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Selectivity of a Herbicide Pendimethaline on *Eleusine coracana* and *Cajanus cajan*

S J ANKE GOWDA*, R DEVENDRA*, T G PRASAD*, M UDAY KUMAR* and M K MUNE GOWDA+

**Department of Crop Physiology, University of Agricultural Sciences, G K V K, Bangalore* 560 065

+*Agronomy Division, AICRP on Weed Control, University of Agricultural Sciences, Hebbal, Bangalore*

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Experiments were conducted with pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6 dinitro benzenamine) a broad spectrum dinitroaniline herbicide, to understand its selectivity in resistant redgram {*Cajanus* cajan (L.) Millsp.} & susceptible finger millet (*Elusine coracana* Gaertn) and two weed species {*Cyperus rotundus* (L.)} & *Digitaria marginata* (L.). Pre-emergent application of pendimethalin completely inhibits germination of finger millet. However, in redgram the germination as well as seedling establisment were not affected. Plots sprayed with pendimethalin showed good control of *Digitaria marginata* L., but the sedge *Cyperus rotundus* was not affected. Though the imbibition rate was four times more in redgram than in finger millet, uptake and translocation of 14C-pendimethalin were more pronounced in finger millet than in redgram. Similarly, more pendimethalin was recovered both from root and shoot of *Digitaria marginata* L. than from that of *Cyperus rotundus* L. It appears that selective absorption of pendimethalin by the plant from soil determines its relative susceptibility or resistance to the herbicide.

Key Words: Selectivity, Absorption, Translocation, Dinitroaniline

Introduction

Selectivity of any herbicide in plants depends upon its differential uptake, translocation and detoxification (Ashton & Crafts 1981). Strang and Rogers(1971) found that much of 14C-trifluralin absorbed was retained only on the surface of the carrot root peel and little was translocated to pulp. Vendeventer et al. 1986) reported that seedlings of *Solanum scabrum* absorbed more 14C-trifluralin and 14C-ethalfluralin than *S. ptycanthum*.

In this study differential uptake and translocation of pendimethalin as a mechanism of selectivity in finger millet (*Elusine coracana* Gaertn), redgram (*Cajanus cajan* (L.) Millsp.) and two weed species {*Cyperus rotundus* (L.) and *Digitaria marginata* (L.)} were assessed.

Materials and Methods

In field experiment, pre-emergent application {1 day after sowing (DAS)} of pendimethalin at 1 kg a.i/ha was given to finger millet and redgram plots (3x2 m2). Ten DAS, data on % germination

of finger millet and redgram were collected. Forty-five DAS, counts of different weed species per unit land area were recorded. Fertilizer dosage and pesticide schedule were as per the recommended package of practices. Soil moisture was maintained at optimum conditions.

Pot Culture Experiments

Plastic pots were filled with 500g of air dried soil and 100ml of 2.5 ppm pendimethalin having 10uCi of methyl group labelled 14C-pendimethalin (sp. act. 2.997 mci/mg - supplied by M/s Cyanamid India Ltd.) was added and mixed thoroughly with the soil. Pre-germinated seeds/tubers of two crops (finger millet and redgram) and two weed species (*Digitaria marginata* L. and *Cyperus rotundus* L.) were dibbled in pots separately with three replications. Radioactivity in plants and soil was determined on 1, 5 and 12 days after planting. Five plants in each species were taken per replication. Root and shoot were separated and fresh weights were recorded. Radioactivity was assessed on a liquid scientillation counter (Raghuramulu et al.1983). Activity in the residue was negligible. Hence, it was ignored for calculating the uptake and translocation. Activity recorded was expressed as cpm/mg fresh weight of plant material and also as cpm/unit root surface area. The root surface area was calculated assuming that root has conical shape. Statistical analysis was carried out after suitable transformation.

Results and Discussion

Field experiments on pre-emergent application of pendimethalin showed that development of the plumule of finger millet on contact with herbicide is inhibited, and as a result the shoot does not emerge from the soil, while redgram seeds germinate and establish well (table 1). The study on the effect on weed population indicated that pendimethalin totally suppressed the population of *Digitaria marginata* L., whereas *Cyperus rotundus* L. was well established (table 2). These

Table 1 *Effect of pendimethalin on germination per cent (7 DAS) of finger millet and redgram. (Field expt.)*

Crops	Treatments	Germination per cent
Finger millet	-Pendimenthalin (1 kg a.i./ha)	0.0(0.0)
	Control	97.9 (81.8)
Redgram	-Pendimethalin	95.7 (78.2)
	Control	97.7 (90.2)
C D (P=0.01)		(2.1)

Data in parenthesis is angular transformation value.

observations indicated that *D. marginata* was suceptible and *C. rotundus* was resistant to pendimathalin. Using radioactive trifluralin and oryzalin it has been shown that in susceptible species dinitroaniline binds to tubulin and thus prevens the microtubule formation, which is essential for mitotic cell division (Strachan & Hess1983). Mitotic cell division of root (Vaughan et al. 1987) and shoot (Malefyt & Duke 1983) is drastically affected and root and shoot growth suppressed.

The concentration of pendimethalin in soil was almost the same irrespective of the species grown (table 3). Radioactivity drastically decreased on 20th day after soil application. As 14C-label was on the methyl group, N-dealkylation may be responsible for reduction in radioactivity in acidic *p*H (Pal et al. 1991), it showed significant variation in different plant parts (table 4). Data could not be obtained for different growth stages of susceptible species, because of high seedling mortality caused by higher uptake of pendimethalin. 14C-pendimethalin recovered from the shoot of the susceptible species was 3-4 times more than that of the resistant species, indicating a variation in translocation. In redgram it was more confined to root than to shoot, while in finger millet reverse

Table 2 *Effect of pedimethalim (1 kg a.i/ha) on population of different weed species (Plants/m^2) in different crops at 45 DAS*

Weed		Finger millet			Redgram	
Species	Control	Pendimethalin	Mean	Control	Pendimithalin	Mean
Cyperus rotundus	9.3(3.2)	16.0(4.1)	12.7(3.6)	18.7(4.2)	21.3(4.5)	20.0(4.3)
Digitaria marginata	5.3(2.5)	9.0(1.0)	2.7(1.7)	2.7(1.8)	0.0(1.0)	1.3(1.4)
Eragrastis sp.	2.7(1.7)	0.0(1.0)	1.3(1.3)	2.7(1.7)	0.0(1.0)	1.3(1.3)
Borreria sp.	4.0(2.1)	0.0(1.0)	2.0(1.5)	5.3(2.5)	0.0(1.0)	2.7(1.7)
Mean	(2.4)	(1.8)		(2.5)	(1.9)	
C.D Treatments	(0.8)			1.1		
(P=0.05) Species	(0.4)			NS		
Interaction	(0.8)			NS		

NS=Non significant; Data in parenthesis is square root of (x+1) transformation value.

was the case. Evidently, apart from uptake, translocation to shoot also may determine the relative susceptibility of the plant to pendimethalin.

To understand the influence of total absorption surface area of the roots on differential uptake, 14C activity in root was expressed per unit root surface area (table 5 & 6). Even on the basis of unit root surface area, the redgram absorbed and translocated significantly lower amount of 14C-pendimethalin than the finger millet.

Differential absorption and translocation was observed only in intact seedlings. In excised root and shoot, no difference in absorption was noted between redgram and finger millet species, sug-

Table 3 *^{14}C-pendimethalin activity (cpm/mg) in soil at different days after herbicide application*

Plant	Days after application		
	1	5	20
Redgram	14.0(2.8)	22.1(3.2)	1.7(0.9)
Cyperus rotundus	15.6(2.8)	17.0(2.7)	1.5(0.8)
Finger millet	23.0(3.1)	19.9(3.0)	2.4(1.0)
Digitaria marginata	14.6(2.7)	13.7(2.7)	0.8(0.6)
CD (P=0.05)	NS	NS	NS

Data in parenthesis is log(x+) transformation value; NS-Non Significant

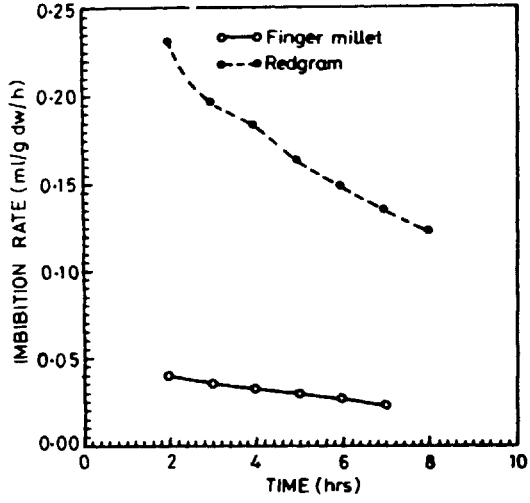

Figure 1. Imbibition rates of germinating finger millet and redgram seeds

Table 4 *Amount of radioactive pendimethalin (cpm/mg fresh weight) present in different plant parts at different days after soil application*

Plant	Root			Shoot		
	1 day	5 day	20 day	1 day	5 day	20 day
Redgram	53.0 (3.97)	131.2 (4.88)	53.6 (2.04)	51.7 (3.95)	6.3 (1.94)	6.8 (2.05)
Cyperus rotundus	13.0 (2.42)	15.5 (2.79)	2.8 (1.68)	34.9 (3.34)	16.2 (2.6)	4.5 (1.08)
Finger millet	437 (6.06)	13.70 (7.18)	NA	204 (5.30)	1524 (6.89)	NA
Digitaria marginata	1756 (7.31)	NA	NA	3459 (7.91)	NA	NA
C.D at 5%	(10.1)	(2.99)	(0.01)	(0.38)	(1.85)	(0.14)

Data in parenthesis is log(x+1) transformation value;
NA - Data not available due to death of seedings.

Table 5 *Amount of radioactive pendimethalin (cpm/mm^2 root surface area) present in different plant parts at different days after soil application*

Plant	Root		Shoot	
	1 day	5 day	1 day	5 day
Redgram	20.1 (3.0)	49.7 (3.9)	20.1 (3.0)	2.4 (1.2)
Finger millet	75.5 (4.3)	233.9 (5.4)	74.5 (3.6)	260.2 (5.1)
CD (P=0.05)	NS	(0.23)	NS	(3.31)

Data in parenthesis is log (x+1) transformation value;
NS-Non Significant.

Table 6 *Amount of ^{14}C-pedimethalin (cpm/mg fresh weight) in intact and excised plant parts after different period of treatment in germinating seeding*

Plant	Intact seedlings				Excised seedlings			
	Root		Shoot		Root		Shoot	
	8 hrs	12 hrs	8 hrs	12 hrs	6 hrs	12 hrs	6 hrs	12 hrs
Redgram	678	858	503	150	696	2524	1627	2773
Finger millet	1101	1775	1117	782	1507	3425	1715	2352
t-test	*	**	**	**	**	NS	NS	NS

*Significant (p=0.05)
**Highly significant (p=0.01)
NS - Non Significant

gesting existence of some barrier for pendimethalin translocation from root to shoot in intact seedlings of finger millet (resistant) as reported by Strang and Rogers (1971) in carrot. Though imbibition of water in seeds of redgram is more than finger millet during germination (figure 1), the differential absorption and translocation of pendimethalin seems to be a selective mechanism for avoiding herbicide toxicity.

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