# BASTA® - A NEW HERBICIDE FOR HORTICULTURE

G.R. Perkins
Hoechst Australia Limited, P.B. 1, Collingwood, Victoria, 3066

*Summary.* Basta® (proposed common name glufosinate-ammonium) is a new non-selective, post-emergence herbicide, active against a wide spectrum of weeds. It has no soil activity and is partially systemic. Rates of 0.6-1.0 kg a.i./ha give excellent control of many annual weeds and suppression of perennial weeds. Glufosinate-ammonium will be a useful horticultural herbicide, based on its particular weed control characteristics, and its relative safety to crop plants when applied for weed control in orchards, vineyards and banana plantations.

## INTRODUCTION

Basta® is a new herbicide to the Australian market. Its active ingredient is ammonium-DL-homoalanin-4-yl (methyl) phosphinate with the proposed common name glufosinate-ammonium. Basta® is formulated as a 200g/L aqueous solution.

Glufosinate-ammonium was synthesized in the laboratories of Hoechst AG and first tested under greenhouse conditions in 1976. The free acid of glufosinate-ammonium, discovered earlier, is a metabolite of a toxin produced by a non-pathogenic soil bacteria *Streptomyces viridochromogenes*. This herbicidally active metabolite is known as phosphinothricin (2, 7).

In Australia, initial investigation of glufosinate-ammonium (then Hoe 39866) activity focussed on its potential as a herbicide for use in minimum tillage and chemical fallow situations (1). However it is now recognised that its major applications are in horticulture.

This paper examines the important characteristics of glufosinate-ammonium, and briefly explores those situations where it will be of particular value.

## CHARACTERISTICS

Product description. Glufosinate-ammonium is a non-selective, post-emergence herbicide, active against a wide spectrum of annual and perennial broad-leaved and grass weeds.

It is non-residual, having no activity via the soil.

Glufosinate-ammonium is partially systemic, however translocation is quite limited in extent and tends to vary in degree according to plant species (8) (Götz et al 1983 unpublished). The limited nature of this systemic action has several practical implications, viz:

(i) thorough spray coverage is necessary.
(ii) perennial weeds are generally only suppressed.
(iii) directed sprays around the base of perennial crop plants are well tolerated by the crop.

Toxicology. The following toxicity data indicates that glufosinate-ammonium is of favourable toxicity: (5)

Acute oral toxicity

| | | |
|---|---|---|
| $LD_{50}$ | Rat ♂ | 2000 mg/kg body weight |
| | Rat ♀ | 1620 mg/kg |

Acute dermal toxicity

| | | |
|---|---|---|
| $LD_{50}$ | Rat ♂ | > 4000 mg/kg |
| | Rat ♀ | approx. 4000 mg/kg |

Inhalation toxicity

| | | |
|---|---|---|
| $LD_{50}$ | Rat ♂♀ | >4170 mg/$m^3$ air (for 200 g/L product) |

Skin and eye irritation

No primary irritation of skin and eye mucosa was observed in rabbits.

Environmental Aspects. Glufosinate-ammonium has been found to be rapidly degraded in micro-biologically active environments such as the soil and surface water (5).

Mode of Action. Under normal conditions ammonia, produced as a result of the various metabolic processes of the plant, is bound to glutamic acid to form glutamine. Glufosinate-ammonium inhibits the enzyme glutamine synthetase which catalyses this reaction. Consequently, ammonia accumulates in plant cells to toxic levels. Simultaneously photosynthesis is severely inhibited (8).

Since it is mainly during reactions linked to photosynthesis that ammonia is produced, its accumulation is higher in glufosinate-ammonium treated plants exposed to light rather than those kept in darkness or shade. Phytotoxic symptoms develop faster under a regime of light (7).

Glufosinate-ammonium treated plants generally exhibit symptoms of phytotoxicity within 2 to 5 days of treatment. Susceptible plants will die within 1 to 2 weeks. This speed of action is intermediate between that of glyphosate and paraquat/diquat.

Conditions required for optimum performance. Glufosinate-ammonium performs best when environmental conditions favour active plant growth. Low temperatures (under 10°C) can have a considerable negative influence on activity, as can extremes of soil moisture status (4).

Perennial weeds appear to be most sensitive when treated at a time of maximum translocation of photosynthetic products to storage organs, i.e. from the beginning of flowering to full flowering (5). Annual weeds generally require an increasing rate of glufosinate-ammonium as they become larger and approach flowering (11).

Rainfall within 6 hours of treatment has been found to reduce the activity of glufosinate-ammonium (4, 12).

Efficacy. Applied generally at rates of 0.6-1.0 kg a.i./ha (3-5 L/ha of formulated product), glufosinate-ammonium gives excellent control of a large number of annual weeds (3, 6, 9, 10, 11) (Hoechst Australia Limited trials, unpublished). Established perennial weeds are suppressed. For many such weeds, particularly perennial dicots, glufosinate-ammonium often gives considerably longer suppression than paraquat or mixtures of paraquat and diquat (3, 9, 10) (Hoechst Australia Limited trials, unpublished).

A sample of results achieved with glufosinate-ammonium in a range of horticultural situations is presented in tables 1 and 2. This data is taken from trials conducted or commissioned by Hoechst Australia Limited.

Table 1. Activity (0 = no weed control, 10 = 100% control) of glufosinate-ammonium and a standard herbicide on annual weeds, capeweed, *Arctotheca calendula (AROCA)*, wire weed, *Polygonum aviculare (POLAV)*, common sow thistle, *Sonchus oleraceus (SONOL)*, green pigeon grass, *Setaria viridis (SETVI)* and square weed, *Spermacoce latifolia (SPELA)*.

| Trial reference | VH12/85 | VH15/85 | VN27/86 | VH1/86 | NQAR & D85/14 |
|---|---|---|---|---|---|
| Weed | AROCA | POLAV | SONOL | SETVI | SPELA |
| Crop | Cherry | Apricot | Grapevine | Cherry | Banana |
| Assessment-D.A.A.[a] | 32 | 49 | 47 | 36 | 32 |
| Treatment (kg a.i./ha) | | | | | |
| Glufosinate-ammonium 0.8 | 9.4 | 7.0 | 8.0 | 10 | 10 |
| Paraquat 0.56 | - | - | - | - | 4 |
| Paraquat 0.55 & diquat 0.25 | 3.3 | 6.6[b] | - | 6.4 | - |
| Paraquat 0.5 & diquat 0.3 | - | - | 3.5 | - | - |

a Days after application
b Treatment applied twice

Table 2 Activity (0 = no weed control, 10 = 100% control) of glufosinate-ammonium and a standard herbicide on perennial weeds, white clover, *Trifolium repens (TRFRE)* ribwort, *Plantago lanceolata (PLALA)*, para grass, *Brachiaria mutica (BRAMU)* and giant sensitive plant, *Mimosa invisa (MIMIN)*.

| Trial Reference | VH21/84 | VH2/86 | NQAR & D 85/14 | NQAR & D 85/1 |
|---|---|---|---|---|
| Weed | TRFRE | PLALA[b] | BRAMU | MIMIN |
| Crop | Strawberry | nectarine | banana | non-crop |
| Assessment - D.A.A[a] | 60 | 36 | 20 | 56 |
| Treatment (kg a.i/ha) | | | | |
| Glufosinate-ammonium 0.8 | 9.0 | 8.5 | 7.0 | 10.0 |
| Paraquat 0.28 | - | - | - | 1.0 |
| Paraquat 0.56 | - | - | 1.0 | - |
| Paraquat 0.55 & diquat 0.25 | 2.5 | 4.3 | - | - |

a Days after application
b Seedling stage

Crop safety. When applied to target weeds around crop plants in orchards, vineyards and plantations, glufosinate-ammonium is well tolerated by the crop. Suckers, leaves and small shoots located toward the base of the plant, which are directly contacted by the herbicide will be damaged or killed, but with no consequent adverse effect on the crop (5, 10). Glufosinate-ammonium can be used in this manner even around young fruit trees and vines, provided no immature bark is contacted (10) (Hoechst Australia Limited trials 1989, unpublished).

Work in annual crops has shown that where glufosinate-ammonium is used for weed control, a wide variety of plants can be safely sown or transplanted within 0 to 7 days of treatment (11) (Hoechst Australia Limited trials 1984, unpublished)

In addition, trials simulating drift of chemical onto vegetable crops found that glufosinate-ammonium caused considerably less damage than a mixture of paraquat and diquat (11).

## POTENTIAL USE SITUATIONS

Glyphosate, paraquat and paraquat/diquat mixtures are the dominant components of knockdown herbicides used in horticulture. The features of glufosinate-ammonium indicate that it may be a useful addition to the range of available herbicides, for a number of distinct uses. In the situations where it will be initially recommended, ie. pome and stone fruit orchards, vineyards and banana plantations, glufosinate-ammonium will be well suited to the following applications;

(i) control of otherwise difficult to kill weeds, particularly clovers and other legumes.
(ii) general weed control in situations where glyphosate is considered a hazard to the associated crop eg. where suckers or low shoots are present, where the crop canopy or branches are hanging low, where the crop is young, and around stone fruit trees where bark is likely to be contacted.
(iii) as an alternative to paraquat based herbicides where superior control of many annual weeds is required.
(iv) as an alternative to paraquat based herbicides where superior suppression of many perennial weeds is required.

Other situations with potential for glufosinate-ammonium use which are being explored include:

(i) weed control in other tree crops such as citrus, nuts, tropical fruit and coffee.
(ii) primocane (sucker) control in raspberries and other brambleberries. Glufosinate-ammonium appears to be particularly effective and safe to the crop for this application (G. McGregor, pers. comm., 1990.)
(iii) weed control between strawberry rows.
(iv) pre-harvest weed control in potatoes, especially where clover is a problem.

## REFERENCES

1. Anderson, I.P. and Henderson, R.N. 1984. Proc. 7th Aust. Weeds Conference, 137-139.
2. Duke, S.O. and Lydon, J. 1987. Weed Technology 1, 122-128.
3. Göetz, W., Amirav, A., Beltran, J.L. and Bonfig-Picard, G. 1984. Proc. EWRS 3rd Symp. on Weed Problems in the Mediterranean Area, 497-503.
4. Hoechst 1983. Hoe 39866, Glufosinate-ammonium Product Information Bulletin, March 1983, 41pp.
5. Hoechst 1985. Basta, the new non-selective herbicide Product Information Bulletin, 27pp.
6. Kassebeer, H., Unglaub, H. and Langelüddeke, P. 1983. Proc 9th Asian-Pacific Weed Sci. Soc. Conf., Manila, 502-509.
7. Köcher, H. 1983. Aspects of Applied Biology 4, 227-234.
8. Köcher, H. and Lotzsche, K. 1985. Proc. 10th Asian-Pacific Weed Sci. Soc. Conf. 193-198.
9. Langelüddeke, P. Reuss, H.U., Ceconi, C., Manning, T.H., and Röttele, M. 1982. Med. Fac. Landbouww. Rijksuniv. Gent, 47/1 95-104.
10. Langelüddeke, P., Bübl, W., Huff, H.P., Kötter, U. and Wallmüller, F. 1985. Brit. Crop Prot. Conf. - Weeds, 1047-1052.
11. Langelüddeke, P., Takagaki, T. and Arceo, M.B. 1987. Proc. 11th Asian-Pacific Weed Sci. Soc. Conf., 63-71.
12. Rahman, A. 1985. Proc. 10th Asian-Pacific Weed Sci. Soc. Conf. 150-155.