

Understanding Spotted Wing Drosophila population dynamics and host preference in Scotland as a basis for pest control

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Spotted Wing Drosophila – *Drosophila suzukii*



- An emerging pest of fruit crops in Scotland
- Better understanding of pest biology might assist in developing control measures

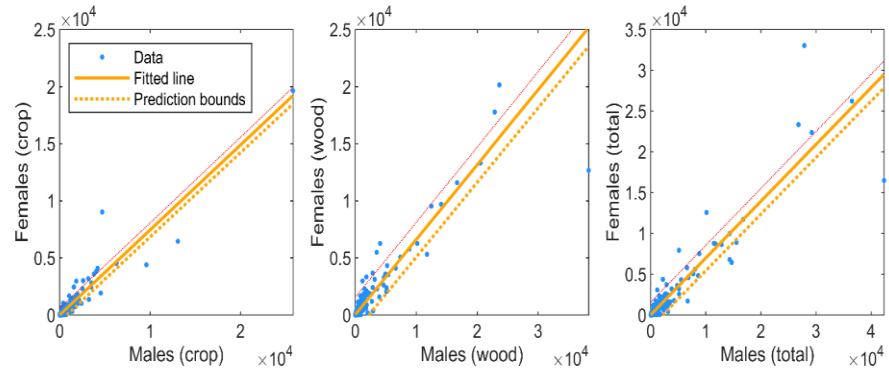
Task 1: Epidemiology studies

monitor hotspots
population (genetic) stability



Task 2: Predictive tools

relating abundance to met data,
habitat and landscape features

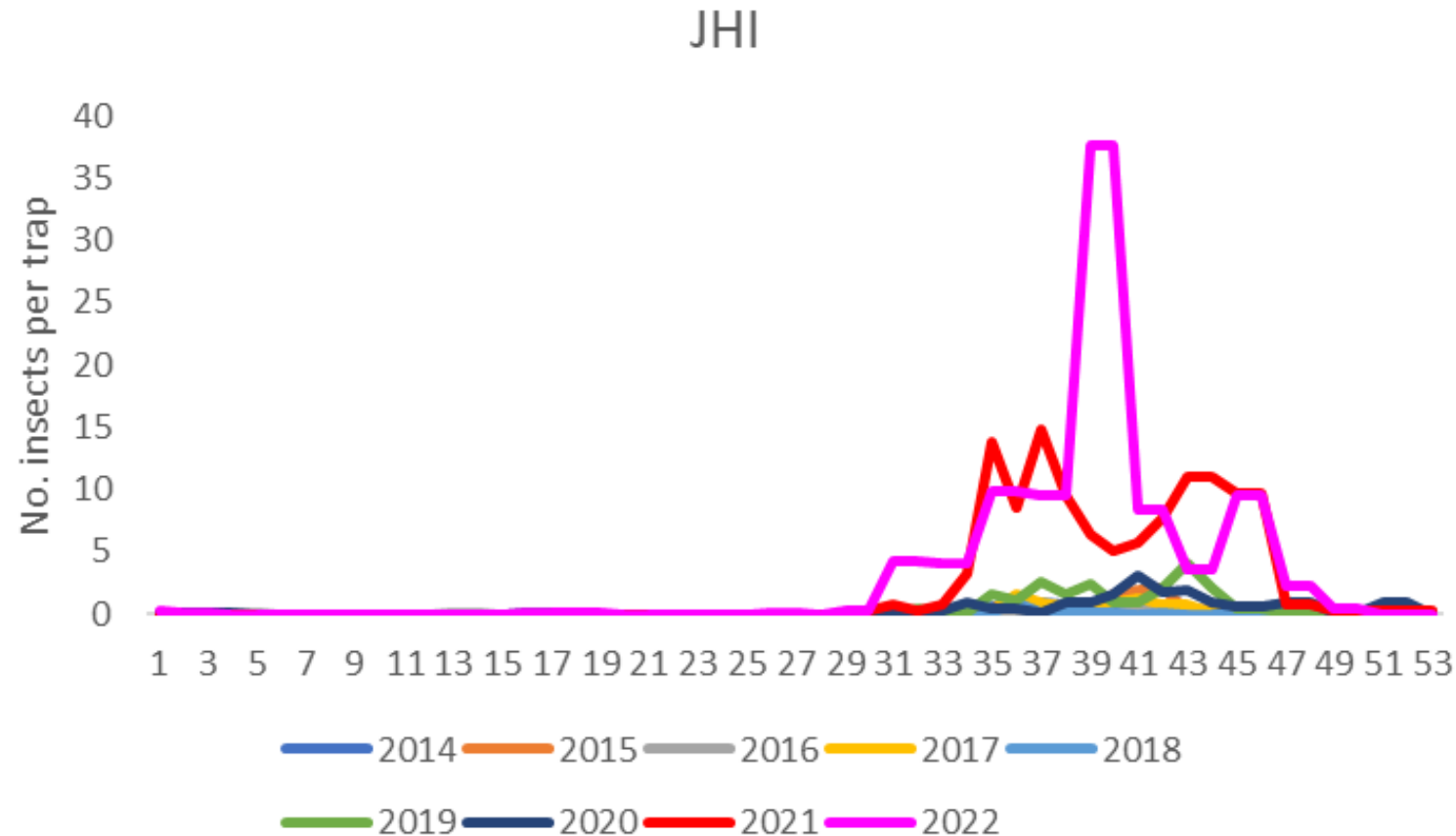


Task 3: Crop selection

test varietal susceptibility to
SWD

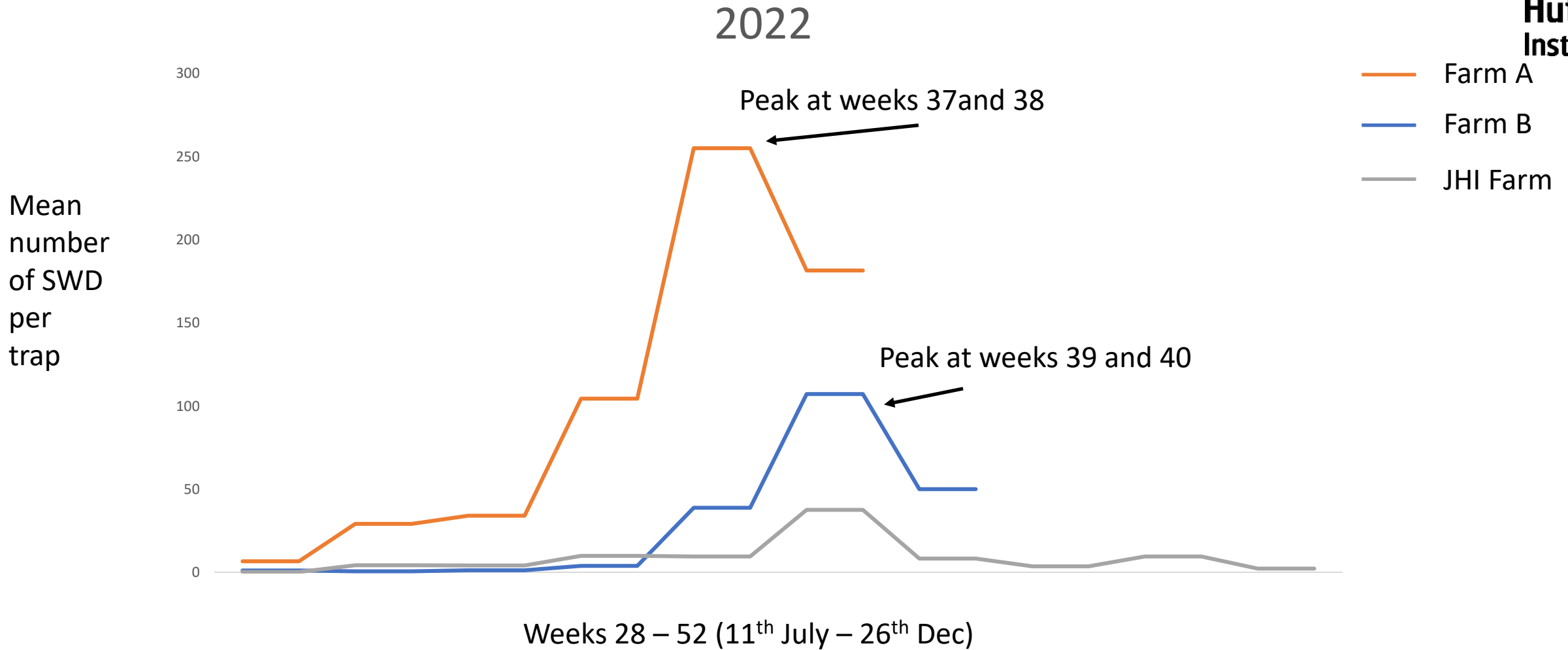


SWD population dynamics



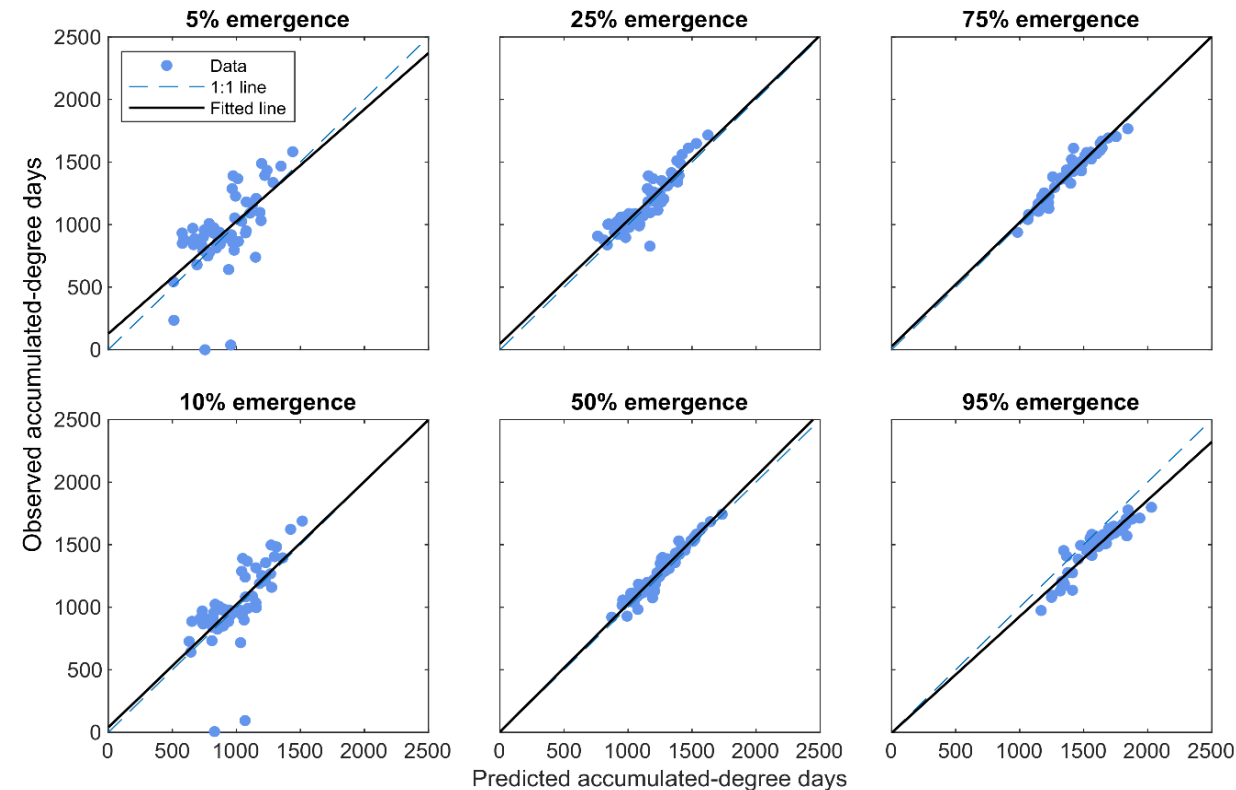
- SWD has been monitored at Hutton for ~10 years
- Abundance has increased noticeably in the last two years
- Two new farm sites are being monitored every 2 weeks in addition to Hutton

SWD population dynamics



Predictive tools for SWD abundance

- Previous modelling work used SWD abundance to predict time required to reach a % value of SWD population size with a high level of accuracy **from weather variables** (min/max/mean temp., RH, wind, SWR, rain, gdd)
- Further develop the model to relate SWD abundance **to environmental factors** using univariate/regression/machine learning techniques
- Aim: to characterise **local** (crop variety, habitat) and **landscape features that influence local SWD population size**



Analysis of the *D. suzukii* population structure in Scotland

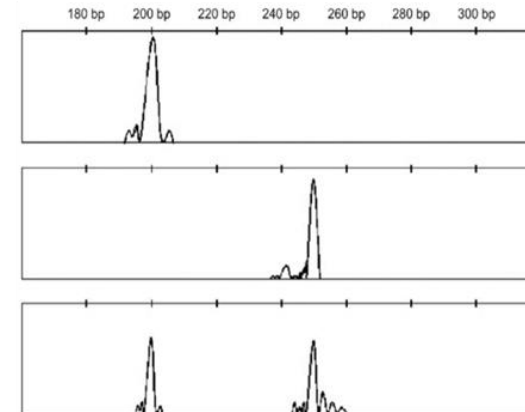
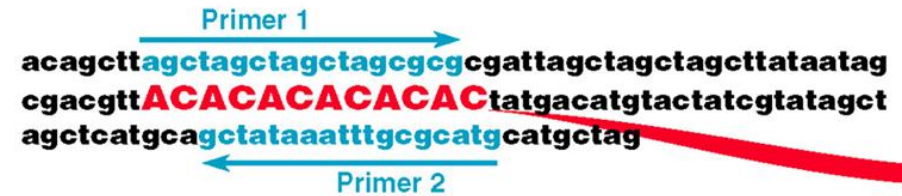


- Genomic technologies can play a key role in understanding aspects of the pest biology including development of insecticide resistance, invasion and migration patterns, seasonal biology and population structure
- This knowledge is fundamental to developing IPM control strategies

AIM

- Assess the SSR marker system for population analysis in UK
- Establish a base line genetic profile for the Scottish population

Repetitive DNA amplified by PCR



SWD genetic analysis

Examples of typical genotypic profiles of 10 *D. suzukii* individuals

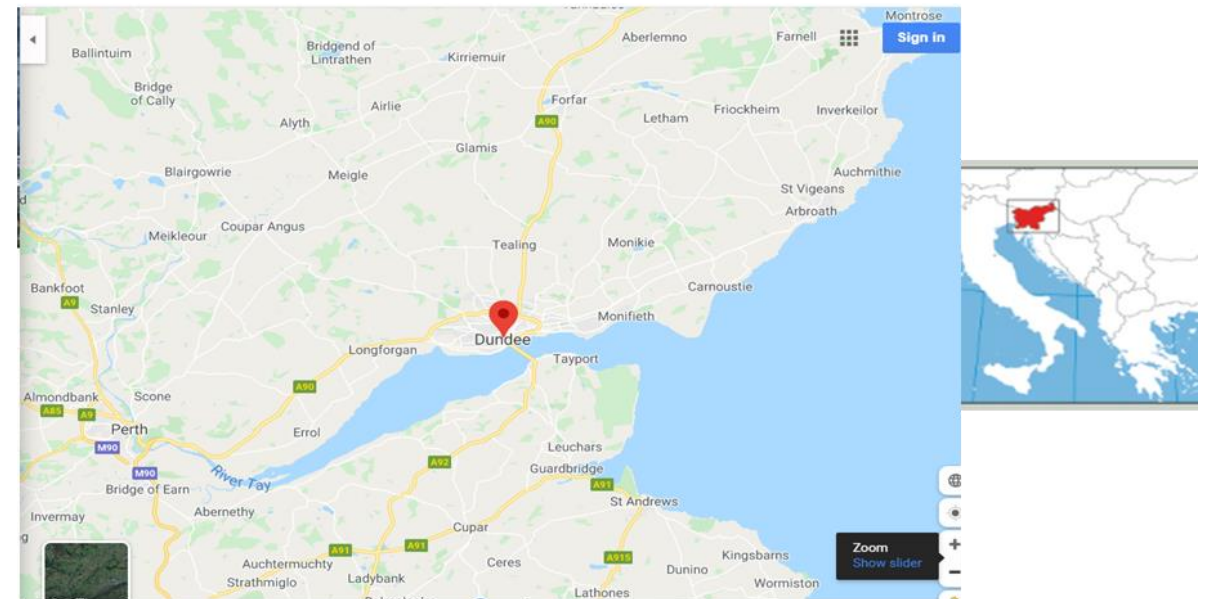
Six primer sets were used (ds7, ds38, ds8, ds9, ds15 and ds 14)

code id	ds 7	ds7	ds38	ds38	ds8	ds8	ds9	ds9	ds15	ds15	ds14	ds14
1	181	181	138	138	145	152	193	213	275	280	205	205
2	181	181	135	135	145	145	215	221	275	280	201	205
3	181	181	135	135	148	150	209	215	280	280	205	208
5	181	184	143	145	128	148	213	213	268	280	205	210
6	181	184	143	143	142	150	219	221	274	274	205	205
7	181	184	143	145	148	150	204	213	272	280	205	205
8	181	184	138	149	150	157	219	221	272	280	203	205
10	181	186	135	143	150	159	213	213	272	278	201	203

Many alleles are shared but each individual has a unique profile

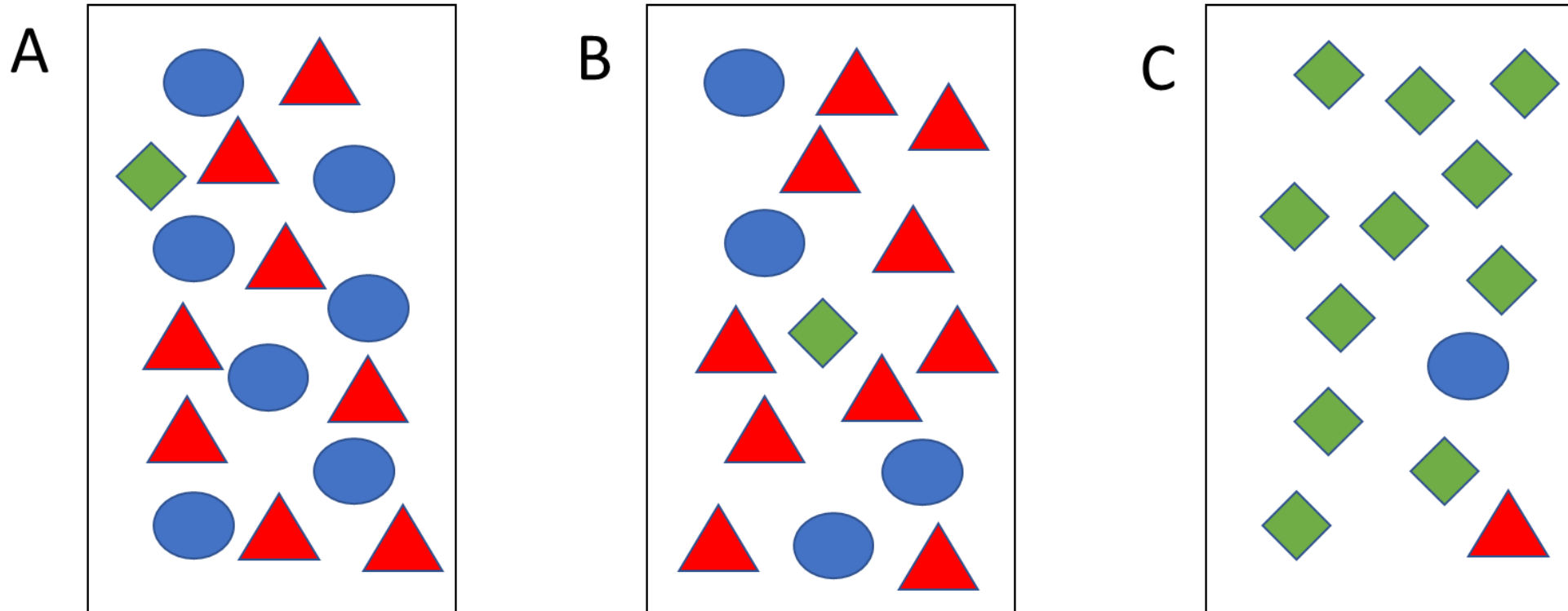
SWD genetic analysis

Population	No. of individuals
1100	17
1200	13
1300	24
1400	32
Slovenia	6
Total	92



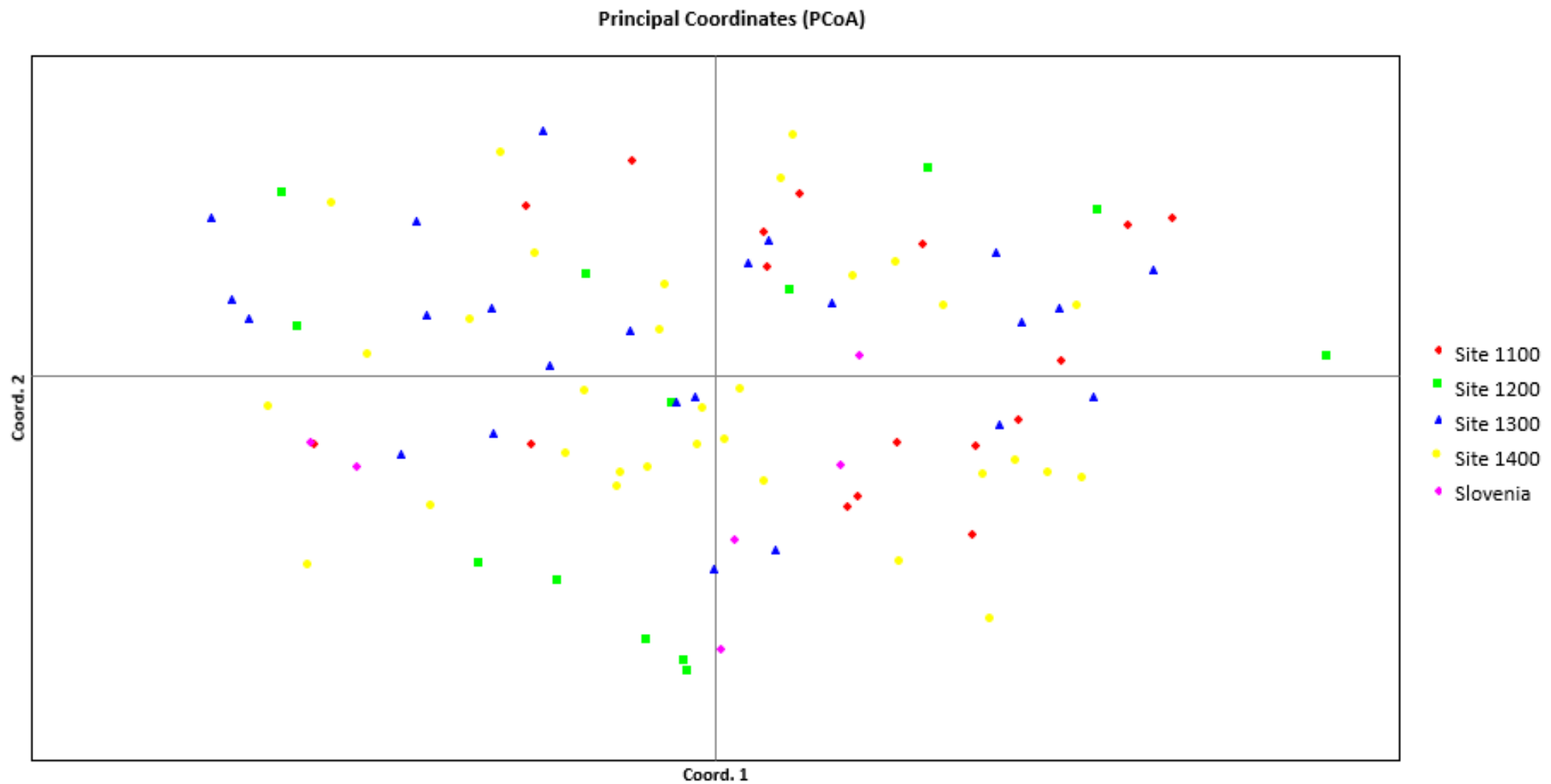
Analysing genetic structure

It is possible to mathematically measure the level of gene exchange between populations



Shapes represent different versions of the same gene (allele)

PCoA to detect clustering



Genetic distance analysis

Pairwise population Matrix of Nei genetic distance

1100	1200	1300	1400	Slov	
	0.000				1100
	0.201	0.000			1200
	0.130	0.138	0.000		1300
	0.097	0.126	0.089	0.000	1400
	0.419	0.320	0.338	0.290	0.000 Slov

Future work

- **Genetic structure**
- Continued analysis of existing data and inclusion of additional samples trapped in 2022
- Has there been a new introduction?
- Lab strains of populations showing increased tolerance to insecticides have been established in culture (EMR)
- Is the genetic profile of these insects different from the general population?



Strategies for control (EMR AHDB)

- Bait sprays, attract and kill, exclusion mesh, mass-trapping (precision monitoring), parasitoids and natural enemies, dead-end hosts, good crop husbandry
- JHI - studying varietal differences in susceptibility

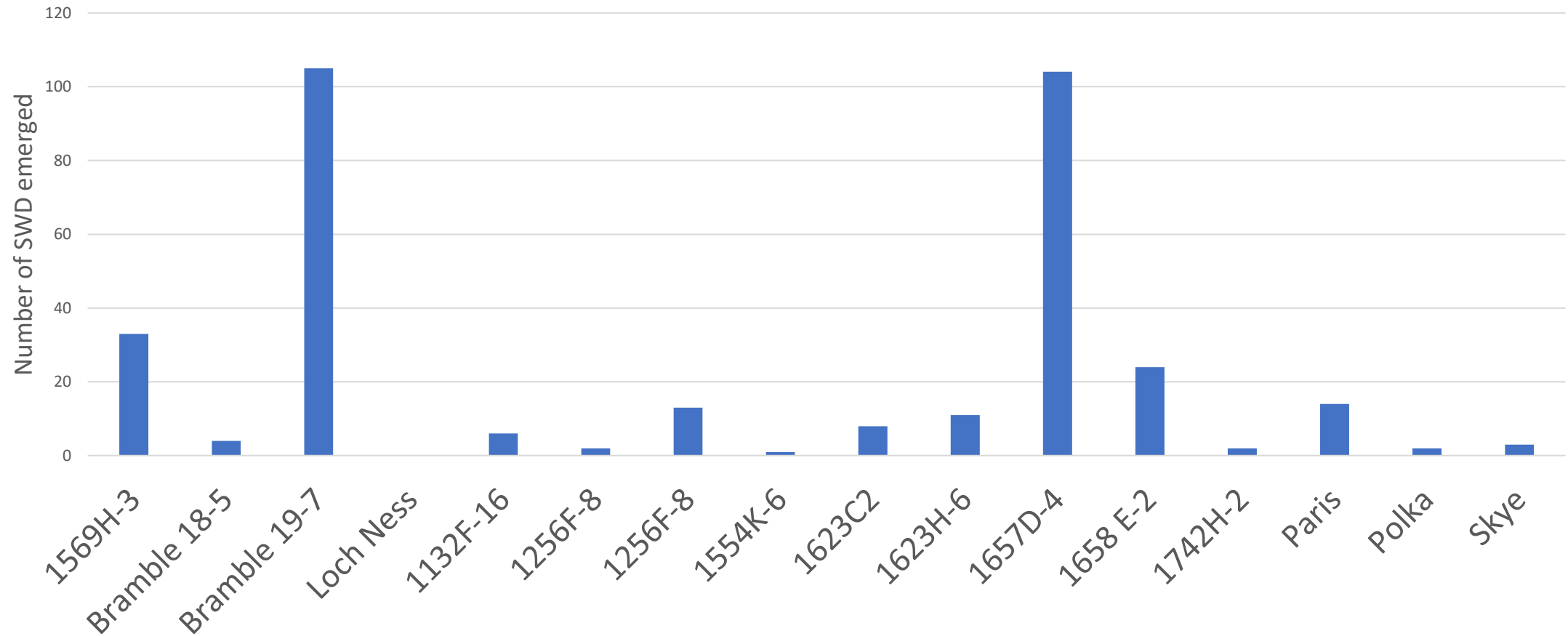
Crop varietal differences in SWD susceptibility

SWD emergence

- Same varieties tested and some additional varieties
- A sample of berries are left in a ventilated tub and checked every few days for three weeks
- The emerging fruit flies are identified and counted



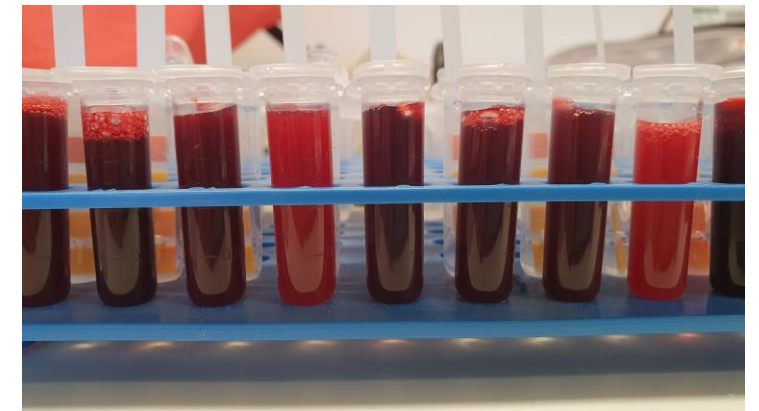
SWD emergence from blackberry and raspberry



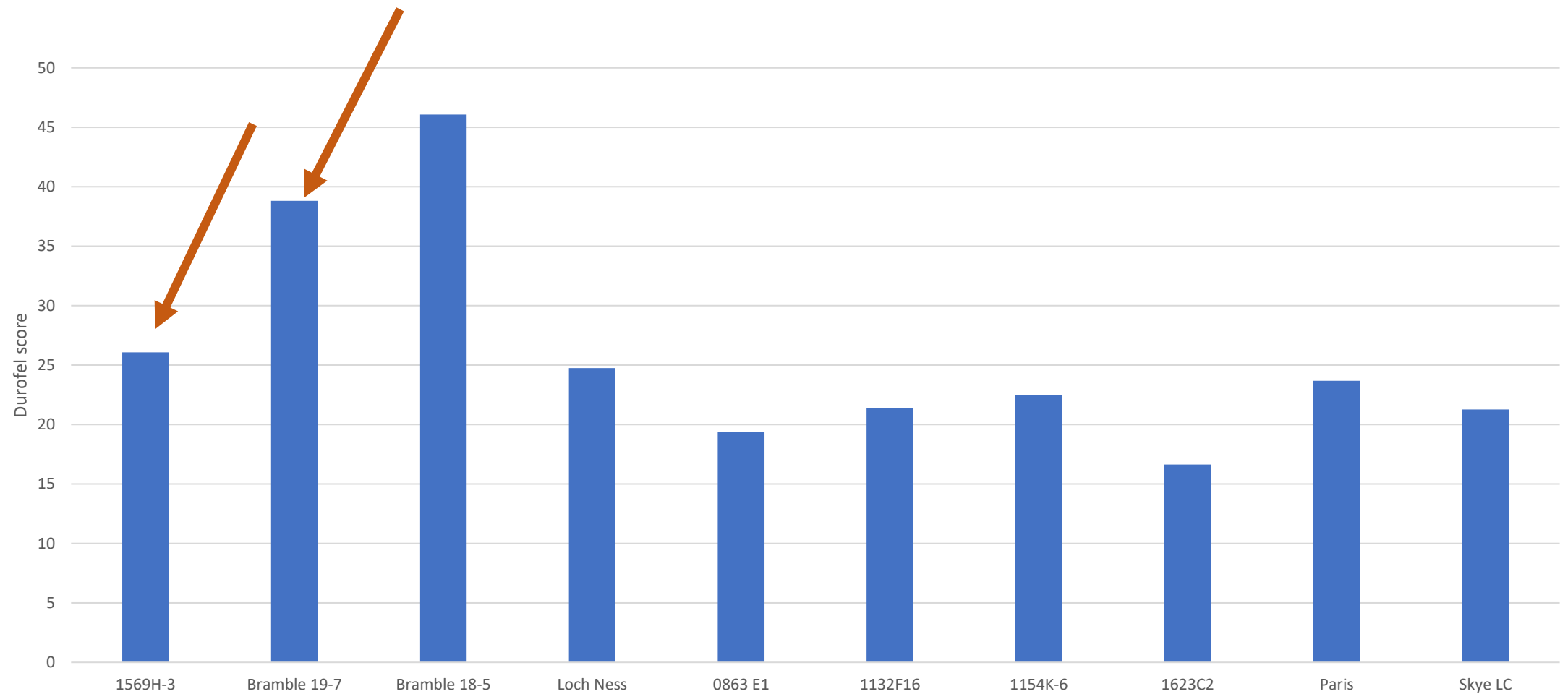
Crop varietal differences in SWD susceptibility

Physical and chemical traits

- **Elasticity of the skin**
 - Approx 20 ripe berries from each variety
 - Measures in Durofel (0=soft – 100=firm)
-
- **Brix and pH**
 - Same berries used for Brix
 - Still to do pH



Fruit physical measurements



Summary

- SWD appears in late summer (mid-July onwards) and peaks in Sept-Oct
- Abundance has increased in the last ~2 years, appearing earlier and staying for longer
- Population genetic composition might indicate whether there are multiple arrivals or a single source population
- Crop varietal differences in fruit infestation have been detected for raspberry and blackberry

Next steps

- Continue monitoring and genetic analysis in 2023
- Identify varietal traits associated with susceptibility/resistance (choice tests)
- Use machine learning to test if SWD abundance can be predicted from environmental factors (weather, crop, habitat features)

Findings will be made available to growers, agronomists and others via fruit industry events and as factsheets in the **IPM@Hutton** 'Soft Fruit IPM' Toolbox

Thanks to...

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Group



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Riaghaltas na h-Alba
gov.scot

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