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Developing tools for a successful UK blueberry Industry



Developing a successful blueberry industry



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- Need knowledge of existing cultivars -crop characteristics and fruit quality and how to grow well across UK
- Consumer requirements fresh and processed met
- Competitive advantage over imported fruit
- Research base including genetics and mapping to sustain and support industry
- Encouragement to invest in a long term crop and overcome future challenges





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Research Aims

Identify current cultivars best adapted to UK climate utilising and where possible extending the fresh market season.

Develop robust marker assisted breeding and selection tools that will enable breeders to accelerate new high quality cultivar development.



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Benefits to UK Industry

- Building on existing HortLINK research
- Improving size, quality and competitiveness of UK blueberry industry
- Increased supply of local fruit for retailers
- UK fruit for processing in UK
- Develop markers associated with fruit quality for use in marker assisted breeding



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Benefits to research

- Utilising TetraploidMap software for linkage map construction in tetraploid blueberry
- Generating an understanding of the complex genetics controlling economically important traits
- New cultivars could be bred more efficiently with marker-assisted selection, to meet the ever-increasing demand



Phenotypic Analysis



Crop characteristics across a number of sites



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- Yield
- Visual fruit quality
- Growth habit and branch strength
- Season
- Natural infection by pests and diseases
- Establishment
- Machine harvest-ability



- Cultivars and mapping population





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Cultivar	Season	Yield	Size	Firmness	Flavour
Berkeley	3	2	3	3	2
Bluecrop	3	4	4	4	3
Bluegold	4	3	2	3	3
Bluetta	1	2	2	2	2
Darrow	3	1	5	3	4
Duke	1	3	3	3	2
Earliblue	1	2	3	2	1
Rubel	3	2	1	3	2
Spartan	2	3	5	3	4

Crop Establishment



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- Major impediments to production
- Known to have generally poor root development
- Creating soil conditions to overcome establishment restrictions
- Characterise soil conditions under best producing crops

SOIL PENETROMETER



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Major Anions			INTERPRETATION				
ANALYSIS		RESULT	VERY LOW	LOW	TARGET RANGE	HIGH	VERY HIGH
Nitrate-N	(1.19 mmol/l)	16.6 mg/l					
Phosphorus		<0.1 mg/l					
Sulphate-S	(0.38 mmol/l)	12.3 mg/l					
Chloride	(0.85 mmol/l)	30.0 mg/l					

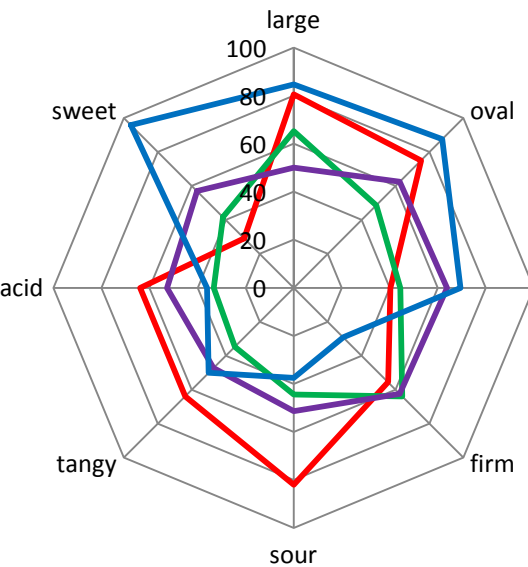
Major Cations			INTERPRETATION				
ANALYSIS		RESULT	VERY LOW	LOW	TARGET RANGE	HIGH	VERY HIGH
Calcium	(1.46 mmol/l)	58.6 mg/l					
Magnesium	(0.85 mmol/l)	20.6 mg/l					
Potassium	(0.05 mmol/l)	1.8 mg/l					
Sodium	(0.69 mmol/l)	15.9 mg/l					

Major Elements			INTERPRETATION				
ANALYSIS	INDEX	RESULT	VERY LOW	LOW	TARGET RANGE	HIGH	VERY HIGH
Phosphorus	6	119 mg/l					
Potassium	4	490 mg/l					
Magnesium	3	126 mg/l					
Calcium		995 mg/l					





















EC/pH			INTERPRETATION				
ANALYSIS		RESULT	VERY LOW	LOW	TARGET RANGE	HIGH	VERY HIGH
pH		4.4					



Consumer and sensory analysis: what are the expectations from blueberry?



Attribute class	Attribute	Reference standards
Appearance	Size	Photograph
	Round vs oval	Photograph
	Matt vs shiny	Photograph
	Firm	Fresh blueberries
	Blue	Photograph
	Red	Photograph
Aroma	Sweet	Honey solution
	Fruity	Forest fruits
	Acid	Solution of vinegar
	Intensity	blueberry juice
Taste	Sweet	Solution of granulated sugar
	Sour	Solution of forest fruits
	Bitter	Diluted tonic water
	Fruity	Forest fruits
	Acid	Diluted citric acid
	Intensity	blueberry juice

Attributes	No. of Reference standards			
	2	5	7	9
Blue				
Matt vs shiny				
Red				
Round vs oval				
Size				

Draper



Jewel



280 mapping individuals

Early to mid season
High chilling
Cold hardy
Firm fruit
Sweet taste

Early to mid season
Low chilling
Cold sensitive
Very large fruit
Slightly tart

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	GENOTYPE	WEIGHT	YIELD	COLOUR	SCAR	FIRM	PH	SOLUBLE	VEGBUD	LEAF:FRUIT	LEAFING	SIZE	VIGOUR
2	1	2.04	6	7	2	8	3.161	10.1	4	2	5	5	5
3	2	2.06	4	4	2	1	3.468	12.1	4	6	8	5	6.5
4	3	2.39	6	9	8	6	2.798	11.6	2	6	8	6	7
5	4	2.05	5	7	1	6	3.067	9.6	3	3	4	6	5
6	5	2.29	6	6	3	1	2.981	10.9	4	4	8	6	7
7	6												
8	7	2.08	5	4	9	7	3.115	10.1	3	3	3	8	5.5
9	8												
10	9	1.01	5	4	8	7	3.423	11.6	2	3	4	5	4.5
11	10	1.71	7	8	5	4	3.179	11.3	5	4	8	6	7
12	11												
13	12	1.28	8	5	8	7	3.204	11.4	3	4	8	8	8
14	13	2.15	4	8	3	3			4	4	6	8	7
15	14	2.42	3	5	5	4	3.169	11.4	5	6	8	6	7
16	15	1.33	8	4	2	7	3.253	12.2	5	3	7	7	7
17	16	1.80	6	8	1	2	3.005	12	7	4	7	5	6
18	17	1.77	5	7	5	2	3.119	13.2	4	5	6	6	6
19	18	1.50	3	5	8	8	3.358	13	4	3	3	6	4.5
20	19	1.83	6	5	2	5	3.097	10.3	4	5	7	6	6.5
21	20	1.64	8	7	1	5	3.113	11.9	3	4	8	8	8
22	21	1.54	6	4	7	6	3.155	11.2	6	3	8	5	6.5
23	22	1.79	6	4	4	9	3.276	10	3	4	5	6	5.5
24	23	1.35	3	9	9	8			6	6	7	5	6
25	24												
26	25	1.84	4	8	1	3	3.1	11.5	5	2	4	7	5.5
27	26	2.62	1	8	8	4	2.884	12.1	4	8	7	3	5

Genic Markers



DFR-2	Dihydroflavonol 4 reductase	Key enzyme of the flavonoid pathway
MYCA1	Myc regulatory protein	Anthocyanin regulatory protein
FLS	Flavanol synthase	Participates in flavonoid biosynthesis.
CBF	Transcription factor	Controlling the flow (or transcription) of genetic information, adjacent gene is either up- or - down-regulated
ATDGK	Diacylglycerol kinase	DGKs potentially affect a number of biological events including cell growth and cytoskeleton - remodeling
CER6	Eceriferum (CER)	Involved in wax biosynthesis, reduce water loss through the epidermis
CRY2	Cryptochrome, circadian clock	In plants, cryptochromes mediate phototropism, or directional growth towards a light source, in - response to blue light
CDF	Cation diffusion facilitator	Integral membrane proteins that increase tolerance to divalent metal ions such as cadmium, - zinc, and cobalt.
CBF	C-repeat/dehydration responsive element	Increase freezing tolerance. cold-response pathway cold acclimation
CHI	Chalcone isomerase	Essential for the biosynthesis of flavanone precursors of floral pigments and phenylpropanoid - plant defence compounds.
F3'H	Flavanoid 3' hydroxylase	Accumulation of flavonoids during development and after stress.

Putative QTLs



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Wgt 10					
Marker	KWSig.	Mean(0)	Count(0)	Mean(1)	Count(1)
MICA112	0.00063	6.972	25	4.3824	17
MIVCCj9b	0.00786	8.8167	6	5.1921	38
ORVc110398a	0.00517	4.3857	14	6.5818	33
FL656b	0.00332	8.3889	9	5.2923	39
FL799	0.01347	3.5667	6	6.2024	42
Wgt 11					
Marker	KWSig.	Mean(0)	Count(0)	Mean(1)	Count(1)
MICA112	0.05943	10.3464	28	7.9	22
FL524b	0.04459	6.64	10	10.174	50
SC2ms2a02b	0.06932	13.375	8	8.9865	52
CER63	0.06028	8.7036	28	11.7667	18
Wgt 12					
Marker	KWSig.	Mean(0)	Count(0)	Mean(1)	Count(1)
MIVCCj9a	0.07625	15.7478	23	12.09	20
MIVCCs10d	0.02989	12.0905	21	16.2931	29
ORVc110398a	0.03556	12.6	18	15.7829	35
CER63	0.00286	12.5129	22	17.7864	31
Wgt 13					
Marker	KWSig.	Mean(0)	Count(0)	Mean(1)	Count(1)
FL656b	0.02445	10.4625	8	14.9163	43
FL799c	0.01701	8.2167	6	15.0178	45
SCCA49a	0.01628	8.8167	6	15.0625	32
CER63	0.02765	12.8913	23	15.8471	17

Results to date



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- Full phenotypic analysis complete on available varieties and mapping population for 2010, 2011, 2012 and 2013
- Initial genotypic results compiled to produce draft tetraploid linkage map
 - Draft diploid map available to align
- QTL analysis initiated
- Socio-economic analysis initiated
- Cultivar “Fact Sheets” for UK performance under development
- Cultivars particularly amenable to UK production identified as potential breeding parents

Future Outcomes



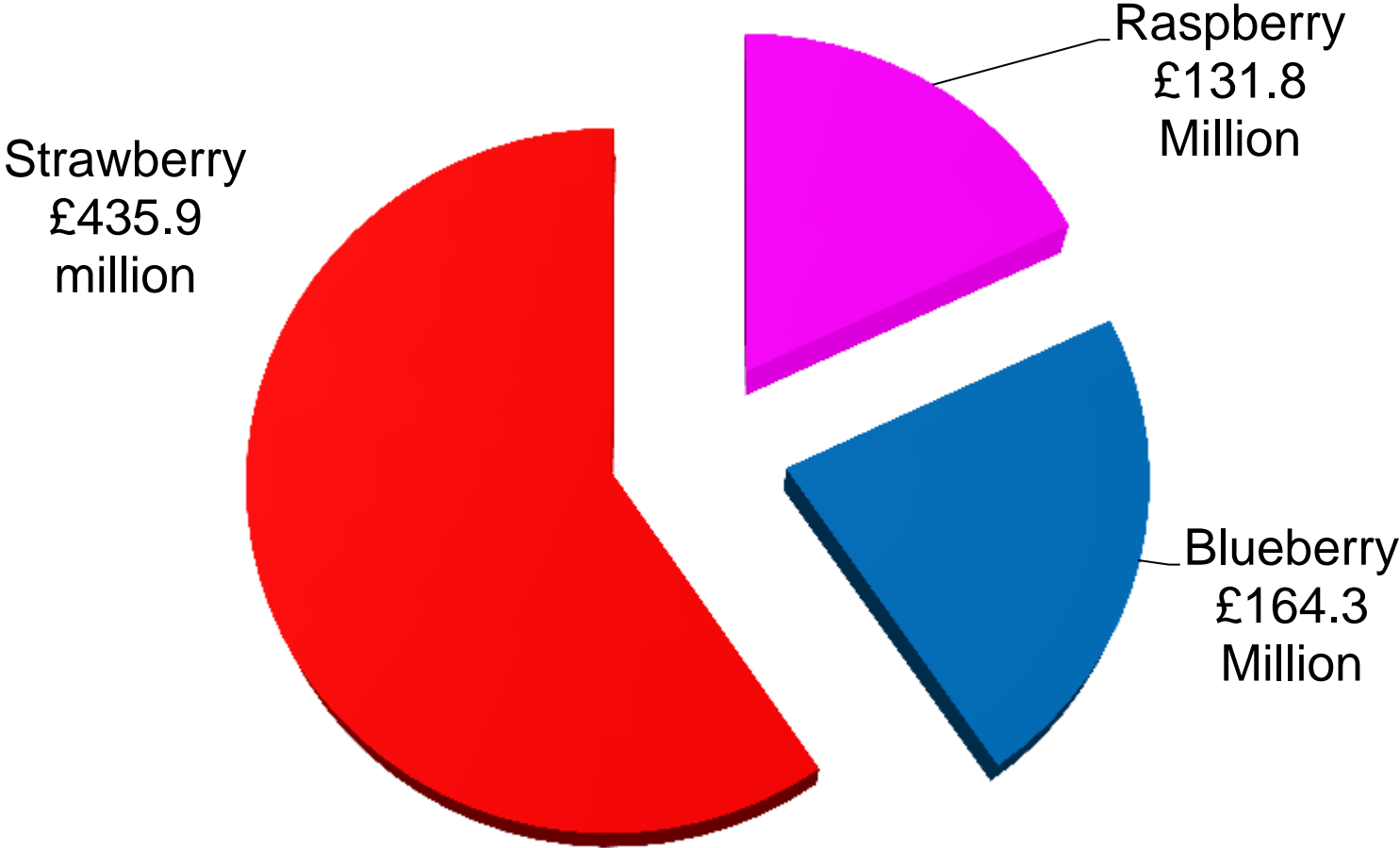
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- Identify suitable high quality varieties for growing across a wide season that meet requirements for UK production
- Develop linkage map and heredity patterns
- Identify QTLs and polymorphic markers for accelerated breeding
- Clear definition of the genetic and environmental impact on variation of key traits including sensory and health promoting compounds
- Initiate a UK breeding programme

UK Blueberry Market



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Kantar Worldpanel blueberry market share data for the 52 weeks prior to week ending 7th July 2013

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