaluation trial 2007-2008.

Devonport district (Forthside) is one of the main delivery and storage district for McCain Foods Smithton processing plant. Planted in late October, the trial was lifted during April 2008.

Table 3

Forthside trial comparison of potato lines for different tuber yield weight grades, tubers per plant and processing parameters.

Entry	Spacing in Rows cm	Yield, Tonnes per Hectare					Rank by Fry Grade	Tuber No. Per Plant	Quality							
		Chats 0-100g	Small 100-170g	Large 170-340g	Over Size >340g	Fry Grade >100g			Dry Matter %	Fry Colour *						
										0	1	2	3	4	Ends	
Cultivar 5	32	10.1	18.5	25.4	2.0	45.9	7	13.1	22.4	100						11.1
Cultivar 6	20	2.1	8.4	29.3	15.7	53.4	5	4.8	19.8	100						26.7
Cultivar 87	32	8.4	29.9	26.1	1.3	57.2	1	13.1	21.9	100						
Cultivar 110	32	9.7	23.2	29.1	3.0	55.3	2	10.9	23.6	100						
Cultivar 111	29	7.8	19.6	28.4	6.5	54.5	4	10.7	22.5	100						
Cultivar 113	32	4.7	16.7	28.6	5.5	50.8	6	9.1	24.2	100						
Cultivar 114	32	12.8	27.1	26.3	1.3	54.7	3	15.1	26.2	100						
Cultivar 123	32	19.1	23.9	16.8	1.6	42.3	8	15.7	22.1	100						
LSD P=0.05		3.5	5.8	6.3	5.1	6.7		1.5	1.3							
LSD P=0.01		4.8	8.1	ns	7.0	9.3		2.0	1.8							
CV%		21.2	15.9	13.8	62.7	7.4		7.3	3.3							

* Fry Colour at harvest (USDA colour chart)

Entry	Days to Maturity	Quality			Hollow Assessment						Length Width Ratio
		Bruise Ste m end	Rose end	Shatt er	1st 10	1st 10	1st 10	2nd 10	2nd 10	2nd 10	
					Hollow%	Brown Centre%	total%	Hollow%	Brown Centre%	total%	
Cultivar 5	130.7	6.0	3.3	0.0	13	43	57	10	33	43	1.79
Cultivar 6	128.0	2.9	3.3	0.2							1.70
Cultivar 87	131.7	4.7	4.1	0.0							1.83
Cultivar 110	148.0	5.4	6.5	0.8							1.65
Cultivar 111	142.0	4.7	4.6	0.0							1.72
Cultivar 113	136.7	6.5	6.1	0.0							1.73
Cultivar 114	150.3	5.4	4.8	0.0							1.85
Cultivar 123	139.0	5.1	4.7	0.0	3		3				1.77
LSD P=0.05	5.2	1.3	1.7	0.2	5	7	10	na	7	7	
LSD P=0.01	7.2	1.8	2.3	0.3	6	10	14	na	10	10	
CV%	2.1	14.5	20.2	111.3	128	75	74	na	98	75	

Table 4

Forthside bulk trial stage 3 comparison of potato lines for different tuber yield weight grades, tubers per plant and processing parameters.

Entry	Spacing in Rows	Yield, Tonnes per Hectare					Rank by Fry Grade	Tuber No. Per Plant	Quality						
		Chats	Small	Large	Over Size	Fry Grade			Dry	Fry Colour *					
	cm	0-100g	100-170g	170-340g	>340g	>100g	Grade	Matter %	0	1	2	3	4	Ends	
Cultivar 5	32	5.4	13.9	28.1	4.1	46.1	6	9.2	22.8	100					7.0
Cultivar 51	29	6.5	22.2	25.5	3.2	50.8	4	9.6	21.4	100					
Cultivar 53	32	4.7	14.4	31.2	12.1	57.7	2	9.5	24.3	100					
Cultivar 61	29	4.9	16.8	35.1	8.4	60.3	1	9.4	22.7	100					
Cultivar 95	29	7.2	13.8	29.3	6.2	49.3	5	9.6	22.4	100					
Cultivar 99	29	4.1	18.5	29.6	8.5	56.6	3	9.6	22.6	100					
LSD P=0.05		1.7	5.3	4.6	4.0	4.2		ns	1.1						
LSD P=0.01		ns	ns	ns	5.7	6.0		ns	1.6						
CV%		16.7	17.7	8.5	31.1	4.4		6.8	2.6						