Research Paper

An Asian Journal of Soil Science

Vol. 6 No. 2 (December, 2011) : 211-214

Received : September, 2011; Revised : November, 2011; Accepted : November, 2011

Degradation of propineb in potato and soil

K.R. ASHOKA, T.H. HANUMANTHARAJU, M.B. MAHENDRA KUMAR, CHAKPRAM BIRENDRAJIT, ATHEEFA MUNAWERY **AND** P. VEERANAGAPPA

SUMMARY

A season study (December 2008 to march 2009) was undertaken with potato crop and was found that propineb residue degraded faster in potato under field condition when applied at 1400 and 2800 g a.i ha^{-1}. However, the propineb was noticed in soil on the day of propineb spray. Degradation was faster at lower dose of than higher dose of application with the half-life values of 2.3 and 2.5 days. The safe waiting period of 3.3 and 4.3 days was recommended for potato when applied at 1400 and 2800 g a.i ha^{-1} of propineb.

Ashoka, K.R., Hanumantharaju, T.H., Mahendra Kumar, M.B., Birendrajit, Chakpram, Munawery, Atheefa and Veeranagappa, P. (2011). Degradation of propineb in potato and soil. *Asian J. Soil Sci.*, **6**(2): 211-214.

KEY WORDS : Propineb, Potato, Degradation, Bisdithiocarbamate

Research recommendations of chemical control of pest are considered as incomplete if data on toxic residue of pesticides are not provided. Propineb [polymeric zinc propylene-bis-(dithiocarbamate)] [$(C_5H_8N_2S_4Zn)_x$] is a polymeric dithiocarbamate fungicide. A new, commercially available fungicide formulation, propineb 70 per cent WP, which belongs to the group of propylene-bis-dithiocarbamates, can be used as a substitute for the control of several fungal diseases of potato (Sharma *et al.*, 1994). Potato (*Solanum tuberosum* L) is one of the prime remunerative crops of southern Karnataka. To sustain the quality and productivity of crops, propineb is being heavily applied close to harvest, since there are no data available on the persistence of propineb on potato, the present investigation was conducted to determine the degradation pattern of propineb.

EXPERIMENTAL METHODS

The field experiment was conducted to study the persistence of residues of propineb (Antracol 70 WP) in potato in winter 2008-09 (December to March), at Bellur cross, Near Narasapura, Kolar (Latitude 13^{0}10´ N and Longitude 78^{0}10´ E). Potato tubers were planted with the spacing of 50 cm x 20 cm in the plots size (5 m x 4 m). The recommended dose of fertilizer 125:100:125 N, P_2O_5, K_2O kg ha^{-1} were applied as per package of practice (UASB). The propineb (Antracol 70 WP) was spayed as per the treatment details.

Treatment details		
T_1	:	Control
T_2	:	Propineb (1400 g a.i.ha^{-1}) spray at 30 DAP
T_3	:	Propineb (2800 g a.i. ha^{-1}) spray at 30 DAP

Sample collection:

Immediately (2 hours after spray) after fungicide applied to the plants, the fourth leaf from the plant apex (young and fully expanded leaf) and whole shoot from the represented plants were separately collected. The samples were collected at different intervals like 0 day, 3, 7, 14, 21, 30 and 45 days after spray. At harvest also, potato plant and potato tuber were collected to know the persistence of propineb. Nearly 250 g (upto 21 days) or 500 g (30th day onwards) of potato foliage from each plot were collected and brought to laboratory under refrigerated conditions and immediately processed for propineb residue analysis.

Address of the corresponding author :
K.R. ASHOKA, Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA
Email : ashoka@gmail.com

Address of the co-authors :
T.H. HANUMANTHARAJU, M.B. MAHENDRA KUMAR, CHAKPRAM BIRENDRAJIT, ATHEEFA MUNAWERY AND P. VEERANAGAPPA, Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA

Table A : Physical and chemical properties of experimental field

Sr. No.	Parameters	Malur (Kolar)
1.	Particle size distribution	
	Sand (%)	64.1
	Silt (%)	10.6
	Clay (%)	25.3
	Textural class	Sandy clay loam
2.	pH (1:2.5)	7.3
3.	Electrical conductivity(dS m^{-1})	0.15
4.	Organic carbon (g kg^{-1})	8.03
5.	Moisture at Field capacity (%)	24.5
6.	Cation exchange capacity [cmol (p+) kg^{-1}]	10.1
7.	Zn (µg g^{-1})	0.76
8.	Cu (µg g^{-1})	0.93
9.	Fe (µg g^{-1})	10.15
10.	Mn (µg g^{-1})	8.04

Method of fungicide residue analysis:

The method used for this purpose was as described by Keppel (1969, 1971) with slight modifications. Dithiocarbamate residues in substrates (soil crop and water sample) were decomposed by refluxing with boiling hydrochloric acid. The evolved CS_2 is carried by gas stream which is purified from H_2S or other interferences by passing through lead acetate (30 %) and sodium hydroxide (10 %) solution and finally trapped in 15 ml of the colour reagent (0.012 g of cupric acetate + 25 ml of diethanolamine and diluted to 250 ml with ethanol) to form the cupric salt of N, N-bis-(2-hydroxy) dithiocarbamic acid which was immediately measured by spectrophotometer at 435 nm. The carbon disulphide was used as a standard for estimation of propineb residues.

Carbon disulphide standard preparation:

To accurately weighed 25 ml volumetric flask containing 5 mL ethanol, about 0.1 ml CS_2 was added and closed the flask with stopper, reweighed and made up the volume to 25 ml with ethanol. From this 2 ml aliquot of solution was diluted with 100 ml ethanol. CS_2 was calculated in µg per ml.

EXPERIMENTAL FINDINGS AND ANALYSIS

The data on the persistence and degradation of propineb on potato are presented in Table 1 and 2. The antracol 70 WP was applied on potato leaves on 30th day after planting with normal dose of 2 kg ha^{-1} (T_2- 1400 g a.i. ha^{-1}) and 4 kg ha^{-1} (T_3- 2800 g a.i. ha^{-1}). The data revealed that no residue was detected in the control (T_1). It was observed that dissipation was faster in both the

Table 1 : Persistence of propineb in potato cropped soil following the application of antracol 70WP

Sr. No.	Treatments/ Dose of propineb (g a.i. ha^{-1})	Residue (µg g^{-1}) at different days	
		0	3
1.	T_2 Spray at 1400 g a.i/ha	1.4±0.146	BDL
2.	T_3 Spray at 2800 g a.i/ha	2.3±0.210	BDL

BDL = below detectable limit (<0.01 µg g^{-1})

rates of application. The persistence of propineb was found more under higher dose than recommended dose. The propineb residue degraded upto 67.6 and 88.2 per cent on 3rd and 7th day after application, respectively.

The higher rate of propineb (2800 g a.i ha^{-1}) was degraded about 62.3 and 85.7 per cent on 3rd and 7th day after application. However, the propineb half-life of 2.3 and 2.5 days were recorded when applied at 2 and 4 kg ha^{-1} of antracol 70 WP, respectively. This was mainly attributed to potato plants which possess broader leaf surface and well exposed to environmental factors like photo-decomposition, volatilisation, temperature etc. The residue persisted more under higher dose of application which was mainly due to formation of thicker spray layer on potato leaves than lower dose which will be lesser exposed to light. The findings of present study are also in confirmation with findings of Wasim *et al*. (2009) who reported that in potato the propineb residue degraded more than 94 per cent within 15 days with the half-life of 2.11 and 2.64 days.

In the present study, the propineb was applied to potato crop as wettable powder by mixing with water at 400 l ha^{-1}. The propineb is stable in solid state due its polymeric nature. However, the structure of propineb starts breaking down by hydrolysis reaction when mixed with water and releases unidentified intermediates.

However, under field condition, the propineb was dissipated within 7 days which was also attributed to UV light that breaks down the chain structure of propineb, which has methyl (CH_3) group and releases unidentified compounds by process called photo decomposition. A half-life for photolysis is of the order of hours and due to UV light under open field condition the propineb degraded very fast with shorter half-life. Present findings are also substantiated by the findings of Uyanik and Ozdemir, (1999) who reported that carbaryl was found to breakdown into non toxic products by UV light, which is having the bond to methyl (CH_3) group.

The environmental factors and moisture were main reasons, where the propineb was below detectable level in potato plants, tuber and potato leaves. Similar results were also recorded by Sarkar *et al*. (1998) where about 96 per cent of initial residue of propineb in potato (tuber

Table 2 : Persistence of propineb in potato following the application of antracol 70 WP

Sr. No.	Treatments/ Dose of propineb (g a.i. ha^{-1})	Residues (µg g^{-1}) in potato at different days					
		0	3	7	14	48 (Plant)	48 (Tuber)
1.	T_1 (Control)	-	-	-	-	-	-
2.	T_2 (Spray at 1400 g a.i ha^{-1})	20.4 ± 1.2	6.6 ± 0.25 (67.6)	2.4 ± 0.49 (88.2)	BDL	BDL	BDL
3.	T_3 (Spray at 2800 g a.i ha^{-1})	34.9 ± 2.7	13.2 ± 0.98 (62.3)	5.0 ± 0.84 (85.7)	BDL	BDL	BDL

Figures in the parenthesis indicate the dissipation (%)
BDL = below detectable limit (<0.01 µg g^{-1})

Table 3 : Equations explaining the kinetics of degradation of propineb residues on potato as affected by application rate at two different rates

Sr. No.	Treatments/ Dose of propineb (g a.i. ha^{-1})	Exponential equation	$K_{(deg)}$ (10^{-3} day^{-1})	Half-life ($t_{1/2}$) (days)	R^2	Waiting period days)
1.	T_2 Spray at 1400 g a.i/ha	$C=18.808e^{-0.303x}$	303.0	2.3	0.9873	3.3
2.	T_3 Spray at 2800 g a.i/ha	$C=33.046e^{-0.2754x}$	275.4	2.5	0.9927	4.3

$K_{(deg)}$ =Rate of residue degradation $t_{1/2}$ =Half-life R^2 = Determination co-efficient

and whole plant) was dissipated after 7 days of application and not detected at harvest, with the half-life of 0.72 to 0.92 day. Sharma *et al*. (2003) observed that dissipation of propineb was found to be 80 per cent and 93.0 to 95.0 per cent of the initial residue, which dissipated within 15 days and 10 days, respectively.

It is evident that, the propineb persisted on the day of spray and found below detectable level on 3rd day after spray. This result is supported by Sarkar *et al*. (1998) who reported that though the propineb residue analysed after three times spray was persisted for 3 days.

The persistence of propineb was found in soil on the day of spray, which might be attributed to more amount of copper content (1.98 µg g^{-1}) in the soil. According to Weissmahr and Sedlak (2000), the applied dithiocarbamate fungicide forms a complex with copper and can slow down the transformation very effectively by inhibiting acid hydrolysis. However, trace amounts of copper (Cu^{2+}) content in soil yielded half-life of fungicide greater than 2 weeks, irrespective of pH and organic matter in soil.

The degradation of propineb in/on potato leaves followed the first-order kinetics. The quantity of propineb that persisted at any time was dependent upon the initial concentration added and the specific reaction rate constant (K_{deg}) (Table 3). The determination coefficient (R^2) values were greater than 0.987 which indicate that the persistence data fitted to first order exponential equation. Similar results were also found by Chakpram *et al*. (2008) on rice.

The rate constants [$K_{(deg)}$] were higher ($303x10^{-3}$ day^{-1}) at lower dose of application (1400 g a.i. ha^{-1}) when compared to higher dose(2800 g a.i. ha^{-1}) of application ($275.4x10^{-3}$ day^{-1}) with the determination coefficients ranging from 0.987 to 0.992 following application of propineb at 1400 g a.i. ha^{-1} and 2800 g a.i. ha^{-1}, respectively at 30 days after planting, having half-life of 2.3 and 2.5 days (Table 2). The results suggested that even though, the dissipation of propineb was faster under field condition, the amount of residue persisted more with the higher dose of propineb compared to lower dose. The residues resulting from the foliar applications of antracol 70 WP were found higher in higher dose of application compared to lower dose with the waiting period of 3.3 and 4.3 days, respectively. The results corroborate with Wasim *et al.* (2009).

Conclusion:

Propineb was noticed in soil on the day of propineb spray under field condition. Degradation was faster at lower dose of than higher dose of application

LITERATURE CITED

Chakpram, Birendrajit, Prakash, N.B. and Hanumantharaju, T.H. (2008). Evaluation of zinc based fungicides and conventional zinc fertilizers on zinc content in rice. 73rd Annual Convention Indian Soc. Soil Sci., 187.

Keppel, G.E. (1969). Modification of carbon disulphide evolution method for dithiocarbamate for dithiocarbamate residues. *J. Assoc. Off. Anal. Chem.*, **52**(1): 162-167.

Keppel, G.E. (1971). Collaborative study of the determination of dithiocarbamate residues by a modified carbon disulphide evolution method for dithiocarbamate residues. *J. Assoc. Off. Anal. Chem.*, **54**(3): 528-532.

Sarkar, M.A, Banerjee, H, Kole, R.K, Chowdhury, A. and Mohasin, M.D. (1998). Studies on the residues and persistence of antracol (zinc propylene bisdithiocarbamate) fungicide in potato and cropped soil. *Pestol.*, **22**(7): 8-14.

Sharma, I.D., Nath, A. and Dubey, J.K. (1994). Persistence of mancozeb (Dithane M-45) in some vegetables and efficacy of decontamination processes. *J. Food Sci. Technol.,* **31**(3): 215-218.

Sharma, I.D., Patyal, S.K., Dubey, J.K. and Nath, A. (2003). Persistence of propineb (fungicide) in apple and tomato. *Pestic. Res. J.,* **15**(1): 60-63.

Uyanik, A. and Ozdemir, M. (1999). Effect of the environmental temperature on the degradation period of carbaryl. *Tropical J. Agric. Forestry*. **23**: 579-584.

Weissmahr, K.W. and Sedlak, D.L. (2000). Effect of metal complexation on the degradation of dithiocarbamate fungicides, *Environ. Toxicol. & Chem*., **19**, (4): 820-824.

Wasim aktar, M.D., Paramasivam, M. and Sengupta, Dwaipayan (2009). Persistence and dissipation of propineb-a dithiocarbamate fungicide in potato under east Indian climatic conditions*, Kasetsart. J. (Nat. Sci.),* **43** : 50 – 55.

****
******
****