

The Best Practice Guide for UK Plum Production

Soil Health Management and Irrigation

Dr Emma Tilston, NIAB EMR

Soil management for plums

Orchard management regimes aim to maximise fruit production by minimising the growth of unproductive wood. Whilst potential scion growth is controlled by the rootstock, soil management practices can either enhance or hinder tree growth and the yields realised. Operations, practices and treatments directed at soil for the purposes of maintaining soil fertility, improving soil health, protecting water quality, reducing soil erosion and the economic production of high quality fruit with good storage behaviour, are a fundamental, yet often overlooked aspect of orchard management.

Tree root systems

Contrary to popular belief, the root systems of trees are typically shallow, comprising predominantly horizontal roots and only a few vertical 'sinker' roots. The large 'scaffold' roots radiating out from the trunk provide anchorage, and their lateral branches give rise to fibrous feeder roots for the absorption of water and nutrients. While rootstock genetics and scion interactions control root system size and the relative abundance of feeder roots, the spatial arrangement of roots is dependent on soil conditions and planting density. Root development is greatest in areas of aerated, well-structured soil with good water retention properties and nutrient availability. Thus, practices such as fertiliser applications, irrigation and ground cover exert considerable influence on the volume of soil occupied by roots, uptake of water and minerals by the trees and the mineral composition of the fruit produced. High-density plantings restrict root development resulting in increased root density, but the roots produced are thinner, shorter and occupy a smaller volume than the root systems developed by trees in low-density plantings.

Site selection and pre-planting soil management

Regarding site selection, the soil requirements of plums are similar to those for culinary apples. While deep, well-drained soils are preferred; plums are able to grown on soils with a range of textures and are considerably more tolerant of poor drainage than cherries. The longevity of orchard plantings means that opportunities to correct physical problems with soil are essentially limited to the year before new trees are planted. High trafficking is an unavoidable aspect of fruit growing and results in considerable compaction of soil in the alleys. Compacted soils rapidly become anaerobic when wet and root growth in these soils is further limited because roots are physically unable to penetrate a compacted soil matrix. In situations where the rows of new trees will coincide with wheeling induced compaction in the former alleys, then compaction down to 40 cm depth should be addressed before planting, as should other areas with hard layers (e.g. plough pans and former gateways). Irrespective of the method of soil loosening, the aim should be to reduce soil bulk density to less than 1.5 g cm⁻³, without redistributing subsoil to the surface, especially if it is clay-rich.

Soil loosening operations are an ideal opportunity to incorporate liming materials and/or phosphorus; so irrespective of previous cropping, soil samples should be taken and soil pH, calcium and phosphorus contents determined. If the soil pH is 5.7 or less, then lime should be applied to increase the pH to between 5.8 and 6.5. Below pH 5.8 various physico-chemical interactions occur, which depending on the element, either increase or reduce availability resulting in stunted root growth. Lime and gypsum should be spread as required, before ripping the soil in both directions to a depth of 30 – 40 cm. This should be followed by light tillage with either a cultivator or disc harrow, when the soil is moist but not dry. If required, phosphorus should be band spread (< 2m wide) to the future rows prior to this. To reduce slumping and slaking of the surface soil by winter rainfall, either a cover crop of ryegrass should be sown in early autumn, or volunteer weeds should be allowed to grow. Ground cover should be sprayed off in spring, before the new trees are planted.

Post-planting soil management

Weeds compete with plum trees for light, nutrients, and water and can severely check the growth of newly planted trees. Weed control, by mechanical or chemical means, should be practiced in the rows to promote tree establishment. Where mechanical methods are used, they should be shallow to minimise damage to the feeder roots in the upper soil layers. The control of weeds in neighbouring areas including other plots, margins and alleys; and the adoption of good biosecurity practices such as cleaning to remove weed seeds from mowing implements will reduce the rate of weed ingress into a newly planted orchard.

Bare soil is vulnerable to erosion and is predisposed to losses of magnesium and potassium via leaching and low water retention, so the grassing down of alleys with a proprietary mix of low and slow-growing grasses that produce a dense, hard wearing sward has multiple benefits. The inclusion of small-leaved, or dwarf forage varieties of white clover also provide good ground cover, without the production of biomass and have the additional benefit of providing modest amounts of nitrogen to companion grasses and the trees. Biodiverse mixes of grasses and broad-leaved plants commonly found in grassy places on rich soil such as black medick, lucerne, red clover, musk-mallow, yarrow, oxeye daisy and red campion have the additional benefit of increasing the diversity of pollinators and predatory insects above-ground, and earthworms and general soil health below-ground, especially if the frequency of mowing is reduced and the mowing height is increased. Delaying mowing until mid-July, or later, will enhance the persistence of biodiverse alley plantings mixtures without impeding harvest. If available, side-discharge mowing equipment has the advantage of simultaneously mowing the alleys and mulching the rows, resulting in increased phosphorus and potassium availability, as well as protecting the soil from water droplet impact erosion. The availability of magnesium may well be reduced, but can be overcome by the use of foliar sprays. Feeder root growth is also increased in mulched soil because mulches retain soil moisture and reduce soil temperatures. Root growth slows above 25°C and ceases at 35°C, so in summer a reduction of 2 – 4°C can make all the difference to root growth and function.

Maximising fruit yields of young trees

Management of high-density plantings is particularly challenging while the trees are young, but with increased age, root growth will slow and the need to control tree vigour will decline as cropping rates reach their maximum. Competition between roots of neighbouring trees is intensified in high-density plantings and suppresses growth below- and above-ground. Controlling shoot growth is further complicated by competition for sunlight and internal shading which can cause shoot extension and reductions in trunk girth. In addition to applications of plant growth regulators e.g. Regalis, or summer pruning, restricting the volume of soil occupied by roots is an effective means of decreasing the vegetative vigour of young trees. The imposition of long-term root restriction simultaneously induces

precocity, which in itself will curb the growth of young fruit trees, and increases yield efficiency of fruiting. Methods for restricting roots include the insertion of barriers into the soil and controlling the spread and penetration of irrigation water, especially on free-draining soils. Root growth activity is seasonal and is strongest in the early spring, slowing with the onset of active shoot growth. During the summer little root growth occurs until after harvest or the cessation of shoot growth. The autumn flush of root growth is not as strong as that occurring in early spring and is curtailed by leaf-fall. Thus, greatest control of shoot growth by single actions such as root pruning can be achieved by targeting the spring phase of root growth. Root pruning is a temporary means of decreasing the above-ground vigour of fruit trees, but owing to compensatory root growth later in the season, or in subsequent years, its effects can be unpredictable.

Irrigation

The application of irrigation serves to provide a consistent and uniform distribution of water, with minimal wastage. Well-designed and managed irrigation systems, especially if used for the delivery of fertiliser, result in a high level of crop production efficiency. The choice of irrigation system and its management is one of the most influential options for manipulating above- and below-ground tree growth, and hence fruit development. Drip irrigation, whereby small amounts of water are delivered to the soil from point sources, not only enables the amount of water supplied, but the growth and distribution of tree roots to be controlled. Root density is typically increased in the surface layers of soil within a 600 mm radius below drippers, so in high-density plantings, tree size can be constrained by encouraging neighbouring trees to compete for water. However, because the roots will be confined to a relatively small volume of predominantly surface soil it is important that optimal soil conditions for root development and the retention of water and nutrients. Mulching with alley-way mowings and regular applications of lime will help to maintain good soil structure for root penetration, aeration and water permeability.

Deficit irrigation

Over-watering causes loss of nitrogen through leaching and promotes the development of anaerobic conditions, which result in impaired tree performance through reduced root activity (including water uptake) and even root death. Transient limitation of water availability during key development phases, or regulated deficit irrigation (RDI) on the other hand, can be an effective method for reducing excessive vigour in trees with fully developed canopies thereby mitigating shading problems. For trees with medium or long fruit development periods RDI is practiced for water-limited soils by decreasing the amount, but not the frequency, of water supplied during early season shoot growth. Optimum irrigation is reinstated with the onset of fruit development. Restricting shoot growth reduces the need for summer pruning and via physiological compensation, there is the added advantage of increased fruit size and yield. Successful implementation of RDI requires knowledge of the available water content of the soil and careful monitoring of soil moisture contents, so that soil moisture contents can be maintained at the point at which readily available water is depleted without inducing wilting.

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

THE BEST PRACTICE GUIDE FOR UK PLUM PRODUCTION – SOIL HEALTH MANAGEMENT AND IRRIGATION

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.