The Best Practice Guide for UK Plum Production
Pollination of Plums

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Introduction

Adequate pollination and fertilization are essential to the production of good crops of plums. Pollination is simply the transfer of pollen grains from the stamens to the stigmas of the flower, and is usually the work of bees or other pollinating insects. Fertilization is the subsequent union of male and female elements resulting in fruit setting and seed formation.

Either self- or cross-pollination may take place. Self-pollination in fruit varieties is the transfer of pollen to the stigmas of the same flower or of other flowers of the same variety. Cross- pollination is the transfer of pollen to flowers of another variety.

Before fertilization and fruit setting can take place the pollen grains germinate on the stigma and grow down the style into the ovary below. There, fertilization takes place by the union of the male element from a pollen grain with the female element inside an ovule. The fertilized ovule can then develop into a seed, while the surrounding parts are stimulated to form the fruit. Fruits that are fertilized are described as being 'set'. Whether or not a fruitlet has set can be determined by cutting it open and seeing whether there is a developing seed inside.

Fruit setting depends on the pollination behaviour of the different varieties, which for commercial purposes can be divided into:

(a) Those which will set and develop a full crop (15-30 percent) with their own pollen, termed *self-compatible*.
(b) Varieties which set a poor crop (2-5 per cent) with their own pollen, termed *partially self-compatible*
(c) *Fully non-self-compatible* varieties which entirely fail to set fruit with their own pollen.
(d) *Unclassified*, where there is insufficient knowledge about their degree of self-compatibility. For safety, these may be treated as fully non-self-compatible

Myrobalan or cherry plums are diploids and are self-compatible. Most other plums, damsons and bullaces grown in the UK are hexaploids and may be completely self-compatible, partly self-compatible or fully self-sterile. All except the fully self-compatible varieties require inter-planted pollinators to ensure crops. Cross-incompatibility also occurs, three groups being known.

Many of the commercially grown varieties of plums are self-compatible and will crop successfully when planted on their own. But a variety that does not set a good crop with its own pollen will need to be pollinated by pollen from another suitable variety. In practice, this is achieved by inter-planting in the orchard suitable varieties which flower at the same time as those which need cross-pollination.

Incompatibility

When selecting pollinators for varieties which occur in either compatibility Group A or B, the choice is preferably restricted to those varieties whose flowering group is the same as or adjacent to that of the variety to be cross-pollinated. A pollinator may be selected from any of the three compatibility groups.
There are a few plum varieties which fail to set fruit when pollinated by one another. Three cross-incompatibility groups are known:

I	**II**	**III**
Jefferson	President	Rivers' Early Prolific
Coe's Golden Drop	Late Orange	Blue Rock
Allgrove's Superb	Old Greengage	
Coe's Violet Gage	Cambridge Gage	
Crimson Drop		

In Group I:	All pollinations fail
In Group II:	Late Orange x President fails both ways
	Late Orange or President pollinated by Cambridge Gage or Old Greengage set a full crop
In Group III:	Rivers' Early Prolific pollinated by Blue Rock sets a full crop
	Blue Rock pollinated by Rivers' Early Prolific sets a very poor crop

Selection of a Pollinator

A suitable variety is usually one which is self-compatible, which will flower at about the same time as the variety to be pollinated and which is not incompatible with it. It should flower regularly each year and not be subject to biennial flowering and cropping. Varieties chosen as pollinators should be of commercial importance in their own right and suitable for the market requirements of the grower concerned.

Relative flowering periods

Cross-pollination can take place only when the varieties flower about the same time. To give an example of different flowering periods, the plum Early Laxton has finished flowering before the variety Marjorie's Seedling begins to blossom; cross-pollination between these varieties in the orchard is there- fore impossible. Again, the time of blossoming of individual varieties may differ slightly from year to year according to seasonal conditions.

In a protracted flowering season the time of onset of full bloom from the earliest variety to the latest is about 20 days. In Table 1 below, this has been divided into four day periods and the varieties divided accordingly into five progressive flowering groups (1 = the earliest flowering – 5 = the latest flowering). In a warm spring the total flowering period of all varieties is shortened and varieties in all these groups may overlap, bringing about very effective cross- pollination. In a cold spring, however, the whole flowering period is lengthened and much less overlapping will occur.

The arrangement in five groups (Table 1) allows for any variety in one group to be pollinated by any suitable pollinator either in the same group or in an adjoining group. This will ensure pollination even in a long drawn out flowering season and gives more than ample cover in a short flowering season.

Arrangement of pollinators

Generally it is best to plant pollinators in complete rows across the orchard. Where a main variety is to be grown with as few pollinators as possible, not more than three rows of the main variety should be planted to one row of pollinators; in very windy situations a 2:1 arrangement would give a better set of fruit.

Where a succession of varieties is required for picking over an extended period it is better to plant varieties in sequence of picking (or as nearly so as possible), at the same time arranging pollinator varieties next to those to be pollinated and no more than three rows together of a variety requiring cross pollination.

The orchard environment and its influence on pollen quality

Plums are generally early flowering, thus being liable to damage by frost, especially in low lying areas. Avoid frost damage to pollinators by good site selection and, where possible, use of frost protection measures. In the event of frosts after bud, check the pollen viability using simple pollen germination tests.

The management of the pollinating variety in the orchard

Prune and train pollinating varieties so as to stimulate renewal growth and adequate production of qua l ity flowers. Apply water and/or nutrients to pollinating varieties so as to sustain their growth and flowering.

Providing ideal conditions for pollen transfer

Pollen transfer is by insects and to a small extent by wind. Best practice is to achieve an orchard environment which encourages a wide range of natural insect pollen vectors especially bumble bees and solitary bees (e.g. Andrena sp.) by leaving (or creating) grassy sheltered banks for bumble bees and bare soil areas for solitary bees as well as alternative food sources. Adequate shelter should be created, to reduce wind speeds to encourage insect flight. However, windbreaks should be semi-permeable to avoid reducing wind speed excessively, creating stagnant air and no wind transfer of pollen and slow drying conditions increasing the risk of disease.

Introducing bees where needed

Where natural levels of insect activity are low, or where pollinator numbers are low and tree vigour is high, pollination can be supplemented by importing hives of honey bees or by encouraging the establishment of mason bees in the orchard. Honey bees will forage more successfully on clear days and when temperatures are above 12 °C. Best Practice - rent healthy well stocked (> 15000 bees) hives and shelter the hives from cool winds.

Introduce hive or bumble bees to orchards only when 20% of the flowers are open. Introduction earlier may lead to the bees seeking food supplies on other crops growing nearby. Once habituated to another crop it is often very difficult to attract the bees back into the apple orchard. Remove (by mowing or use of herbicides) weeds or other species that are flowering in the orchard at the same time as the apples. These may prove more attractive to the bees than the apple flowers. Avoid broad-spectrum insecticides during blossom.

Supplementing pollen supply in the orchard using floral bouquets

Where pollen supply in the orchard is inadequate, due to biennial flowering of the pollinators, growers should consider placing floral bouquets in the orchard during the flowering period to supplement pollination. Where inadequate pollination is a more consistent problem (i.e. in every year), growers should either

interplant the trees with additional pollinators or graft branches of these pollinating varieties into some of the existing trees of the main commercial variety.

Improve conditions for Pollen Germination and pollen tube growth

The fertilization process begins with the pollen falling on the stigma and germinating. Germination requires adequate moisture but not excessive as the pollen grains need to take in water in order to germinate, drying winds will reduce viability. Pollen grains lose viability rapidly once wetted so rain will significantly reduce pollination. Germination is temperature dependent with optimum temperatures being between 15°C and 25°C.

Some laboratory tests have indicated that certain sprays can reduce pollen germination. The relationship between these tests and the effect in the orchard is not known at today's spray volumes. Captan and sulphur are known to cause some reduction in apple pollen germination and may have similar effects on plum pollen.

Laboratory tests have shown that Boron and Calcium can aid apple pollen germination but field experiments on apple have given very variable results and effects on plum have not been investigated.

Disclaimer

The information contained within this Best Practice Guide is correct to the best of the authors' knowledge at the time of compilation but it must be understood that the biological material/systems and the regulatory framework referred to within these guides are subject to change over time. Anyone looking to make use of the information should check it against prevailing local conditions.

All pesticide recommendations and approvals are subject to change over time and the user of this Guide is reminded that it is his/her responsibility to ensure that any chemical intended for use by them is approved for use at the time of the intended application. The user is reminded that they must carefully read and follow the label on each chemical before applying any treatments.

Table 1. Fertility Groups and Flowering Periods of Plums. Preferred varieties for UK production are given in bold.

Fertility grouping	Flowering period				
	Earliest (group 1)	**Early (group 2)**	**Mid (group 3)**	**Late (group 4)**	**Latest (group 5)**
Self-compatible varieties which will set and develop a full crop (15-30 percent) with their own pollen.	Golden Transparent Goliath Monarch	**Haroma** **Herman** **Juna** **Katinka** **Top End** **Top Taste** Brahy's Greengage Denniston's Superb Guthrie's Late Langley Bullace Ontario Prosperity Reine-Claude de Bavay Warwickshire Drooper	**P7-38** **Victoria** Aylesbury Prune Bastard Victoria Bountiful Czar Early Transparent Gage Laxton’s Cropper Laxton’s Supreme Merryweather Damson Pershore Purple Pershore Severn Cross Stanley	Blaisdon Red Bradley’s King Damson Early Transparent Giant Prune Oullins Golden Gage Shepherd’s Bullace Ontario	Belle de Louvain Belle de Septembre Gisborne's Kentish Bush Laxton's Blue Tit Marjorie's Seedling Shropshire Damson White Bullace
Partially self-compatible varieties which set a poor crop (2-5 per cent) with their own pollen	Blue Rock Utility	**Avalon** **Haganta** **Top Hit** Angelina Burdett Curlew	**Jubilee (Jubileum)** **Lancelot** **Meritaire** **Opal** **P6-19** **Seneca** Early Favourite Early Laxton River’s Early Prolific Goldfinch	**Top Five** Belgium Purple Cambridge Gage Cox’s Emperor Early Orleans Stint Farleigh P Damson	

			Reine-Claude Violette		
Fully non-self-compatible varieties which entirely fail to set fruit with their own pollen.	Allgrove's Superb Black Prince Grand Duke Jefferson Mallard	**Coe's Golden Drop** Admiral Black Diamond Coe's Violet Heron Late Orleans President Edwards Valor Excalibur	**Reeves** Bryanston Gage Golden Esperen M.S. Kirke's Blue Late Orange Sanctus Hubertus Washington	**Delicious (Laxton's Delicious)** Count Althann's Gage Peach Greengage Wyedale	Fellenberg Frogmore Damson Late Transparent Old Greengage Ponds Seedling Red Magnum Bonum
Unclassified	Olympia	Mitchelson's	Archduke Avon Cross Laxton's Abundance Swan Edda	Liegel's Apricot Teme Cross Thames Cross Wye Cross	Pacific

M.S. = Male sterile (ineffective as a pollinator)