and 10.68 q ha^{-1} green forage, dry matter and crude protein. As regards to phosphorus, increasing the level from 0 to 60 kg ha^{-1} progressively increased the forage yield.

Significantly higher yields of green forage (260.73 q ha^{-1}), dry matter (51.97 q ha^{-1}) and crude protein (11.30 q ha^{-1}) were obtained with application of 60 kg phosphorus per hectare. The favourable effect of phosphorus on yield may be ascribed to its role in the constitution of ribonucelic acid, deoxyribonucleic acid and ATP which regulate the vital metabolic processes in the plant, helping in root formation, nitrogen fixation and finally the crop yield. This confirms the findings of Tripathi *et al.* (1977), Sairam *et al.* (1984), Tripathi *et al.* (1984), Sheoran *et al.* (1994) and Mishra and Baboo (1999). The interaction effect due to varieties and phosphorus levels was found to be non significant.

The results indicated that growing of UPC-606 with application of 60 kg phosphorus per hectare showed better proposition for achieving higher forage yield in cowpea.

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Research Notes

Degradation and persistence of chlormequatchloride in soil and water

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Plant growth regulators (PGRs) are applied to the plants to modify the vegetative characters and thereby enhancing the yield of crops. PGRs are having dynamic role in various physiological and biochemical process in plants. The PGRs after application to plants reaches the soil through drift and foliar wash off. The persistence of this PGR in soil may pose problems of persistence and residues. Any xenobiotic that reaches the soil should degrade fast to innocuous products without any residue hazards.

Chlormequatchloride (CMC) is an aqueous solution to the alkyl ammonium chloride. It is very stable in the form and is very resistant to acid hydrolysis. Decomposition in water below pH 5 is negligible but at pH above 10 is significant. McCall *et al.* (1979) reported that often the applied growth regulator remain in the soil for longer periods posing the environmental hazard. Considering the necessity for such information an attempt was made in the present investigation to study the degradation of CMC in soil and water.

Laboratory experiments were conducted at Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University,

Table 1. Linearising transformations for the general regression equation Y = a+bX

Function	Transformation	
	For Y (Residue)	For X (Time)
1st order	Log R	None
1.5th order	$1/\log\sqrt{R}$	None
2nd order	1/R	None
RF 1st order	Log R	$\sqrt{t}$
RF 1.5th order	$1/\sqrt{R}$	$\sqrt{t}$
RF 2nd order	1/R	$\sqrt{t}$
Inverse power law	In (R/R_1)	In (t/t_1)

Coimbatore during 1999-2000 to study the degradation pattern and persistence of CMC in soil and water.

Degradation studies of CMC in soil

The soil under study is a sandy loam belongs to inceptisol (Typic Ustropept) having a pH 7.5 and EC 0.18 dSm^{-1}. The soil sample was collected from the control plot of the experiment conducted at Agricultural Research Station, Bhavanisagar during *rabi* 1999-2000 where CMC formulations and doses were tried in cotton. The soil samples were air dried, processed to pass through 2 mm sieve and used for the laboratory experiment. Twenty five gram of soil was taken in polythene containers and water was applied to the level of field capacity. The soils were treated with CMC at 50,100 and 200 µg g^{-1} and incubated for a period of 30 days at 25 ± 1°C under the same moisture conditions. The soil samples were taken at 0 (1 h), 1,3,5,10,15 and 30 days after application and analysed for CMC using the following procedure.

The polythene shaking bottle containing 25 g of soil with CMC were taken at 0 (1 hr), 1,3,5,10,15 and 30 days after applications and then filtered and the filtrate was collected. The soil in the filter paper was washed with methanol three times. The filtrate was evaporated nearly 1-2 ml in a rotary vacuum flash evaporator. The column cleanup was accomplished in a clean dry glass column the anhydrous sodium sulphate was poured over a pledget. Then 9:1 ratio of silica gel and charcoal mixture was filled and to above that again sodium sulphate was poured and allowed to settle. The concentrated extract was eluted with two 50ml portions of methanol and concentrated to 2-3 ml in a rotary vacuum evaporator. To the concentrated extract 7N HCl was added and transferred to separating funnel. Then 30% $FeCl_3$ in 7N HCl was added and mixed well. Then 1,2-dichloroethane was added and shaken for 2 minutes to extract the ion pair into the organic phase. The extraction was done for three times. The layers were allowed to separate and the organic layer was filtered. The filtrate was condensed and the absorbance measured against blank at 364 nm in spectrophotometer model Perkin Lambda Bio.

Degradaion studies of CMC in water

The water used for irrigating the cotton was used in the present study. Fifty ml of water sample was incubated after treating with 50,100, and 200 µg g^{-1} of CMC for 30 days in polythene bottles. The CMC in water were determined at specified incubation periods *viz.* 0 (1 hr), 1,3,5,10,15 and 30 days. The CMC in water samples was extracted and determination is done similar to soil without column cleanup.

The data on the residues of CMC and the corresponding elapsed time were subjected to simple regression analysis and the time required for the applied CMC to get degraded to its 50 per cent of applied dose ($T_{1/2}$) was computed. The data was also fit in to different mathematical models to depict the degradation curves as described by Nigg and Stamper (1980). Linearisation of data was attempted by transforming the time (X) and /or the residues left over in the soil or water (y). Based on the regression co-efficient, (R) the best fit model was chosen from the regression analysis (Table 1). The intercept (a)

ıble 2. Residues of CMC in soil and water

ays er plication	Soil						Water					
	50 µg g^{-1}		100 µg g^{-1}		200 µg g^{-1}		50 µg g^{-1}		100 µg g^{-1}		200 µg g^{-1}	
	Mean residue (R)	Degra-dation (%)	Mean residue (R)	Degra-dation (%)	Mean residue (R)	Degra-dation (%)	Mean residue (R)	Degra-dation (%)	Mean residue (R)	Degra-dation (%)	Mean residue (R)	Degra-dation (%)
	45.7	-	89.1	-	167.5	-	45.0	-	81.3	-	161.0	-
	40.3	11.8	74.6	16.2	146.5	12.5	37.0	17.7	66.8	17.8	129.3	19.6
	3604	20.3	66.3	25.5	133.4	20.3	25.5	43.3	51.2	37.0	108.4	32.6
	30.5	33.2	58.9	33.8	119.6	28.5	153	66.0	30.0	63.0	56.2	65.0
	26.0	43.1	50.3	43.5	103.1	38.4	9.60	68.6	18.6	77.1	25.5	84.1
	19.9	56.4	39.7	55.4	84.8	39.3	5.4	88.0	10.5	87.0	18.2	88.6
	9.80	78.5	19.0	78.6	353	78.9	0.9	98.0	1.5	98.1	2.5	98.4

slope (b) and half life ($T_{1/2}$) which is th time needed for the initial concentration o the reacting substance to decrease to half wer derived.

Degradation and persistence of CMC

Soil

The data on the residues of soil ar presented in Table 2 and Figure 1. From th results it was found that per cent degradatio of CMC in soil after 30 days was 78.5 fo 50 µg g^{-1} followed by 78.6 for 100 µ g^{-1} and 78.9 for 200 µg g^{-1}. The actual quantit of CMC persisted in the soil after 30 day increased with increasing doses of CMC *viz* 10.2, 19.0, 39.9 µg g^{-1} of soil respectively

The half life time ($T_{1/2}$) needed for th CMC to dissipate to its 50 per cent was 14.0 days for 50 µg g^{-1}, 14.40 days for 100 µ g^{-1} and 14.17 days for 200 µg g^{-1}. It wa also found that the residues of CMC followe first order function with time at all the dose of CMC applied.

Water

The data showed that almost 98 per cen of the applied CMC degraded at the end o 30 days of incubation. It is also seen tha only a very little amount of CMC persiste in water medium indicating the faster rate o degradation than in soil medium. This is alsc confirmed by the half-life period. The $T_{1/}$ was low in water when compared to soil. Th $T_{1/2}$ was 5.64 days for 50 µg g^{-1} followe by 5.31 days for 100 µg g^{-1} and 5.04 day for 200 µg g^{-1}.

Work done else where on the degradatio pattern showed that the pesticide residue deca vs. time followed a semi logarithmic functio either by using log 10 (Hoskins, 1961; Timm and Freshe, 1980).

To conclude, the rate of degradation wa rapid at higher doses in water medium tha in soil. The initial deposit and residue lef over after the expiry of the 30 days was highe in higher doses of CMC applied. Further a compared to soil, the degradation was almos

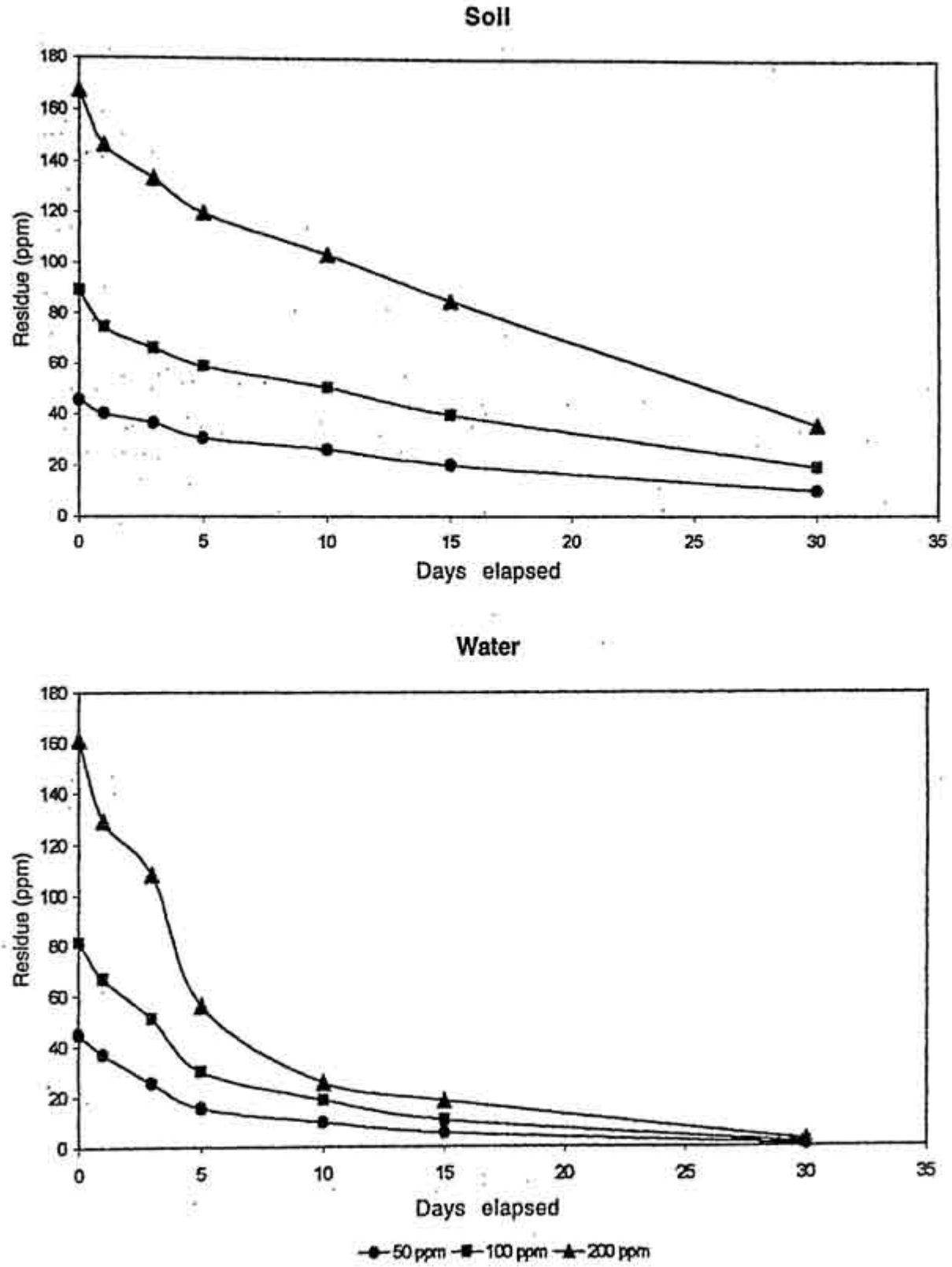

Fig.1. Degradation of chlormequatchloride in soil and water

Table 3. Initial deposit, degradation constant and half lives of CMC in soil and water

Sample	Dose ($\mu g\ g^{-1}$)	Initial deposit (a)	Degradation constant (b)	T ½ (days)	Prediction equation
Soil	50	42.36	-0.0214	14.01	Y = 42.36 - 0.0214 X
	100	80.16	-0.0201	14.40	Y = 8.16 - 0.0201 X
	200	160.3	-0.0212	14.17	Y = 160.32 - 0.0212 X
Water	50	37.40	-0.0552	5.452	Y = 37.40 - 0.0482 X
	100	72.11	-0.0566	5.317	Y = 72.11 - 0.0513 X
	200	138.0	-0.0596	5.048	Y = 138.03 - 0.0596 X

CMC in soil and water followed first order function. The half life period for CMC in soil and water followed the same trend of results wherein least number of days (5.0-5.4) were required for CMC to degrade to its 50 per cent in water and for soil was 14.0-14.6 days.

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Research Notes

Bioassay studies on the residual effect of herbicides applied to rainfed maize on succeeding cucumber

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Herbicides are applied to control wide range of weed flora in various field crops which apart from controlling target weeds, part of the applied herbicide slowly gets degraded, leaving certain amount in the soil for some period which may get translocated into plant produce and seepage into water bodies in course of time. The residues of soil applied herbicides are estimated qualitatively as well as quantitatively by both instrument and bioassay technique. By using bioassay technique, an attempt was made to study the residual effect of herbicides applied to rainfed maize on the growth of succeeding cucumber and residues of herbicides was quantitatively determined (Sankaran *et al.* 1993).

Composite soil sample was collected at two stages of maize crop growth (30 DAS and at harvest) from each plot applied with herbicides (atrazine 0.25, metolachlor 1.0, anilofos 0.40 and pendimethalin 1.0 kg ha^{-1}) by two methods (pre-emergence 3 DAS and early post