

Achieving effective pollination in NZ hazelnut orchards

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14th September 2021



Hazel flowering

- Wind pollinated during winter.
- Self-incompatible.
- Incompatible with varieties with same S alleles.
- Fertilization in late spring/early summer.
- Nuts develop shell first then the kernel develops to fill the shell.

Catkins



Catkins

Cluster on left are unopened

Middle cluster are open and releasing pollen (yellow colour)

Right hand cluster have finished releasing pollen (brown colour)



Female flowers



Spent flowers?



Butler flowers

M Redpath 2015

Stages of flowering



Butler flowers on catkin peduncle



Whiteheart – red dot stage



San Giovanni – pollinated flowers

Female flower clusters

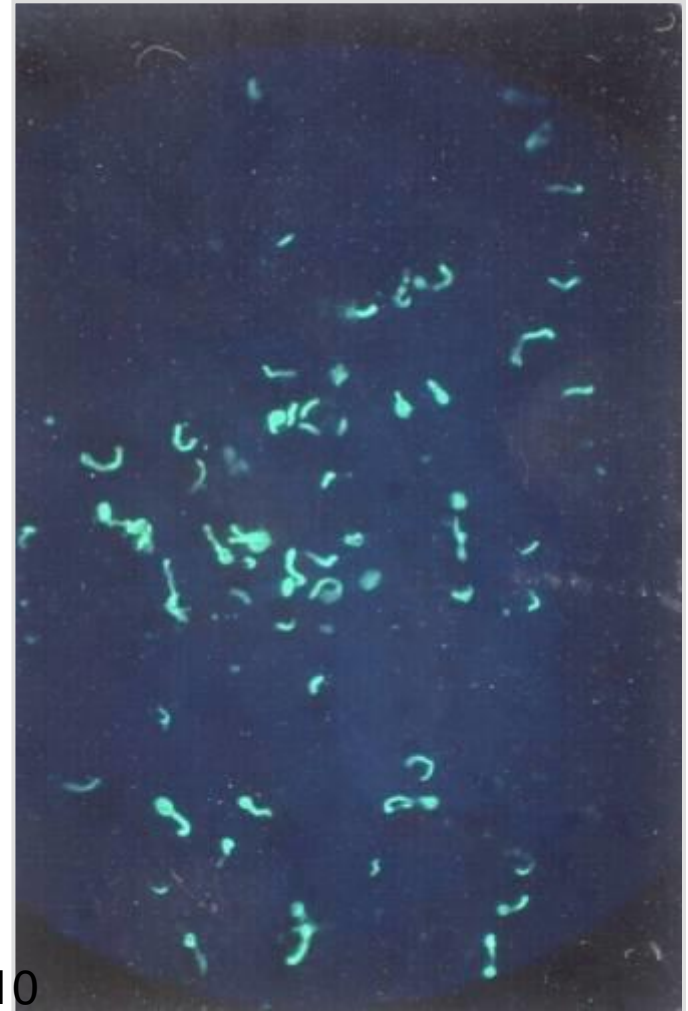
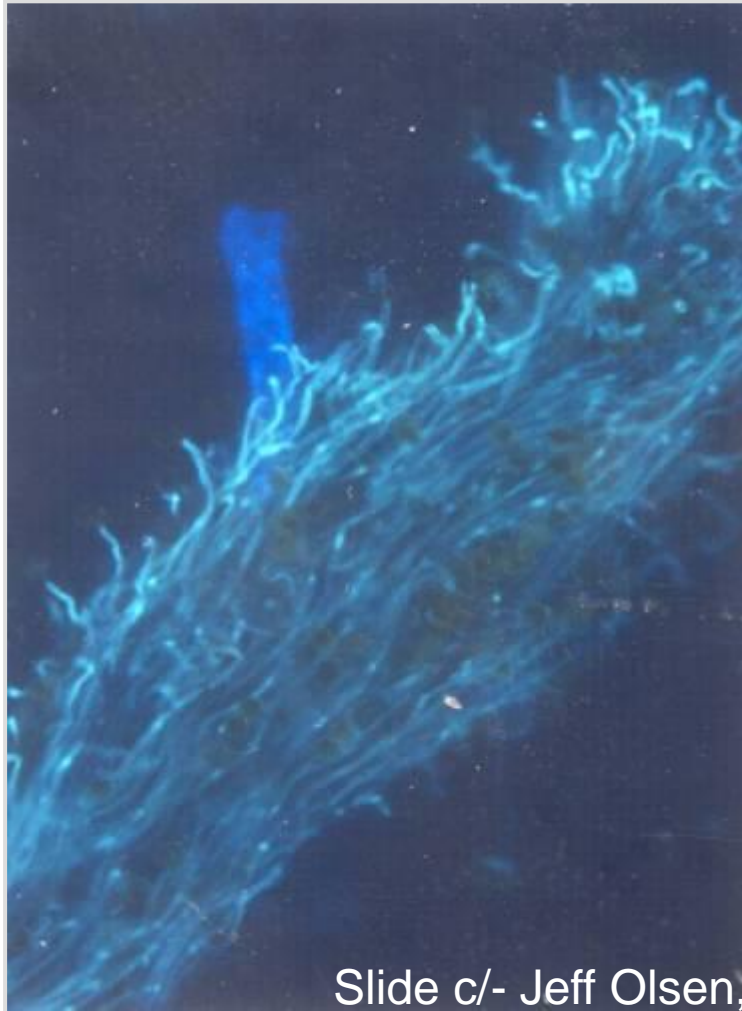


Slide c/- Jeff Olsen, OSU, 2010

Sporophytic self-incompatibility

Compatible

Incompatible



Slide c/- Jeff Olsen, OSU, 2010



OSU S allele testing row 2008

Polliniser spacing

- Each tree should be no further than 20 metres from a polliniser.
- At a 6 metre x 6 metre spacing, every 3rd tree in every 3rd row (approx. 10% of planting)
- At a 5 x 3 spacing, every 6th tree in every 4th row (approx. 4.5% of planting).
- Separate polliniser rows (only useful if the pollinisers are commercial cultivars)

Which pollinisers?

- Need to drop pollen at the same time as female flowers of main variety are open.
- Timing varies season to season and area to area.
- Most pollen should be available at the peak of flowering.
- Need to be compatible – use compatibility charts

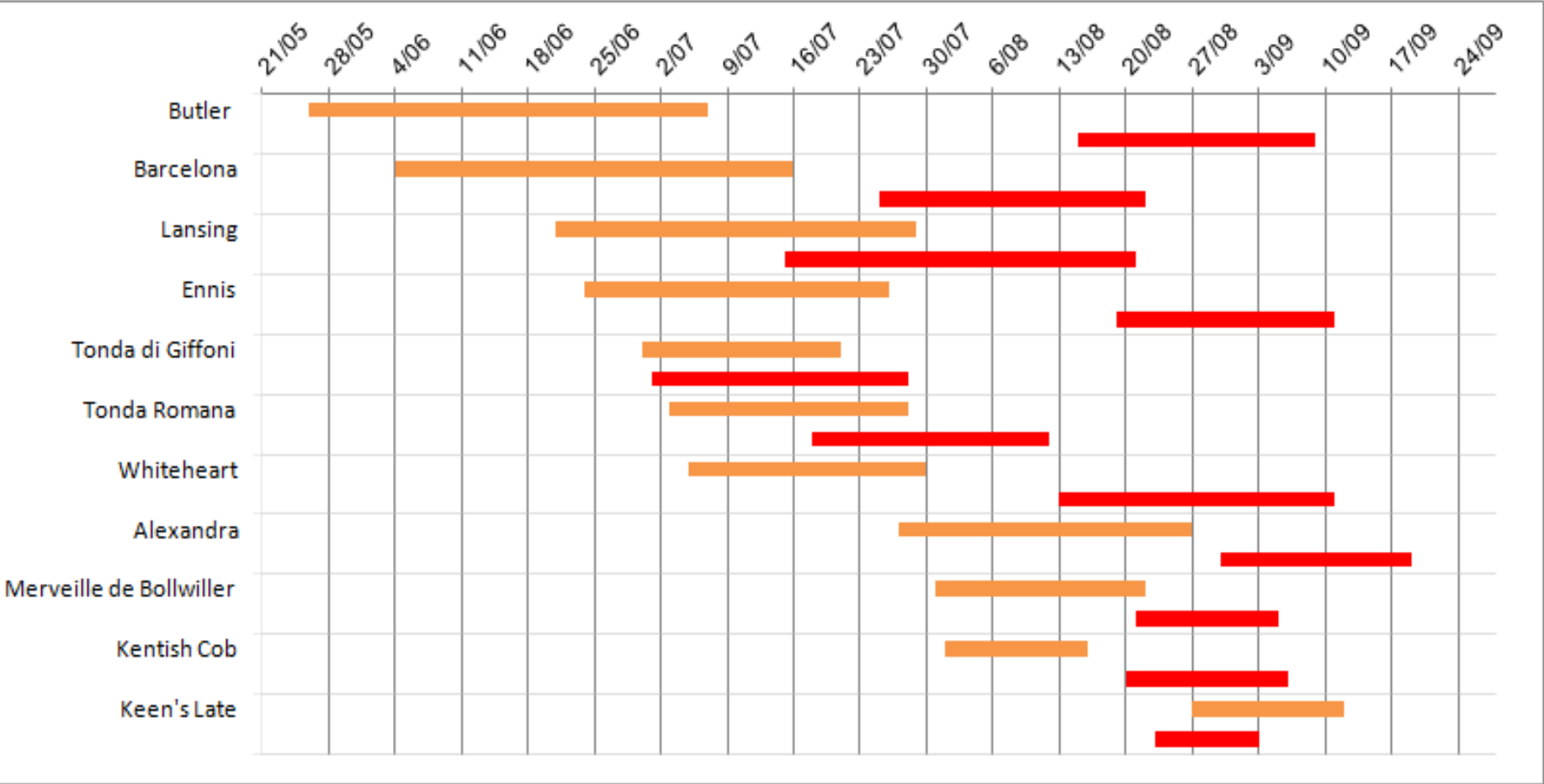
Pollen-flower compatibility of hazelnut varieties grown in New Zealand.

| Female parent | Pollinisers | | Alexandra | Barcelona | Butler | Ennis | Epsilon | Eta | Keen's Late | Kentish Cob | Lansing | M. de Bollwiller | Royal | Theta | T. di Giffoni | Zeta |
|------------------|-------------------|----|-----------|-----------|--------|-------|---------|-------|-------------|-------------|---------|------------------|-------|-------|---------------|------|
| | Alleles Expressed | | ? | 1 | 3 | 1 | 1 | 11 16 | ? | 8 14 | 3 | 5 15 | 3 | 5 15 | 2 | 1 |
| Barcelona | 1 | 2 | ?L | | +E | | | +L | + | +L | +E | +L | + | | | |
| Butler | 2 | 3 | +E,M | + | | +E | | +M | +L | +E | | +E | | | | +L |
| Campanica | 1 | 2 | ? | | +E | | | | + | + | +L | + | +E | | | |
| Ennis | 1 | 11 | ?M | | + | | | | +L | +E | + | +E | + | | + | |
| Jefferson | 1 | 3 | ? | | | | | +E | ? | +E | | +E | | +L | | |
| Kentish Cob | 8 | 14 | ?E,M | + | + | + | | | | | + | +E | + | +L | + | |
| Lansing | 1 | 3 | ?M,L | | | | | | + | M | | +M | | | +E | |
| Nocchione | 1 | 2 | ? | | +E,M | | | | + | + | +E,M,L | +L | + | | | |
| Royal | 1 | 3 | ? | | | | | | + | +M,L | | +M,L | | | + | |
| Tonda di Giffoni | 2 | 23 | ? | +E | +E | +M,L | | | ? | + | +E,M,L | + | + | | | |
| T.G.D.L. | 2 | 7 | ? | + | + | + | | | ? | + | + | + | + | | | |
| Tonda Romana | 10 | 20 | ? | + | + | +E,M | | | ? | +L | +E | +L | + | | +E | |
| Whiteheart | 2 | 10 | +M | + | + | + | +E | +M | +L | +E | + | +E | + | +L | | +M |

| | |
|---|---|
| | + indicates that pollen is compatible with the flower of the female tree. |
| | A blank cell indicates an incompatible cross |
| ? | A "?" indicates that the compatibility is unknown |

Text indicates whether pollen of the male parent is shed early (E), mid-flowering (M) or late (L) in the flowering period of the selected female parent. Dates have been calculated from records taken at Wairata Forest Farm, Bay of Plenty. Variations may occur in other parts of New Zealand. Pollen is shed earlier in warm areas. Orchards in Nelson and the North Island should use mid and late pollinisers

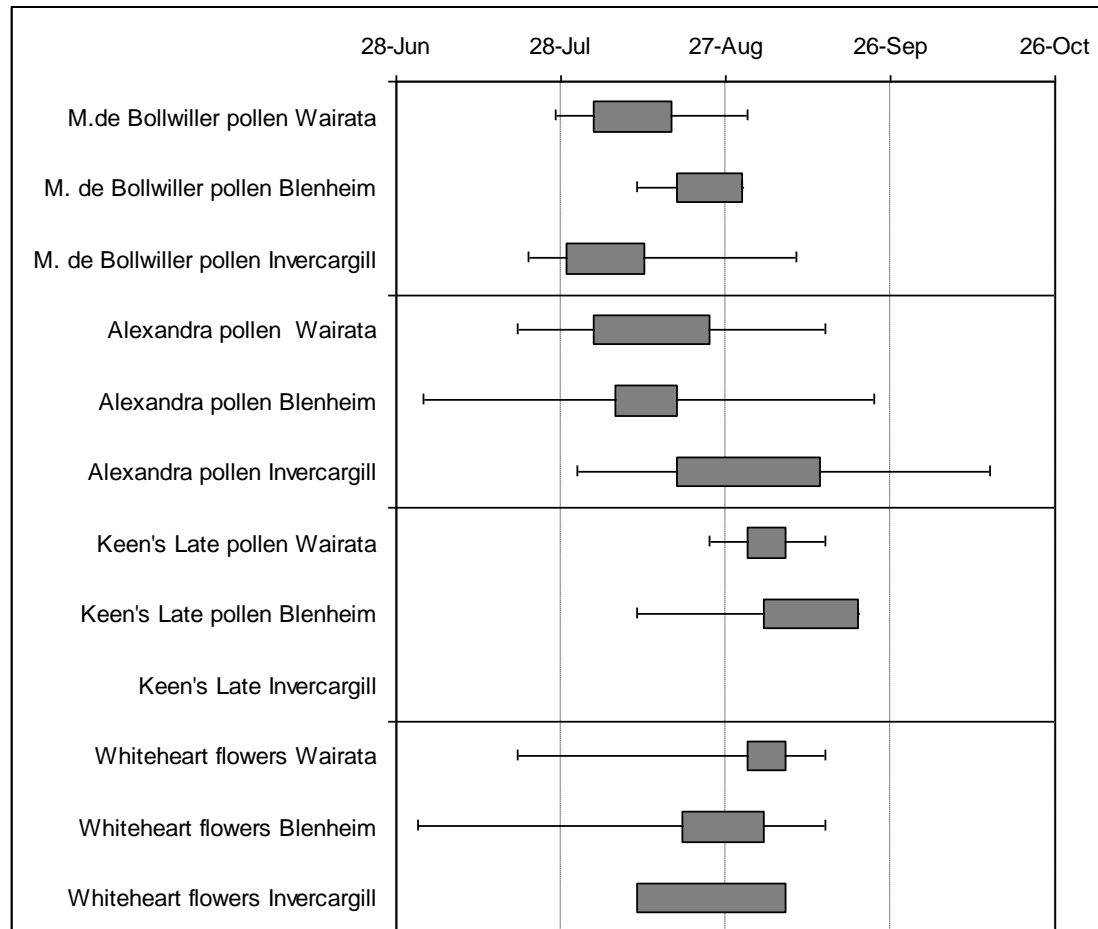
Hazel flowering times (Wairata averaged)



Whiteheart flowering and pollinisers.

Wairata, Blenheim and Invercargill. 2007

Note differing times of pollen release and Whiteheart flowering between different regions



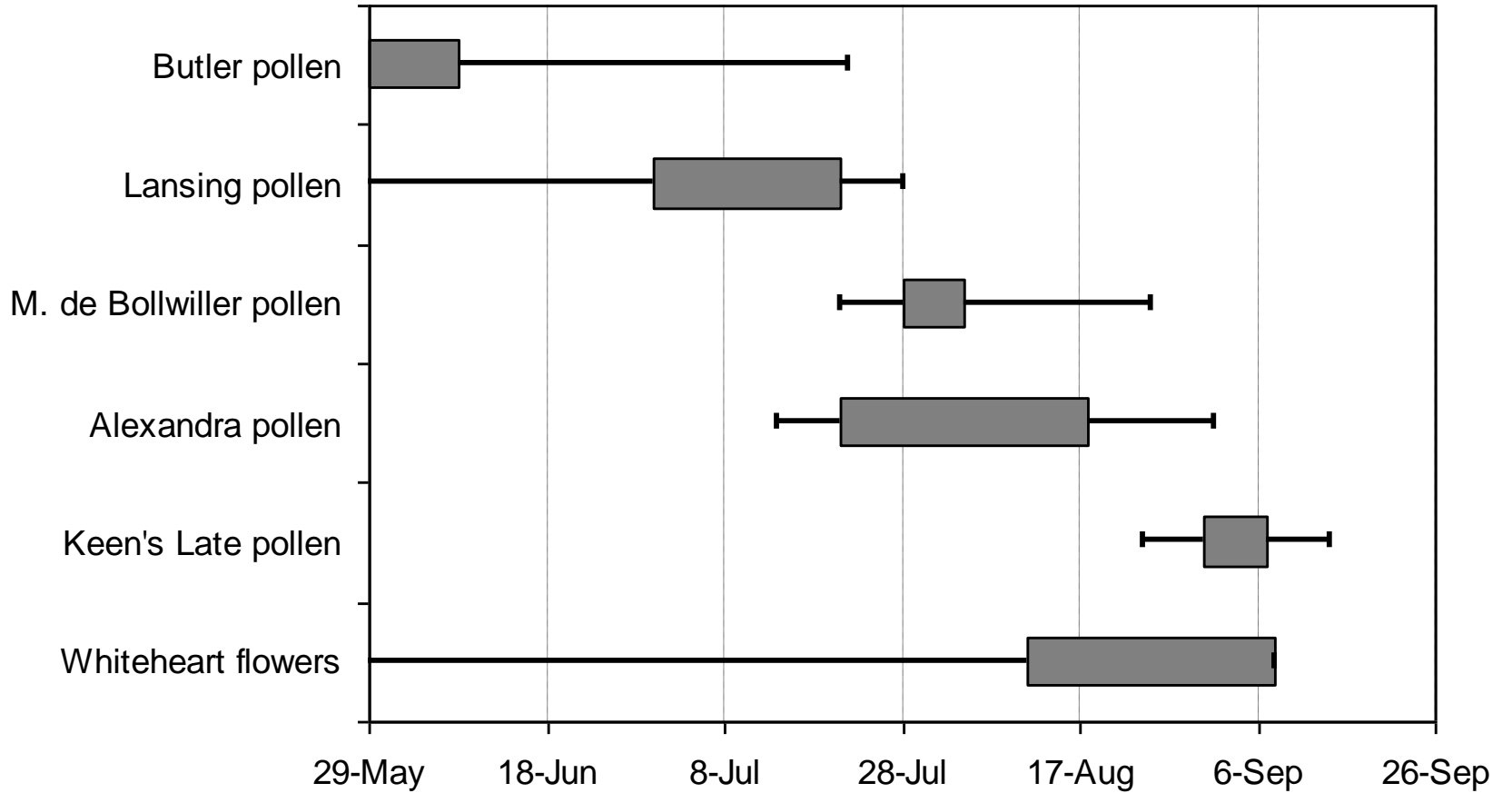
**Pollen shedding at Wairata 2018.
Barcelona and Ennis flowering 2018**



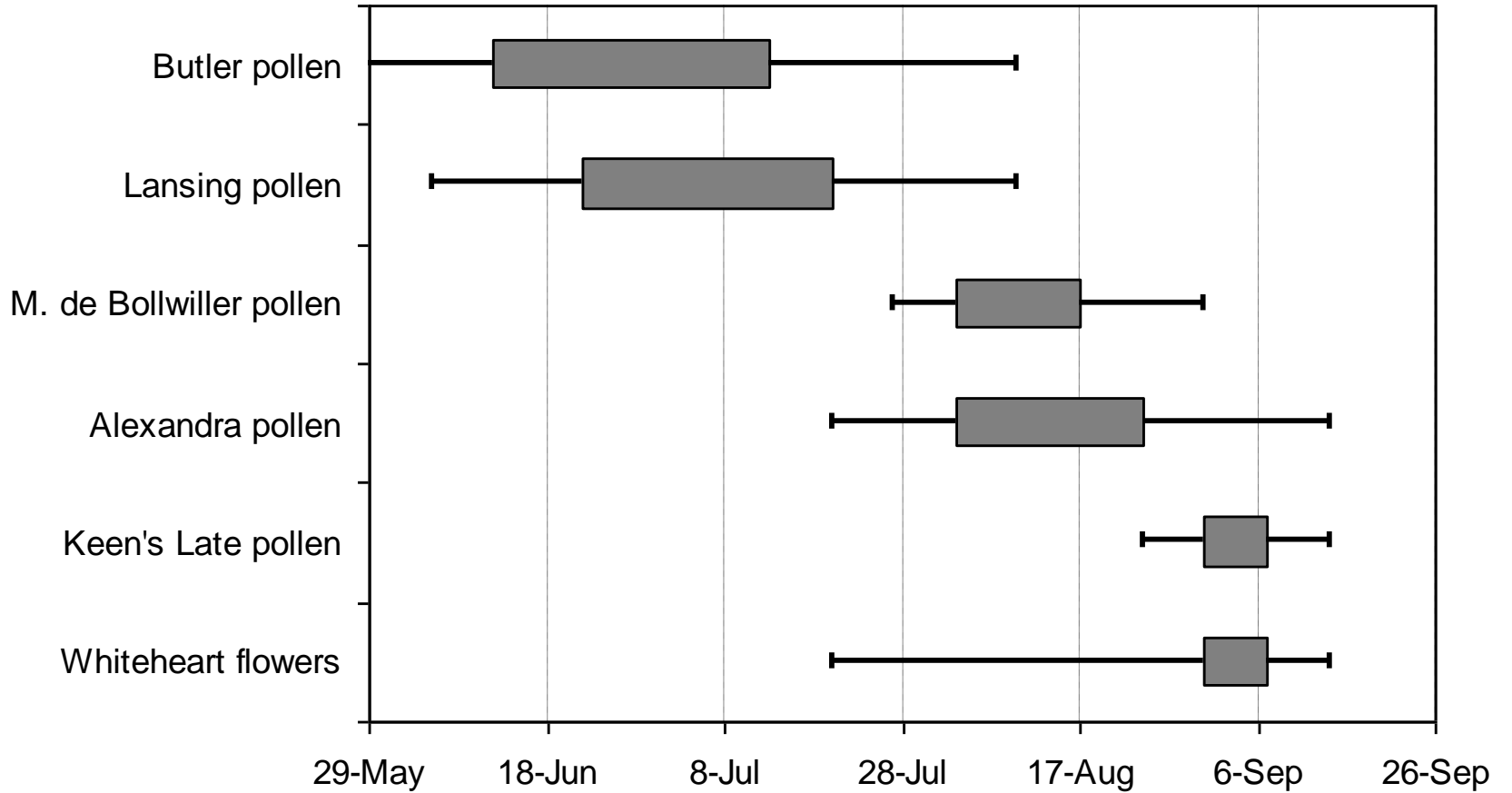
Checking the timing of suitable pollinisers for Whiteheart at Wairata Hazels, eastern Bay of Plenty

- The main pollinisers usually recommended for Whiteheart are Merveille de Bollwiller and Alexandra.
- Keen's Late was selected as a late polliniser for Whiteheart in the North Island.
- Over the last 8 years, Butler and Lansing have been suggested as suitable early pollinisers for Whiteheart.
- The following charts examine the flowering periods for Whiteheart and the suggested pollinisers over a 5 year period. Note the difference between flowering periods in 2006 and 2007, years with differing chilling characteristics.
- The box indicates the peak of flowering/pollen release, the whiskers cover periods with few flowers/pollen released, comparable to <5%.
- From these charts, the main polliniser recommended for Whiteheart in this orchard should be Keen's Late. Butler and Lansing are not suitable as they drop pollen far too early.

Whiteheart flowering + pollinisers, 2006, Wairata



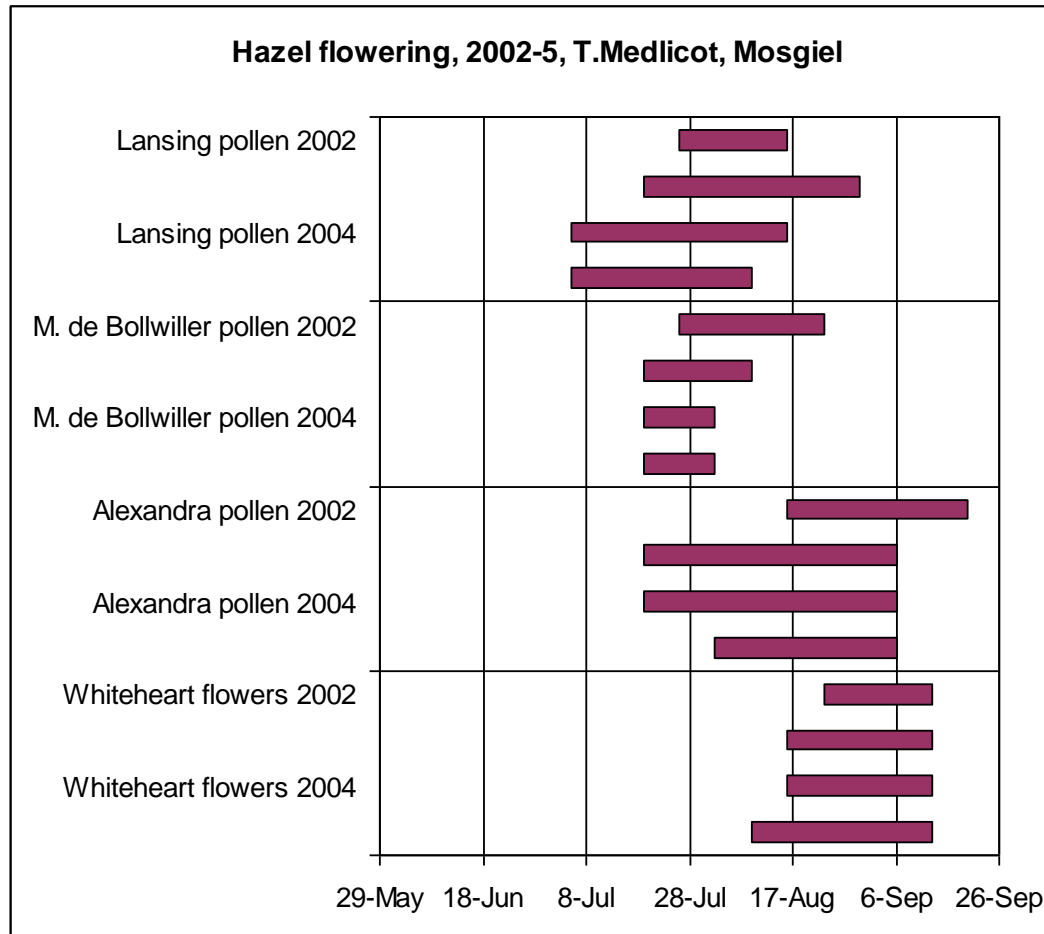
Whiteheart flowering + pollinisers, 2007, Wairata



Whiteheart and pollinisers

T. Medicott, Mosgiel, 2002-5

The main flowering period for Whiteheart occurs after 17th August. In this orchard Alexandra is the only polliniser consistently providing pollen over this period.



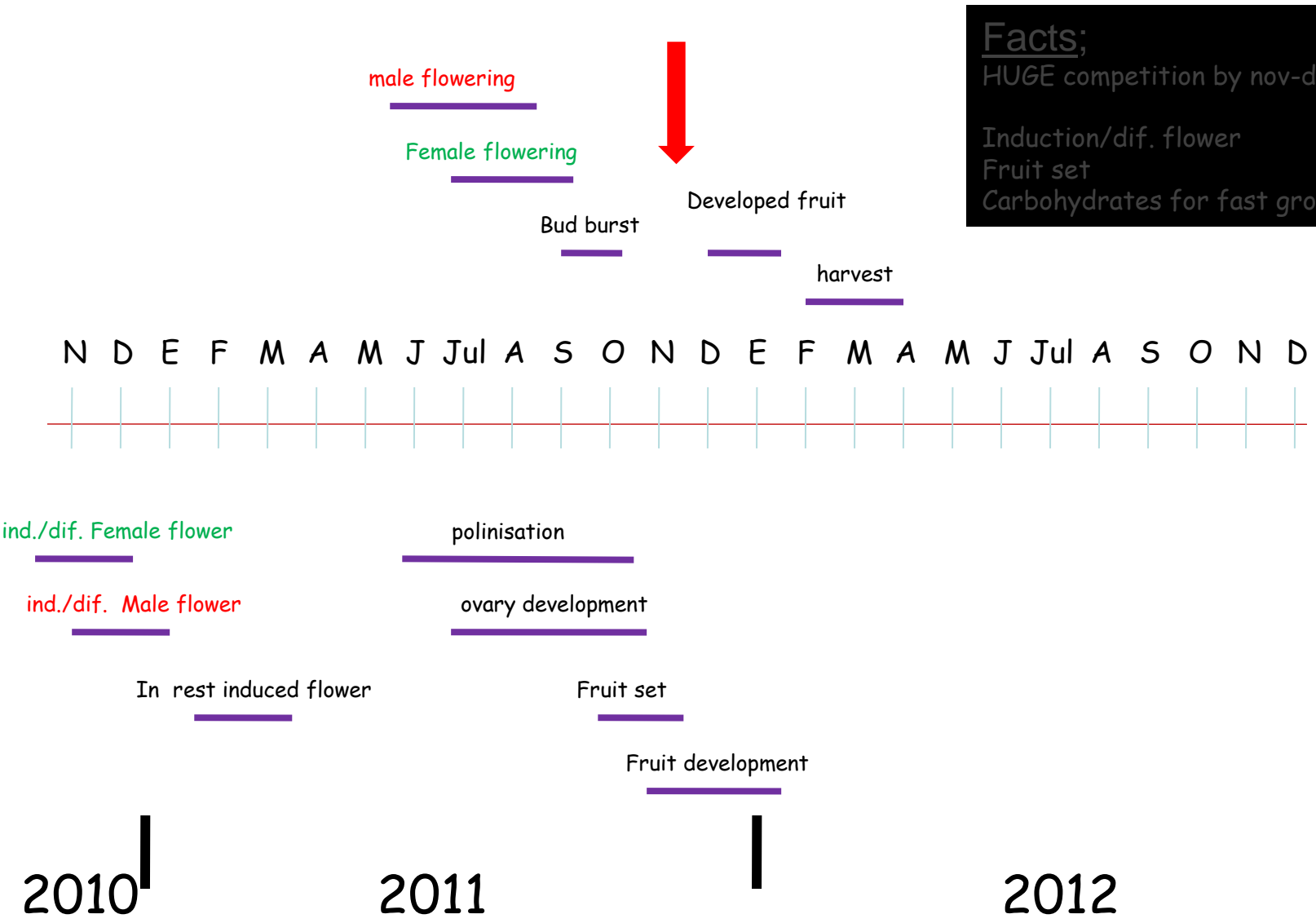
Recording your own flowering dates

- Select a convenient part of the orchard with all the varieties grown.
- Try to record on the same day each week.
- Record the date when about 5% of the flowers or catkins are open – ignore a few early or late flowers/catkins.

| Orchard Name: | | | | |
|---|--------|-------|--------|-----------|
| Year: | | | | |
| <p>Select an accessible part of the orchard. Try to visit the same trees once a week on the same day of the week. Look for flowers and catkins on vigorous growth on the outside of the tree.</p> | | | | |
| <p>Flowers: Flowering occurs when the red stigmas have emerged from the bud. They remain viable for up to 3 months, gradually darkening if they are not pollinated. Once they have been pollinated, they will shrivel and disappear. There are always a few flowers that are earlier or later than the main flowering period so we aim to record the start date when about 5% of the flower buds have emerged stigmas and record the finish date when most of the flower buds have black shrivelled stigmas.</p> | | | | |
| <p>Catkins (the male flowers): Pollen is released as the catkins extend. Catkins that are fully extended and brown have released their pollen. Ignore the few catkins that extend earlier or later than the rest.</p> | | | | |
| <p>Bud burst should be recorded when leaves can be seen emerging from the buds.</p> | | | | |
| <p>Dates can be recorded either as the calendar date (e.g. June 1st or 1/6) or as the Julian date, the number of days after January 1st. June 1st is Julian day 152; July 1st is 182; August 1st is 213; September 1st is 244.</p> | | | | |
| Cultivar | | Start | Finish | Bud Burst |
| Whiteheart | Male | | | |
| | Female | | | |
| Alexandra | Male | | | |
| | Female | | | |
| Merveille de B | Male | | | |
| | Female | | | |
| Keen's Late | Male | | | |
| | Female | | | |
| Barcelona | Male | | | |
| | Female | | | |
| Ennis | Male | | | |
| | Female | | | |
| Butler | Male | | | |
| | Female | | | |
| Lansing | Male | | | |
| | Female | | | |
| Campanica | Male | | | |
| | Female | | | |
| T. di Giffoni | Male | | | |
| | Female | | | |
| Tonda Romano | Male | | | |
| | Female | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | June | | | July | | | August | | | September | |
|--|------|--------|--|------|--------|--|--------|--------|--|-----------|--------|
| | Date | Julian | | Date | Julian | | Date | Julian | | Date | Julian |
| | 1 | 152 | | 1 | 182 | | 1 | 213 | | 1 | 244 |
| | 2 | 153 | | 2 | 183 | | 2 | 214 | | 2 | 245 |
| | 3 | 154 | | 3 | 184 | | 3 | 215 | | 3 | 246 |
| | 4 | 155 | | 4 | 185 | | 4 | 216 | | 4 | 247 |
| | 5 | 156 | | 5 | 186 | | 5 | 217 | | 5 | 248 |
| | 6 | 157 | | 6 | 187 | | 6 | 218 | | 6 | 249 |
| | 7 | 158 | | 7 | 188 | | 7 | 219 | | 7 | 250 |
| | 8 | 159 | | 8 | 189 | | 8 | 220 | | 8 | 251 |
| | 9 | 160 | | 9 | 190 | | 9 | 221 | | 9 | 252 |
| | 10 | 161 | | 10 | 191 | | 10 | 222 | | 10 | 253 |
| | 11 | 162 | | 11 | 192 | | 11 | 223 | | 11 | 254 |
| | 12 | 163 | | 12 | 193 | | 12 | 224 | | 12 | 255 |
| | 13 | 164 | | 13 | 194 | | 13 | 225 | | 13 | 256 |
| | 14 | 165 | | 14 | 195 | | 14 | 226 | | 14 | 257 |
| | 15 | 166 | | 15 | 196 | | 15 | 227 | | 15 | 258 |
| | 16 | 167 | | 16 | 197 | | 16 | 228 | | 16 | 259 |
| | 17 | 168 | | 17 | 198 | | 17 | 229 | | 17 | 260 |
| | 18 | 169 | | 18 | 199 | | 18 | 230 | | 18 | 261 |
| | 19 | 170 | | 19 | 200 | | 19 | 231 | | 19 | 262 |
| | 20 | 171 | | 20 | 201 | | 20 | 232 | | 20 | 263 |
| | 21 | 172 | | 21 | 202 | | 21 | 233 | | 21 | 264 |
| | 22 | 173 | | 22 | 203 | | 22 | 234 | | 22 | 265 |
| | 23 | 174 | | 23 | 204 | | 23 | 235 | | 23 | 266 |
| | 24 | 175 | | 24 | 205 | | 24 | 236 | | 24 | 267 |
| | 25 | 176 | | 25 | 206 | | 25 | 237 | | 25 | 268 |
| | 26 | 177 | | 26 | 207 | | 26 | 238 | | 26 | 269 |
| | 27 | 178 | | 27 | 208 | | 27 | 239 | | 27 | 270 |
| | 28 | 179 | | 28 | 209 | | 28 | 240 | | 28 | 271 |
| | 29 | 180 | | 29 | 210 | | 29 | 241 | | 29 | 272 |
| | 30 | 181 | | 30 | 211 | | 30 | 242 | | 30 | 273 |
| | | | | 31 | 212 | | 31 | 243 | | | |

Floral induction cycle until harvest time in hazelnut flower



Facts;
 HUGE competition by nov-dec;
 Induction/dif. flower
 Fruit set
 Carbohydrates for fast growing plant

Thank you

A large, shallow wooden bowl is filled with hazelnuts. On top of this bowl sits a smaller wooden bowl containing hazelnut shells. To the right, a silver, crinkled bag is partially open, showing hazelnuts inside. The background is a plain, light-colored surface.

Hazelnuts: Delicious, Nutritious and versatile