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ASSURE – A NEW SELECTIVE HERBICIDE FOR THE CONTROL OF ANNUAL AND PERENNIAL GRASS WEEDS IN BROADLEAVED CROPS

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ABSTRACT

Assure [2-[4-[(6-chloro-2-quinoxalinyl)oxy]-phenoxy]- propionic acid, ethyl ester], (formerly DPX-Y6202) is a new post-emergence herbicide for the selective control of annual and perennial grasses in broadleaved crops. It was evaluated in a wide range of broadleaved field crops, including vegetables, on different soil types and seasons in Trinidad and showed excellent activity against grass weeds including *Brachiaria* spp., *Cynodon dactylon, Digitaria* spp., *Eleusine indica,* and *Paspalum* spp. None of the herbicide treatments caused any apparent damage to crops or significant taints in crop products. Annual and perennial grasses were controlled by rates between 0.05 to 0.1 kg a.i ha^{-1}.

RESUMEN

Un nuevo herbicída de post-brote-Assure- [2-[4-[(6-cloro-2-quinoxalinyl) oxy]-phenoxy]-acido propiónico, ester etilíco], (anteriormente, DPX-Y6202), sirve para el control selectivo de hierbas anuales y perennes, en cultivos de hojas anchas incluyendo, verduras y en una variedad de suelos y estaciones, a la vez mostrando tener una potencia excelente contra las hierbas de pasto, incluyendo entre ellas la *Brachiaria* spp., *Cynodon dactylon, Digitaria* spp., *Eleusine indica* y *Paspalum* spp. Ninguno de los tratamientos con herbicídas, causó daños apparentes a los cultivos o descoloraciones en los productos de cultivo. Los pastos anuales y perennes fueron controlados por tazas entre los 0.05 a 0.1kg a.i. ha^{-1}.

Keywords: Selective herbicide, Grass weeds, Broadleaved crops.

One of the major constraints limiting the production of field crops in Trinidad and Tobago is the control of weeds. Farmers still rely on manual methods which are tedious, expensive, and frequently ineffective. Weed growth can be rapid and severe, especially in the wet season (June to December), with grass weeds frequently the most common species (Brathwaite, 1978a, b; 1979a, b; 1981; 1982; 1985). Although safe and economic pre-plant and pre-emergence herbicide treatments which can contribute to adequate weed control have been identified (e.g. Brathwaite, 1979a, b; 1981) their adoption by farmers has been slow and limited. Farmers still prefer to wait until weeds are in evidence before applying a herbicide treatment. The recently developed selective post-emergence herbicides for control of grass weeds in broadleaved crops (see for example Plowman *et al,* 1980; Slater and Hirst,1980; Schumacher *et al.*, 1982) offer considerable potential for safe and effective weed control in broadleaved crops. Results of a study with fluazifop-butyl in Trinidad were reported by Brathwaite and Martin (1982). This paper summarizes data from trials carried out since 1983 with DPX-Y6202 (Annexes 1, 2 and 3) for the control of grass weeds and volunteer corn in selected broadleaved crops in Trinidad.

Materials and Methods

All experiments were field trials carried out on loam soils at different locations in Trinidad. Sixty per cent of the trials were on River Estate loam (fluventic eutropept); the pH (water) of the surface 15cm of this soil ranged from 5.2 to 6.5, organic matter from 1.0 to 2.3 per cent, cation exchange capacity from 7.2 to 10.8 meq. 100 g^{-1} and the clay content from 20 to 21 percent. Experimental sites were normally disc ploughed and rotavated before sowing or transplanting the crops. Plot size varied with crop and the minimum plot size used in the study was 1.5m x 0.9m in cabbage. The experimental design was a randomized block with at least four replications. The cultivars of the different crops tested are shown in Table 1. Crops were rainfed or received sprinkler irrigation. All cultural practices except grass weed control followed the normal local recommendations.

All treatments were applied over-the-top when weeds were growing actively with seedlings of annual grass weeds having about four to eight leaves and perennial grass weeds having about six leaves per shoot. Treatments were applied with a CP3 knapsack sprayer at a volume of 200 to 350 litres of clean water per ha using a flat fan Tee Jet nozzle at a pressure of 1.6 to 2.1 bars. Standard treatments in many trials included either appropriate commercially available products, e.g. fluazifop-butyl, alloxydim-sodium, or controls, one of which was maintained weed-free throughout the season and the other an unweeded check. The research chemical, HOE 33171, was included in some trials. Agral 90 at a rate of 0.1 per cent of spray volume was included in all herbicide treatments except HOE 33171. No early weed control was done in any of the crops.

Visual assessments of the crop condition and weed control were made using a scale of 0 to 10 where 0 represented no crop injury or no weed control while 10 represented complete destruction of the crop or 100 per cent weed control. Weed counts, observations on plant stand and the dates of flowering and maturity were made. Many of the trials were harvested and the yields recorded. Cabbage heads and tomato fruits were taken for residue analysis. Analysis of variance was computed on the data.

Results

Crop tolerance

A number of broadleaved crops (Table 1) showed tolerance to DPX-Y6202 at rates at least twice those required for effective grass weed control. In general, there was no visable crop injury nor any effects on date to blooming and maturity, plant height, branching and plant stand in the study. Good crop yields were obtained with DPX-Y6202 treatments which did not affect grade qualitv of harvested products.

Grass weed control

Table 2 presents a list of grass weeds susceptible to DPX-Y6202 applied post-emergence. The rates of DPX-Y6202 indicated are required to provide 90 per cent or more weed control.

The excellent activity of DPX-Y6202 against grass weeds in selected crops under cropping conditions in Trinidad is shown in Table 3 (tomato), Table 4 (cabbage), Table 5 (bodie bean - *Vigna unguiculata*) and Table 6 (bodie bean/sweet potato intercrop).

In three trials DPU-Y6202 at rates of 0.05 - 0.1kg a.i. ha^{-1} gave excellent control of established stands of *Cynodon dactylon.* At one location a repeat application of 0.1kg a.i. ha^{-1} DPX-Y6202 was necessary because of regrowth.

DPX-Y6202 gave excellent control of *Sorghum halepense* in pigeon pea with a single application of 0.1kg a.i. ha^{-1}. In another trial at a different location regrowth occurred and a second application of DPX-Y6202 at 0.1kg a.i. ha^{-1} was necessary for full season control of the perennial weed.

Rainfastness

A trial was conducted during the 1984 dry season to study the effect of rain-washing at 0.5, 1, 2, 3, and 4 hours after DPX-Y6202 at 0.05kg a.i. ha^{-1} treatment to *Eleusine indica* and *Echinochloa colonum.* A sprinkler irrigation system was employed to simulate rain applied at 30mm. Results showed that rainfall 0.5 hours after treatment decreased the control of both grasses, an average of 42 per cent control, but that rainfall after at least 1 hour had no effect on the DPX-Y6202 activity. The average ratings were 100, 95, 100, and 98 per cent after 1, 2, 3, and 4 hours for DPX-Y6202 applied at 0.05kg a.i. ha^{-1}.

Discussion

The considerable potential of DPX-Y6202 for the selective post-emergence control of annual and perennial grass weeds was clearly demonstrated in the many trials. DPX-Y6202 exhibits excellent selectivity to a range of broadleaved crops and compares very favourably with the already commercially available post-emergence grass weed herbicides. The rate advisable for the crop/weed situations studied appears to be 0.05 to 0.1kg a.i. ha^{-1} dependent on the grass weed flora, the higher rate being employed where perennial weeds are predominant. Users must be advised that, as with the already commercially available post-emergence grass weed herbicides, a suitable broad-leaved herbicide or other form of broadleaved weed control must be included in the cropping programme when implementing the adoption of the chemical, particularly if the control of problem weeds, e.g. *Parthenium hysterophorus,* is to be efficient.

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Table 1 Crops tolerant to the herbicide DPX–Y6202

Crop	Cultivar
Bean	Contender, Harvester, Top Crop
Cabbage	Bravo, Greenboy, Kono Cross, Summer Queen
Cowpea	California Blackeye No 5, Kanhai, Laura B, Los Baños Bush Sitao No. 1, Vita 5
Cucumber	Chipper, Local, Tempo
Eggplant	Early Long Purple, Local
Hot pepper	Red Hot Local
Okra	Clemson Spineless, Lee, Local, Puerto Rico Dwarf
Pigeon pea	Chaguaramas Pearl, Tobago, UW17
Sorrel	Dwarf Early Red
Soya bean	Hsi-hsi, Jupiter
Sweet pepper	California Wonder, Jupiter, Skipper, Starr
Sweet potato	A28/7, Local, 049
Tomato	Calypso, Duke, Early Cascade, Floradel, President, Roma
Watermelon	Charleston Grey, Gloria, Sweet Princess.

Table 2 Grass weeds susceptible to the herbicide DPX–Y6202[a]

A.	DPX–Y6202 at 0.02 - 0.05 kg a.i. ha^{-1}
	Brachiaria spp.
	Digitaria sanguinalis
	Echinochloa colonum
	Eleusine indica
	Leptochloa spp.
	Panicum spp.
	Rottboellia exaltata
	Sorghum bicolor (volunteer sorghum)
	Zea mays (volunteer corn)
B.	DPX–Y6202 at 0.05 - 0.01 kg a.i. ha^{-1}
	Cynodon dactylon
	Paspalum fasciculatum
	Sorghum halapense

[a] At least 90% control of the weeds

Table 3 Grass control at 5 weeks after application of herbicidal treatments in tomato[a]

Treatment	Rate (kg a.i. ha^{-1})	Grass control (%) *E. colonum*	*E. indica*	*B platyphylla*	*P. fasciulatum*
DPX–Y6202	0.02	92	95	90	86
DPX–Y6202	0.05	95	100	98	92
DPX–Y6202	0.1	98	100	100	96
Fluazifop-butyl	0.5	95	100	100	92

[a]Summary data from four trials. In one trial where *Sorghum halepense* occurred it was controlled by DPX–Y6202 at 0.1 kg a.i ha^{-1} only. *Cyperus rotundus* frequently showed some bronzing but was not controlled by any of the treatments.

Table 4 Grass control at 5 weeks after application of herbicidal treatments in cabbage[a]

Treatment	Rate (kg a.i. ha^{-1})	Grass control (%) *E. colonum*	*E. indica*	*B. platyphylla*	*P. fasciulatum*	*L. scabra*
DPX–Y6202	0.02	93	100	98	85	90
DPX–Y6202	0.05	98	100	100	98	94
DPX–Y6202	0.1	100	100	100	100	100
Fluazifop-butyl	0.5	98	100	95	90	92
Alloxydium-sodium	1.0	82	86	84	75	86
Alloxydim-sodium	1.5	86	96	82	82	90
HOE 33171	0.24	94	98	100	94	93
HOE 33171	0.36	100	100	100	98	96
HOE 33171	0.48	100	100	96	100	100

[a] Sumary data from three trials

Table 5 Grass control at 6 weeks after application of herbicidal treatments in bodie bean (*Vigna unguiculata*)[a]

Treatment	Rate (kg a.i. ha^{-1})	Grass control (%) *E. colonum*	*E. indica*	*B. platyphylla*	*Digitaria* spp.
DPX–Y6202	0.02	100	100	95	98
DPX–Y6202	0.05	100	100	100	96
DPX–Y6202	0.1	100	100	100	100
Fluazifop-butyl	0.5	100	95	98	95

[a] Summary data from four trials

Table 6 Grass control at 56 days after treatment in a bodie bean/sweet potato intercrop[a]

Treatment	Rate (kg a.i. ha^{-1})	Grass control (%) *E. colonum*	*E. indica*	*B. platyphylla*	*P. fasciulatum*
DPX–Y6202	0.05	98	100	98	95
DPX–Y6202	0.1	100	100	100	98
Fluazifop-butyl	0.5	98	100	94	95
Alloxydim-sodium	1.5	90	92	86	86
HOE 33171	0.36	95	98	98	92
HOE 33171	0.48	100	100	98	98

[a] Summary data from two trials. In both *Cyperus rotundus* showed some bronzing but was not controlled by any of the treatments.

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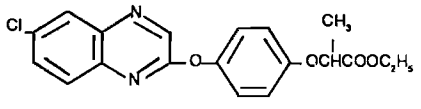
Annex 1

Chemical and physical properties of DPX–Y6202

Chemical name: 2-[4-[(6-chloro-2-quinoxalinyl) oxy] -phenoxy]-propionic acid, ethyl ester

Structure:



Physical form: White crystalline solid

Molecular weight: 372.81

Melting point: 91°C

Solubility at 20°C:

water	0.3 x 10^{-4} g 100 ml^{-1}
n-hexane	0.26 g 100 ml^{-1}
xylene	12.1 g 100 ml^{-1}
acetone	11.1 g 100 ml^{-1}

Vapour pressure: 3 x 10^{-7} mm Hg at 20°C

Formulation: DPX–Y6202 is formulated as an amber coloured emulsifiable concentrate with petroleum odour containing 95.8 g l^{-1} of active ingredient.

Source: Anon. (1983).

Annex 2

Toxicology of DPX–Y6202

The acute oral LD_{50} values to male and female rats are 1,670 and 1,480 mg kg^{-1}, respectively, for the active ingredient and above 5,000 mg kg^{-1} for the formulated product. The acute skin LD_{50} values to the mouse and rat are over 10,000 and 5,000 mg kg^{-1} for absorption and subcutaneous treatments, respectively with the active ingredient. The acute skin LD_{50} value to the rabbit is greater than 2,000 mg kg^{-1} with the formulated product.

The active ingredient is not a skin sensitizer to either rabbit or guinea pig. The formulated product is an irritant but not classified as a primary skin irritant to rabbit, and is a mild skin irritant but non-sensitizer to guinea pig. The active ingredient is a mild eye irritant and the formulated product is a severe eye irritant to rabbit.

DPX–Y6202 is non-mutagenic in the Ames test. It is non teratogenic at 300 mg kg^{-1} day^{-1}. The acute oral LD_{50} value to mallard ducks is greater than 2,000 mg kg^{-1} with the active ingredient. The LC_{50} at 96 hours for rainbow trout is 10.7 ppm.

Source: Anon. (1983).

Annex 3

Mode of action of DPX–Y6202

DPX–Y6202 is primarily absorbed through the leaves and readily translocated throughout the plant (Anon., 1983). The first visible symptom is a cessation of growth which was frequently observed within 48 hours of application under Trinidad conditions. Chlorosis and necrosis begins on the young leaves and then spreads to the older leaves and shoots. Death usually occurs within 2 to 4 weeks of application. Effective control of root system regrowth of some perennial grasses has been observed. The effectiveness of DPX–Y6202 is enhanced when the chemical is applied to actively growing weeds. Rainfall 1 hour after application did not reduce the effectiveness of DPX–Y6202.