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Bioassay techniques for determination of the dose of Atrazine and Pendimethalin as pre and post-emergence for Maize (*Zea mays)* in Terai region of West Bengal

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Abstract: *Field experiment was carried out during the rabi season of 2013 in the research farm of Uttar Banga Krishi Viswavidyalaya located at Pundibari, Coochbehar, (W.B). The soil of the experimental site was sandy loam in character. Ten treatments under each herbicide were setup with plot size of 2X3 M in maize verity (JKMH-1001). The dose of different herbicides (kg/ha) for the both treatment [Post-emergence application (PPSA) and Pre- emergence application (PE)].*

I. Introduction

In weed research, bioassay is used to measure the biological response of living plant to herbicide and to quantify its concentration in a substrate. Bioassay is usually conducted with sensitive plant species also referred to as indicator or test species. Bioassay is being used widely as a useful tool to regulate herbicide doses in a particular crop. This technique also leads to identify the herbicide that is safe for a crop in terms of phyto-toxicity and growth reduction by relating the different herbicidal doses with percent reduction in fresh weight as individual plants. (Tag et. Al.1981). The bioassay experiment has been conducted at the research farm of Uttar Banga Krishi Viswavidyalaya in maize with the following objectives.

- To find out the dose of Atrazine and Pendimethalin in Maize and their time of application.
- To measure selectivity index (SI) of the herbicides.
- To study the comparative performance of the herbicides based on SI, time of application and dose.

II. Methodology

Field experiment was carried out during the *rabi* season of 2013 in the research farm of Uttar Banga Krishi Viswavidyalaya located at Pundibari, Coochbehar, (W.B). The soil of the experimental site was sandy loam in character. Ten treatments under each herbicide were setup with plot size of 2X3 M in maize verity (JKMH-1001). The dose of different herbicides (kg/ha) for the both treatment [Post-emergence application (PPSA) and Pre- emergence application(PE)].

Table: 1 Effect of different doses of herbicides as pre and post-emergence (kg/h)

Herbicide doses	Pendimethalin	Atrazine		Atrazine	
	Pre-emergence application	Pre-emergence application		Post-emergence application(20DAS)	Post-emergence application(40DAS)
1	0.00	0.00		0.00	0.00
2	0.10	0.10		0.10	0.10
3	0.20	0.20		0.20	0.20
4	0.30	0.30		0.30	0.30
5	0.40	0.40		0.40	0.40
6	0.60	0.60		0.60	0.60
7	0.80	0.80		0.80	0.80
8	1.00	1.00		1.00	1.00
9	1.50	1.50		1.50	1.50
10	2.00	2.00		2.00	2.00

The per cent growth inhibition values obtained at different herbicidal doses both in case of Maize and weed were transformed to probit values and regressed against log values of doses. The linear regression equation was computed by using excel programmed Y=bx+a, where Y indicates probit value of per cent dry weight reduction, b is regression coefficient ,x is log dose of herbicide and a is intercept of Y. Selectivity index (S.I.) value was calculated by using the following formula:

S.I.=Maximum dose tolerated by crop(Maize)/Minimum dose required to control weed

Maximum dose of herbicide tolerated by maize was equal to dose that caused 15% growth reduction of Maize (GR_{15}) at initial stages and minimum dose required to control the weeds was equal to the dose that resulted in 80% growth reduction in weed (GR_{80}) or 80% weed control efficiency of herbicide. Selectivity index

value greater than 1 is always desirable to get selective control over weeds without any lethal effect on crop plant. The proportional increase of plant response in terms of growth reduction to herbicidal doses led to identify the level at which the plant produce 50% response which is known as GR_{50}(dose of herbicide that led to 50% growth reduction).

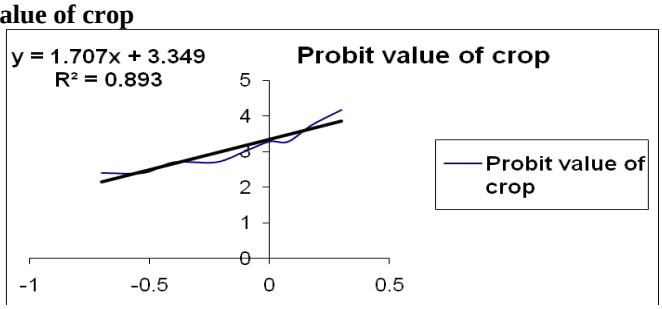
The following weed flora were recorded during the experimentation

Cynodon dactylon, Cyperus rotundus,
Cyperus iria, Oxalis spp

III. Result

- **ATRAZINE**

Pre-emergence Probit value of crop



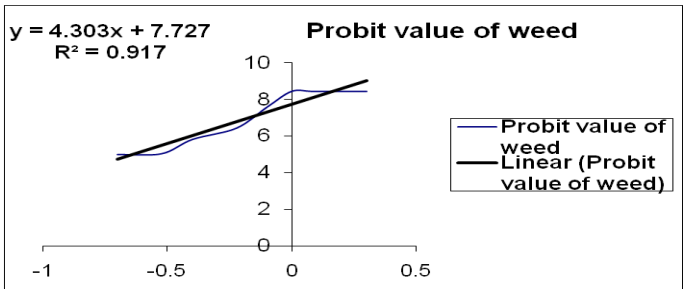
- **Calculation of GR_{15}**

Y=Probit Value of 15% growth reduction of Maize i.e. 3.50
3.50=1.7079x +3.349
Then x = 0.0883
Anti log of 0.0883-=1.2, then GR_{20} =1.2kg/ha. dose of Atrazine

- **Calculation of GR_{50}**

Y=Probit Value of 50% growth reduction of maize i.e. 5.22
5.22=1.7079x +3.349
Then x = 1.0954
Anti log of 1.0954=12.5, then GR_{50} =12.5 kg/ha dose of Atrazine.

Probit value of weed

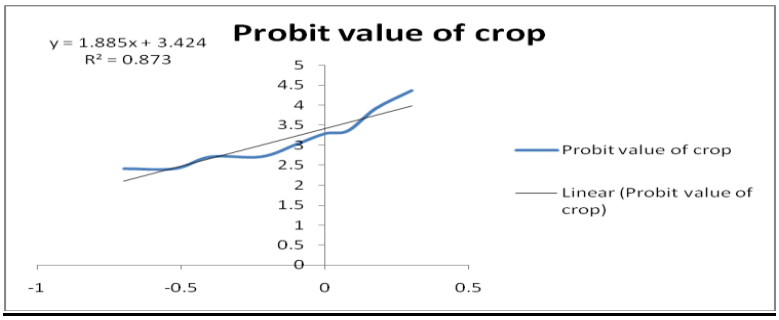


Calculation of GR_{80}

Y=Probit Value of 80% growth reduction of weed i.e 6.88
6.88=4.3031x +7.727
Then x = -0.1969
Anti log of 0.1969 =0.6, then GR_{80} =0.6kg/ha. dose of Atrazine

PENDIMETHALIN

Pre-emergence Probit value of crop



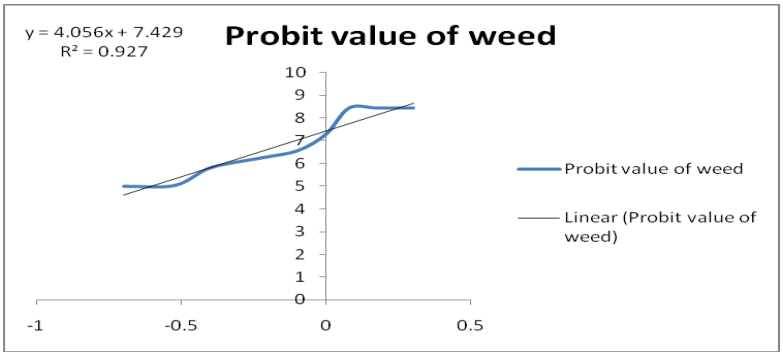
- **Calculation of GR_{15}**

Y=Probit Value of 15% growth reduction of Maize i.e 3.50
3.50=1.885x +3.424
Then x = .053
Anti log of .053 =1.1, then GR_{20} =0.1.1kg/ha. dose of Pendimethalin

- **Calculation of GR_{50}**

Y=Probit Value of 50% growth reduction of maize i.e. 5.22
5.22=1. 1.885x +3.424
Then x = 0.9527
Anti log of 0.9527=8.9, then GR_{50} =8.9kg/ha dose of Pendimethalin.

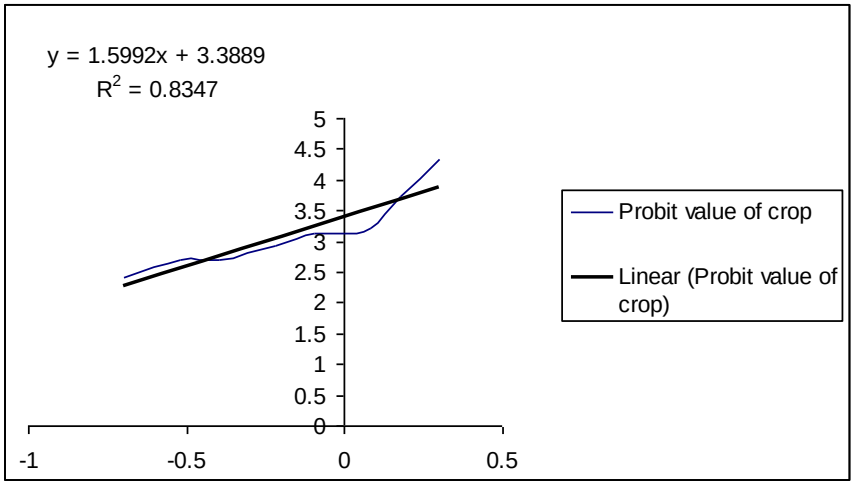
Probit value of weed



- **Calculation of GR_{80}**

Y=Probit Value of 80% growth reduction of weed i.e 6.88
6.88=4.056x +7.429
Then x = -0.1
Anti log of -0.1 =0.8, then GR_{80} =0.8kg/ha. dose of Pendimethalin.

ATRAZINE
Post-emergence (20 DAS)
Probit value of crop



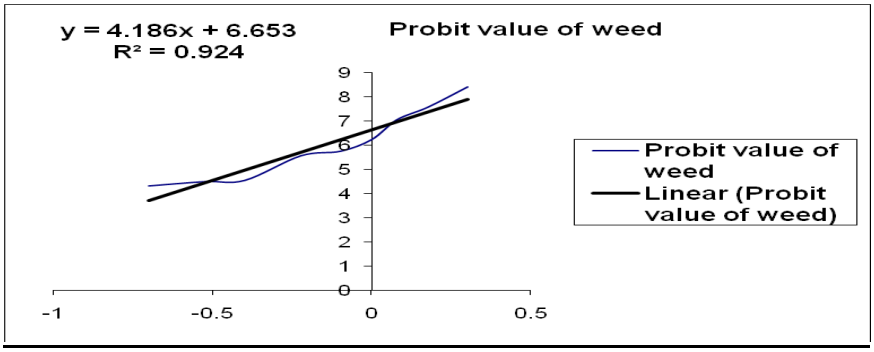
- **Calculation of GR_{15}**

Y=Probit Value of 15% growth reduction of Maize i.e. 3.50
3.50=1.5992x +3.3889
Then x = 0.1
Anti log of 0.1 =1.3, then GR_{15} =1.3kg/ha. dose of Atrazine

- **Calculation of GR_{50}**

Y=Probit Value of 50% growth reduction of maize i.e. 5.22
5.22=1.5992x +3.3889
Then x = 1.1
Anti log of 1.1=12.6, then GR_{50} =12.6 kg/ha dose of Atrazine.

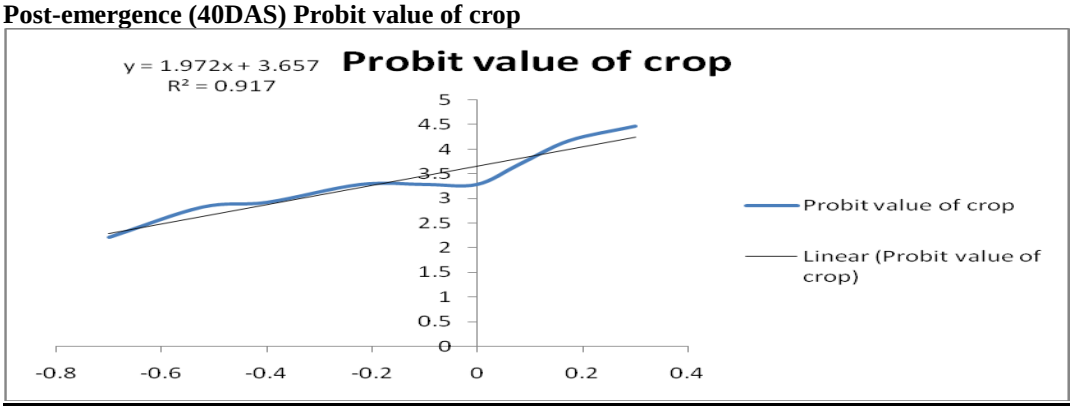
Probit value of weed



Y=Probit Value of 80% growth reduction of weed i.e 6.88
6.88=4.186x +6.653
Then x = .054
Anti log of 0.54 =1.1, then GR_{80} =1.1kg/ha. dose of Atrazine

ATRAZINE

Post-emergence (40DAS) Probit value of crop



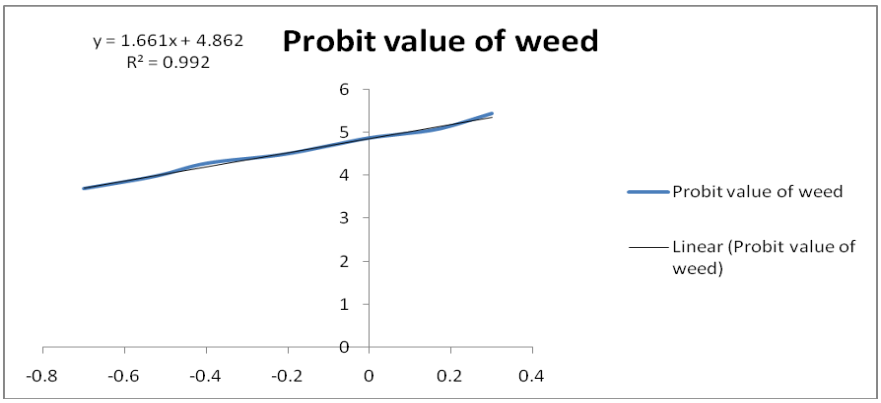
- **Calculation of GR_{15}**

Y=Probit Value of 15% growth reduction of Maize i.e 3.50
3.50=1.972x +3.657
Then x = -0.1
Anti log of -0.1 =0.8, then GR_{20} =0.8 kg/ha. dose of Atrazine.

- **Calculation of GR_{50}**

Y=Probit Value of 50% growth reduction of maize i.e. 5.22
5.22=1.972x +3.657
Then x = 0.8
Anti log of 0.8 =6.3, then GR_{50} =6.3 kg/ha dose of Atrazine.

Probit value of weed



- **Calculation of GR_{80}**

Y=Probit Value of 80% growth reduction of weed i.e 6.88
6.88=1.661x + 4.862
Then x = 1.2
Anti log of 1.2 =15.8, then GR_{80} =15.8kg/ha. dose of Atrazine

Table 2: GR_{15}, GR_{50} of Maize, GR_{80} of weed and SI value of the herbicides

Herbicide	Maximum dose(kg/ha) tolerated by crop (GR_{15})	Minimum dose(kg/ha) required to control weed(GR_{80})	Selectivity Index(SI)	GR_{50} value(kg/ha) of Maize	Linear regression equation		R^2 value	
					crop	Weed	crop	weed
Atrazine Pre-emergence	1.2	0.6	2.00	12.5	Y=1.707x +3.349	Y=4.303x +7.727	0.893	0.917
Pendimethalin Pre-emergence	1.1	0.8	1.375	8.9	Y=1.885x +3.424	Y=4.056x +7.429	0.873	0.927
Atrazine post-emergence(20DAS)	1.3	1.1	1.1818	12.6	Y= 1.5992x +3.3889	Y=4.186x +6.653	0.8347	0.924
Atrazine post-emergence(40DAS)	0.8	15.8	0.1	6.3	Y = 1.9724x +3.6574	Y=1.6613x +4.8629	0.9724	0.9925

IV. Conclusion

Maximum up to 1.2 kg/ha of Atrazine can selectively be used in Maize under pre-emergence application . However, minimum dose required to control the weed is 0.6 kg/ha with the SI value of 2.00. Whereas in pre -emergence treatment of Pendimethalin ,maximum and minimum doses are 1.1 kg/ha and 0.8 kg/ha, respectively, with the SI value of 1.375. Low SI value in pre- emergence treatment of Pendimethalin treatment makes the treatment less selective than that of pre -emergence treatment in atrazine. Therefore, the dose 0.6 kg/ha Atrazine can be applied in Maize safely as pre-emergence for controlling weeds.

Maximum up to 1.3 kg/ha Atrazine can selectively be used for maize under post-emergence application (20DAS).However, minimum dose required to control the weed is 1.1 kg/ha with the SI value of 1.1818.Whereas in post-emergence treatment (40DAS), maximum and minimum doses are 0.8 kg/ha and 15.8 kg/ha respectively, with the SI value of 0.1. Low SI value in post-emergence treatment (40DAS), makes the treatment less selective than that of post-emergence treatment (20DAS). Therefore, the dose of 1.1kg/ha can be applied in Maize safely as post-emergence application treatment controlling weeds.

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