

Persistence of pendimethalin in soybean (*Glycine max*)–wheat (*Triticum aestivum*) sequence following pre-emergence application to soybean

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ABSTRACT

An investigation was conducted at the Indian Agricultural Research Institute, New Delhi, during the rainy (*kharif*) season of 1995 and 1996 to determine the persistence of pendimethalin in soil in soybean [*Glycine max* (L.) Merr.]–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) sequence following its application to soybean. In sandy-loam soil, the half-life of pendimethalin at 1.0 and 1.50 kg a.i./ha was 24 and 26 days respectively. The initial dissipation of pendimethalin was rapid and nearly 35–36% of the original value was lost in 15 days and thereafter it was gradual. Nearly 27–28% residues remained in the soil after 45 days of its application and ascertained safety to succeeding wheat crop, as the pendimethalin residues reached non-detectable level after the harvest of soybean.

Key words : Persistence, Pendimethalin, Dissipation, Half-life, Soybean–wheat sequence

Better understanding about the persistence of any herbicide in different cropping systems is of utmost importance where succeeding crop follows preceding crop in a quick succession and herbicidal residues if left-over may adversely affect the growth and development of sensitive succeeding crop in rotation (Walsh *et al.*, 1993). Pendimethalin is most potent and safe herbicide, recommended for selective weed control in oilseed crops particularly in soybean (Bhalla *et al.*, 1998). The

persistence of pendimethalin on cropped land varied with its dose, soil type and climate (Kulshrestha and Yaduraju, 1987). Since an information on the persistence of pendimethalin applied during rainy season to a soybean–wheat sequence is meagre, a comprehensive study was undertaken.

MATERIALS AND METHODS

The field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, during the rainy season of 1995

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and 1996. Soybean cv. 'Pusa 22' was sown on 10 and 17 July in respective year. The soil of the experimental field was sandy loam with low organic matter content (0.35%) and pH 7.9. Total rainfall of 716.6 and 828.8 mm was recorded in respective years. Pendimethalin was sprayed during mid-day in 1995, while in the subsequent year it could not be sprayed during mid-day due to rains and the same could be sprayed during evening hours @ Pendimethalin @ 1.0 and 1.5 kg a.i./ha was sprayed 1 day after sowing of soybean in both the years. The soil samples were collected at 0, 15, 30, 45 days following its application to soybean and also before sowing of wheat without disturbing the original layout of the experiment in the field. The residues of pendimethalin were extracted with hexane. The supernatant liquid was filtered and filtrate was concentrated to about 5 ml using evaporator. The residues were determined by gas-liquid chromatography (GLC) on gas chromatograph fitted with Ni ECD and a OV - 17 megabore column.

The column, injector and detector temperatures were maintained at 200, 225 and 250°C respectively. The flow rate of nitrogen was 30 ml/min. The half-life of pendimethalin was calculated from logarithmic plots of concentrations of herbicide versus time with the help of the following equation : $T_{0.5} = 0.693/K$.

RESULTS AND DISCUSSION

Rate of dissipation of pendimethalin did not change due to its both rates (Table 1). However, the dissipation was more in 1996 over preceding year 15 and 30 days after its application at both the rates. The variation in dissipation of pendimethalin could be attributed to faster decomposition due to more mean maximum temperature (35°C) and moisture level (322.2 mm rainfall) during aforesaid period (Table 2). We endorse similar views to those of Zimdahl *et al.* (1984). The initial dissipation of pendimethalin was more acute and nearly 35 to 36% of the original value was dissipated 15 days after its application to

Table 1. Pendimethalin residues in soil at different intervals and its half-life

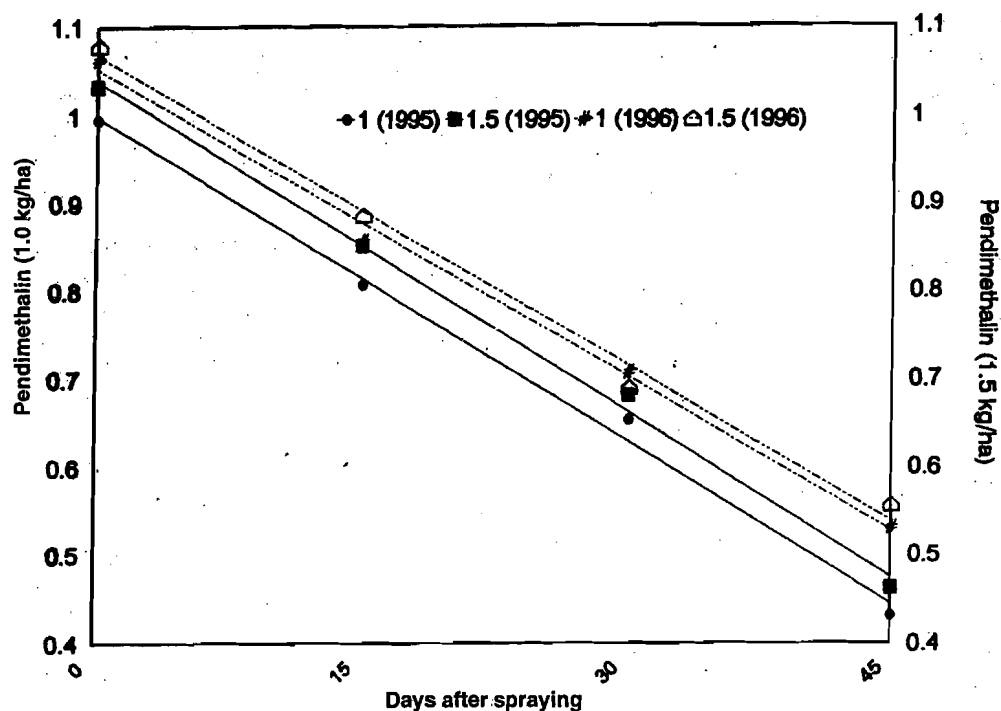
Herbicide	Rate (Rs/ha)	Year	Residual in soil (µg/g) at DAS*					Half-life days
			0	15	30	45	120**	
Pendimethalin	1.0	1995	0.99	0.64	0.45	0.27 (35.35)	ND (54.54)	24.2 (72.73)
		1996	1.16	0.72	0.51 (37.93)	0.34 (56.03)	ND (70.68)	25.6
	1.5	1995	1.08	0.71 (34.25)	0.48 (54.45)	0.29 (73.14)	ND	23.8
		1996	1.20	0.77 (35.83)	0.49 (59.16)	0.36 (70.00)	ND	25.4

*Figures of composite samples; Figures in parentheses indicate % dissipation; ND not detected,** before sowing of wheat

DAS, Days after sowing

Table 2. Mean weekly temperature and rainfall data during the rainy season of 1995 and 1996

Month	Standard weeks	Temperature (°C)				Rainfall (mm)	
		1995 Max.	1995 Min.	1996 Max.	1996 Min.	1995	1996
July	27	45.5	30.3	35.2	25.5	0	60.9
	28	35.2	27.6	35.4	27.7	19.4	12.0
	29	33.8	27.2	35.5	27.0	29.4	58.0
	30	32.5	26.3	33.5	26.7	21.8	62.0
August	31	32.2	26.7	31.8	26.3	65.2	112.4
	32	30.7	26.0	33.6	26.9	120.0	33.9
	33	31.1	26.7	31.3	26.2	14.6	40.7
	34	32.2	26.0	30.0	24.7	51.8	128.6
September	35	30.7	25.1	33.9	26.3	173.4	0
	36	31.8	23.5	30.7	25.1	184.4	142.0
	37	32.4	19.3	32.0	25.0	0	0
	38	35.0	23.6	33.0	24.5	0	0
	39	36.0	24.0	35.1	22.5	0	0

**Fig.1.** Log [residues ($\mu\text{g/g}$) $\times 10$] residues of pendimethalin in soil at different intervals

soybean at 1.0 and 1.5 kg/ha in the rainy season. At 45 days after application, 27 to 28% residues remained in the soil at both the rates. Thus, it could be said that an ideal persistence of pendimethalin during the first 30 days of crop growth would have given competitive advantage to the soybean by selective control of weeds during critical stage of weed competition and ascertained safety too in case of succeeding wheat crop, as the residues reached the non-detectable level after the harvest of soybean.

The semi-logarithmic plots of data indicated that rate of dissipation of pendimethalin did not follow first-order rate kinetics at any rate of application in both the years (Fig. 1). The half-life of pendimethalin at 1.0 and 1.5 kg/ha was 24 and 26 days, respectively, when it was applied to soybean in the rainy season. Jayakumar *et al.* (1992) also estimated 26 days half-life of

pendimethalin in alluvial soil.

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