Sydney Environmental & Soil Laboratory

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Feeding Native Plants

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Feeding Native Plants.

Question: There is a lot of differing advice on feeding of Australian Native plants, particularly with regard to phosphorus. Can you explain in simple terms what your recommendations might be?

When people observe poor or negative responses of natives to fertiliser it is often due to either simple excessive use or to the phenomenon of phosphorus toxicity. Phosphorus toxicity, in certain native species is really confined to the Proteaceae, Rutaceae, some Fabaceae and many Mimosaceae. Most of these plants have become adapted to growing in very low P soils and have developed mechanisms to extract otherwise unavailable P. when presented with abundant P they cannot prevent excessive uptake and an interaction with trace elements occurs, upsetting their metabolism.

Symptoms of this toxicity usually begin with an apparent iron deficiency (interveinal chlorosis of youngest leaves), or P induced iron deficiency. If P is present in high enough amounts true P toxicity symptoms of red colours starting in oldest leaves, drop of oldest leaves, tip necrosis in the worst cases, and a susceptibility to root rot fungi such as phytophthora, begin to set in ultimately resulting in death. The condition is common in pot culture and artificial soils and is often a compounding factor in transplant and environmental shock. Goodwin (1981) showed that plants not exhibiting symptoms could be made to produce symptoms under temperature or moisture stress.

Research has firmly established that this toxicity effect is influenced by other nutrients, particularly iron. Goodwin (1981), and Handreck (1991a and 1991b), showed that sensitivity to high P levels can be reduced by improving iron supply. Our own experience is that P toxicity has occurred in old orchard soil improved over many years by superphosphate and fowl manure additions and in landscape soils ammended with sewage sludge containing high P levels and that in both cases considerable control can be exerted over this toxicity by improving iron supply. Particularly, symptoms can be reduced and prevented by supplementing iron as iron sulphate or chelated iron.

There is abundant nursery evidence that even thrifty species such as Acacia or Banksia will respone well to N, K, and S in high amounts in a fertiliser program but if P becomes too available they rapidly die. When people observe this they often falsely conclude that the plants don't like fertiliser and proceed not to feed them to the great detriment of growth rates.

Soils will respond differently to P fertiliser. Some soils with high P fixation ability, usually red clay type soils can lock up almost any amount of P you give them without P sensitive plants suffering. Others, usually of a more sandy nature with limited P fixation ability, cause P toxicity problems with exactly the same amount of P added simply because more of it is available. We use the phenomenon of P fixation to prevent pollution of waterways in effluent irrigation schemes.

Addition of high levels of phosphate to a soil results in an insoluble phosphate being formed-

$$Fe^{3+} + PO_4^{3-} \text{ ---------------} > FePO_{4(s)}$$

This is the same reaction resulting from rust converter being painted on rusty metal, phosphoric acid being the active ingredient. It is known from crop plants that high P levels can induce Cu, Zn, and Fe deficiencies. This is called a nutrient interaction.

Inside the plant the same reaction of phosphate with iron can occur resulting in a depletion of iron reserves in the plant as iron phosphate is laid down mostly in the stem tissue and at the margins of leaves. With meagre iron supply already, the uptake of excessive phosphate levels can result in an acute deficiency of iron. Where the plants in question are "iron inefficient", that is they are adapted to abundant iron supply (see Handreck 1991a), the problem is often worse and proteaceae are the most susceptible groups of plant being both P sensitive and iron inefficient. Others such as Azalea and Camellia are just "iron inefficient" and excessive P levels, while not actually causing P toxicity, show a rapid onset of P induced iron deficiency chlorosis if fed excessive P.

This knowledge is best illustrated by showing the work of Handreck (1991b) who produced a table illustrating Fe requirements given a range of P levels, in potting media. Table 1. is not an exhaustive list of P sensitive plants but it illustrates the range of genera to watch for.

Table 1

Maximum concentrations of P tolerated by species growing in a soil-less potting medium at two levels of extractable Fe. After: Handreck (1991a)

Fe (ppm)in the mix		**Species**
34	19	
3	<3	*Acacia merrallii, Grevillea leucopteris, Hakea bucculenta, H. francisiana, H. petiolaris*
5	<3	*A. imbricata, Banksia benthamiana, B. brownii, B. lemanniana, B. leptophylla, B. sphaerocarpa, G. banksii, H. salicifolia*
5	3	*A baileyana, A. decurrens, A. spectablis, H. sericea*
8	7	*A. dealbata, A. glaucoptera, A. ligulata, A. lineata, A. montana, A. myrtifolia, A. retinoides, H. laurina*
11	3	*B. tricuspis, H. rostrata*
11	10	*A. argyrophylla, A. baileyana purpurea, A. burkittii, A. calamifolia, A. florabunda, A. iteaphylla, A. menzelii, A. microcarpa, A. papyrocarpa, A. paradoxa, A. rigens,* A. rivalis, A. rotundifolia, A. sclerophylla, B. aculeata, B. laricina, B. speciosa, G. intricata, G. robusta, H. suberea
>20	14	*A. cyclops, A. fimbriata, A. hakeoides, A. longifolia sophorae, A. melanoxylon, A. nyssophylla, A. pendula, A. ramulosa, H. muelleriana*
>20	>25	*A. longifolia, A. saligna, A. truncata, A. victoriae, H. leucoptera*

Note that the Table can be read as going from most to least sensitive as you read down the table. In our experience Banksia ericifolia, B. spinulosa, and B. marginata should be included as moderately to highly sensitive, and B serrata as least sensitive. Nearly all the Grevilleas are highly sensitive.

Fertilising Native Plants

Almost all natives will respond to fertiliser and responses are most profound in instances of very poor soil lacking in N, P, K and a range of possible other combinations, and in cases of N drawdown due to the use of woody mulches. As a general rule fertilisers can and often should be used to speed the growth of potted and soil grown P sensitive plants as well. It is also true that the great majority of native plants are not sensitive to high P levels and will respond well to added phosphorus. However, since the lists of known sensitive plants are incomplete and many landscapes plantings contains mixtures of plants some of which are going to be P sensitive, caution should be exercised in using fertilisers and the following could be taken as a guide to such use.

Through experience we have found the following soil improvers and fertilisers to be particularly dangerous and recommended that they be entirely avoided for the growing of native gardens where a proportion of the plants are P sensitive.

To be avoided-
- Mushroom compost
- Composted or raw sewage sludges
- Poultry manure or litter bulk or pelletised
- Cow, Horse, or Sheep manure.
- Compost containing rich wastes such as food wastes.
- Worm Castings

The best advice we can give on feeding is that fertilisers low in water soluble P and low in total P are to be preferred. Fertilisers supplying insoluble P in the form of bone are routinely used by Protea growers with few ill effects but the same P amount applied as soluble phosphate would almost certainly kill them rapidly. Various native plant fertilisers are available and P levels are usually less than 2%, preferably as blood and bone. P should not be supplied as water or citrate soluble P in these formulations. A suitable home made mixture might be-

Sulphate of ammonium	1 part
Blood and Bone	1 part
Sulphate of potash	1 part
Sulphate of iron	1 part

For improving poor soils the choice of organic matters is often difficult. The only products low enough in P are usually composted sawdusts, barks and some pure green waste products.

Suitable slow release fertilisers are low P Osmocotes, or no P Nutricote for the most sensitive plants. Nutricote generally is considered reasonably safe since it contains a rather insoluble P source. A recent nutricote product which appears to give good results across a wide range of sensitivities is Nutricote Total (Handreck 1996).

Where soils are alkaline or naturally low in iron (such as sands) the addition of sulphate of iron at 100g/sqm is advised to improve iron supply.

References

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