



INTRODUCTION

- Biodegradable plastic mulch (BDM) emerged several decades ago as a new technology for crop production.
- The relatively high purchase price of BDM compared with polyethylene (PE) mulch appears to be a primary factor limiting widespread adoption.
- There is also concern regarding the level of mulch biodegradation in the field following soil-incorporation and impacts on soil health and productivity of subsequent crops.
- Currently, there is no standard field method to measure BDM remaining in the soil after incorporation.



Fig. 1. Rototilling biodegradable mulch after crop harvest in the field experiment in 2015.

OBJECTIVES

- (1) Develop a reliable method to measure the amount of mulch recovered in soil samples.
- (2) Determine the sampling area needed to confidently estimate how much mulch remains in the soil.
- (3) Calculate the number of soil samples needed from the sample area.

MATERIALS AND METHODS

This study included three experiments:

- 1) 5 BDMs were soil-incorporated, 5 soil samples were collected randomly in each plot, representing 0.6 % of the soil in the plot (based on volume) (Fig. 3).
- 2) 1 BDM was soil-incorporated, 15 soil samples were collected from each plot, representing 1.7 % of the soil in the plot (Fig. 3).
- 3) 1 BDM was soil-incorporated, 128 soil samples were collected from each plot, representing 79 % of the soil in the plot (Fig. 3).

Experiment 1 was carried out in 2015 at 2 locations: Mount Vernon, WA, with a cool, humid climate and Skagit silt loam soil; and Knoxville, TN, with a hot, humid climate and Shady loam soil. Experiments 2 and 3 were carried out only at Mount Vernon in 2016.

Mulch area measurement

Mulch area was measured using weight, graph paper and image methods to see the relationship among these methods. The weight method was used for all other analysis as it was found to be the most accurate method.

TABLE 1. Mulch treatments, manufacturers and percent biobased content (provided by manufacturers) for three experiments at Mount Vernon, WA and Knoxville, TN in 2015 and 2016.

Expt.	Treatment	Manufacturer	Bio-based %
Expt.1	BioAgri®	BioBag Americas, Inc. Dunedin, FL	20-25 %
	Exp. PLA/PHA	Experimental Film	86 %
	Naturecycle	Custom Bioplastics, Burlington, WA	20 %
	Organix	Organix Solutions, Maple Grove, MN	< 10 %
	Polyethylene (reference)	Filmtech, Allentown, PA	< 1 %
Expt. 2 & 3	WeedGuardPlus	Sunshine Paper Co., Aurora, CO	100 %
	Exp. PLA/PHA	Experimental Film	86 %



Fig. 2. Field experiment with 5 BDMs and 1 PE mulch at WSU Mount Vernon NWREC in 2015.

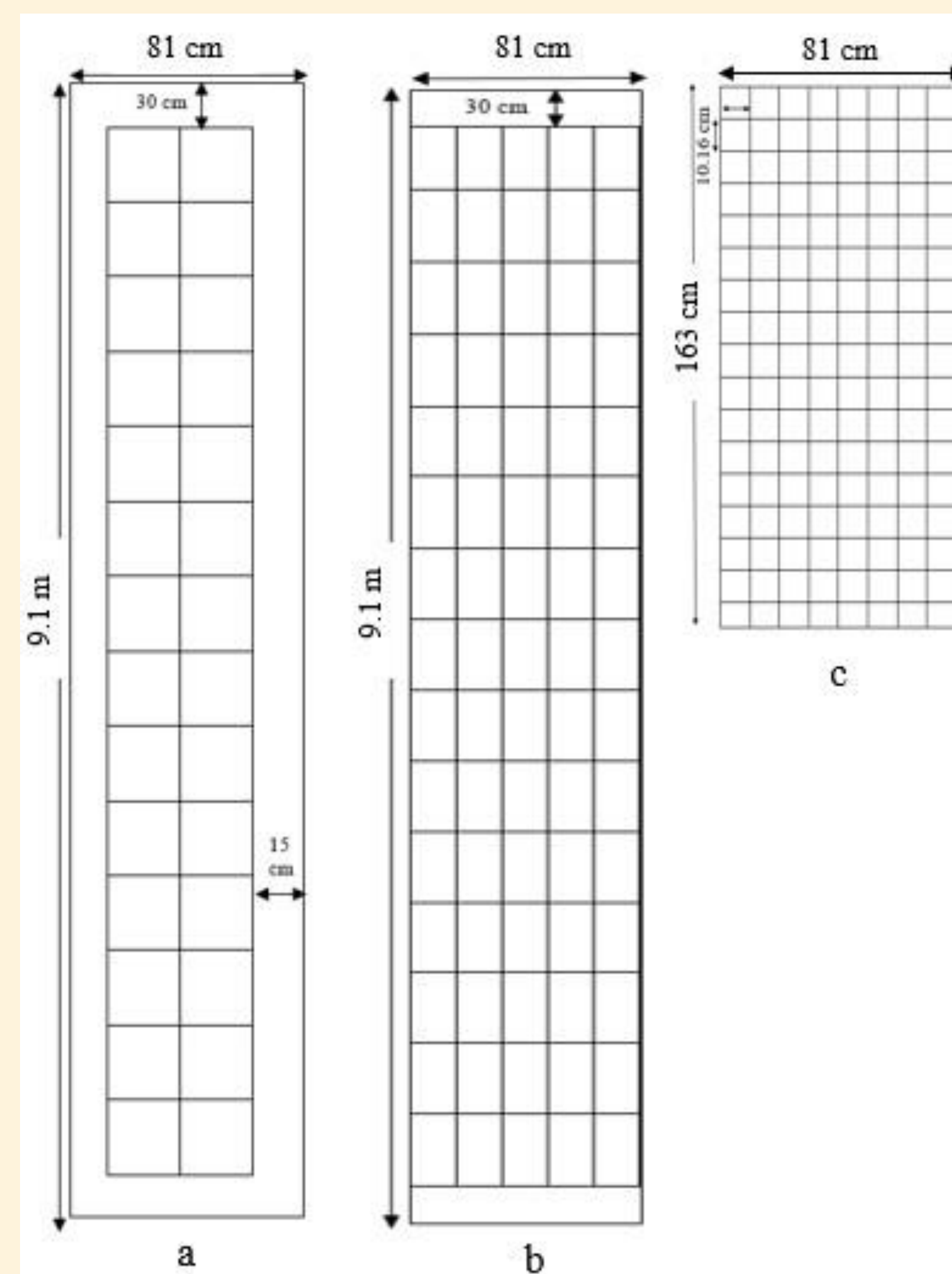


Fig. 3. Plot sampling grids in Experiments 1 (a), 2 (b) and 3 (c).

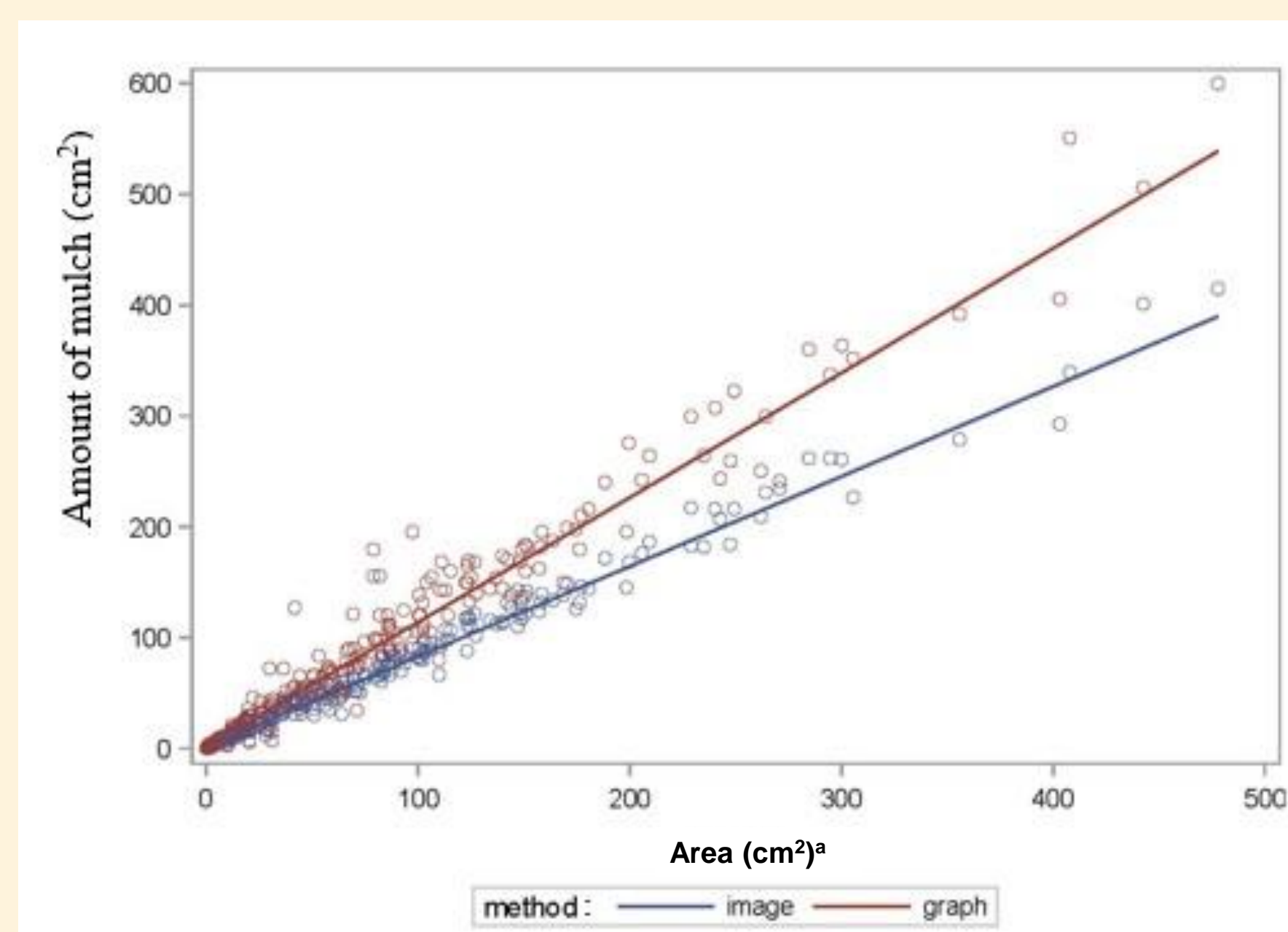
RESULTS

TABLE 2. Maximum, minimum and average percent mulch recovered from the field after soil incorporation, using core sampling (10.16 cm by 15.24 cm) and the weight method at Mount Vernon, WA and Knoxville, TN in Fall 2015.

Treatment	Percent mulch recovered					
	Mount Vernon, WA			Knoxville, TN		
	Maximum	Minimum	Average	Maximum	Minimum	Average
BioAgri®	95	14	46	87	49	68
Exp. PLA/PHA	77	34	54	83	8	43
Naturecycle	21	3	13	18	2	8
Organix	75	36	53	88	50	72
PE reference	83	44	59	- ^a	-	-
WeedGuardPlus	30	19	24	0 ^b	0	0

^a PE reference plot was not included at Knoxville.

^b WeedGuardPlus was almost completely deteriorated prior to soil incorporation at Knoxville (Ghimire et al. unpublished).



^a Area calculated with weight method

Fig. 4. Analysis of covariance for area of mulch (cm²) obtained from two methods, image and graph paper, as compared to weight. Image underestimates area, graph paper over-estimates, compared to weight.

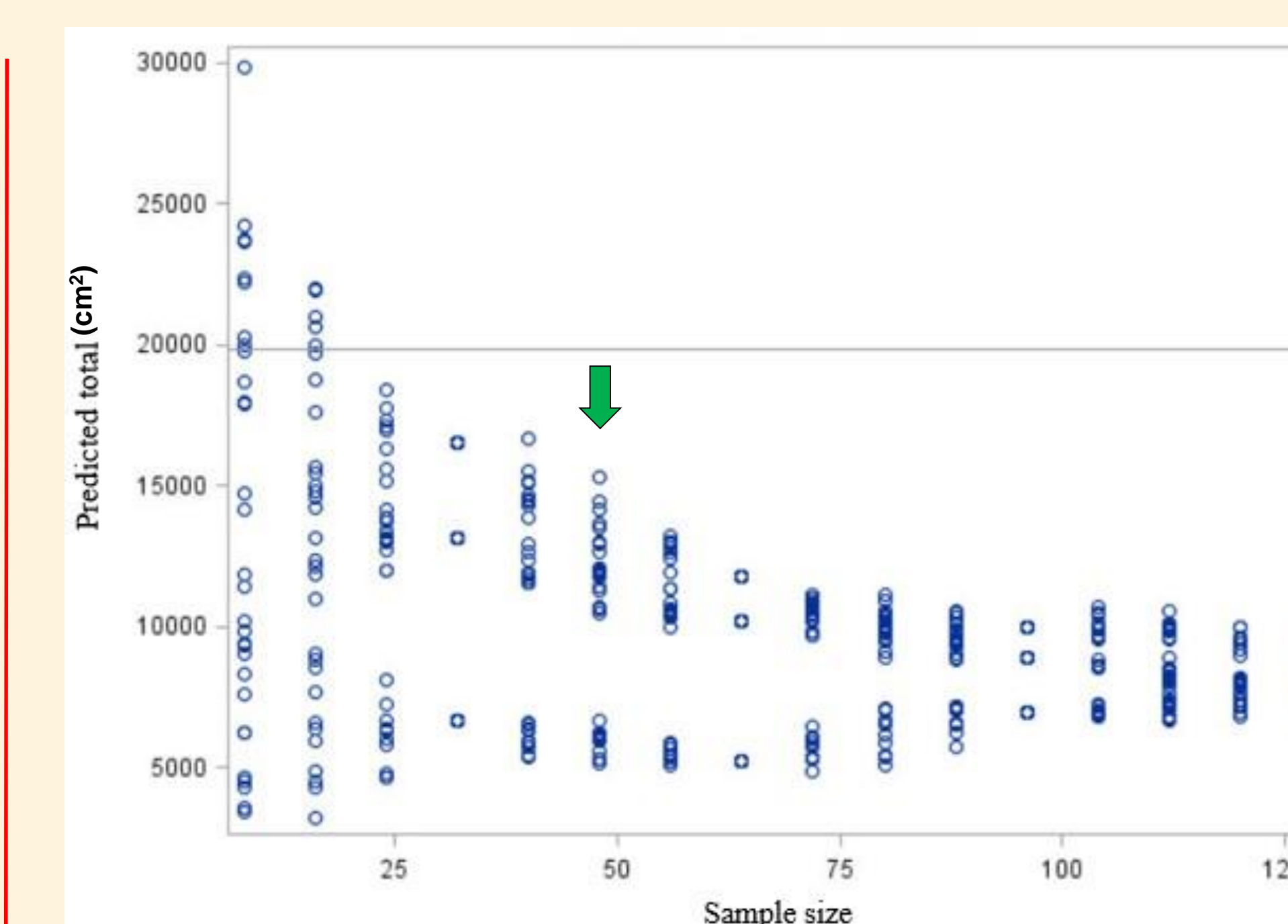


Fig. 6. Simulation of sample size (cores per plot) to find the minimum adequate number of soil core samples; the minimum number of soil samples is 50, indicated by arrow, to provide a stable measure of the amount of mulch remaining in the field after soil incorporation in Experiment 3 at Mount Vernon, WA in 2016. Horizontal line at 20,000 cm² indicates the amount of mulch tilled in the plot.

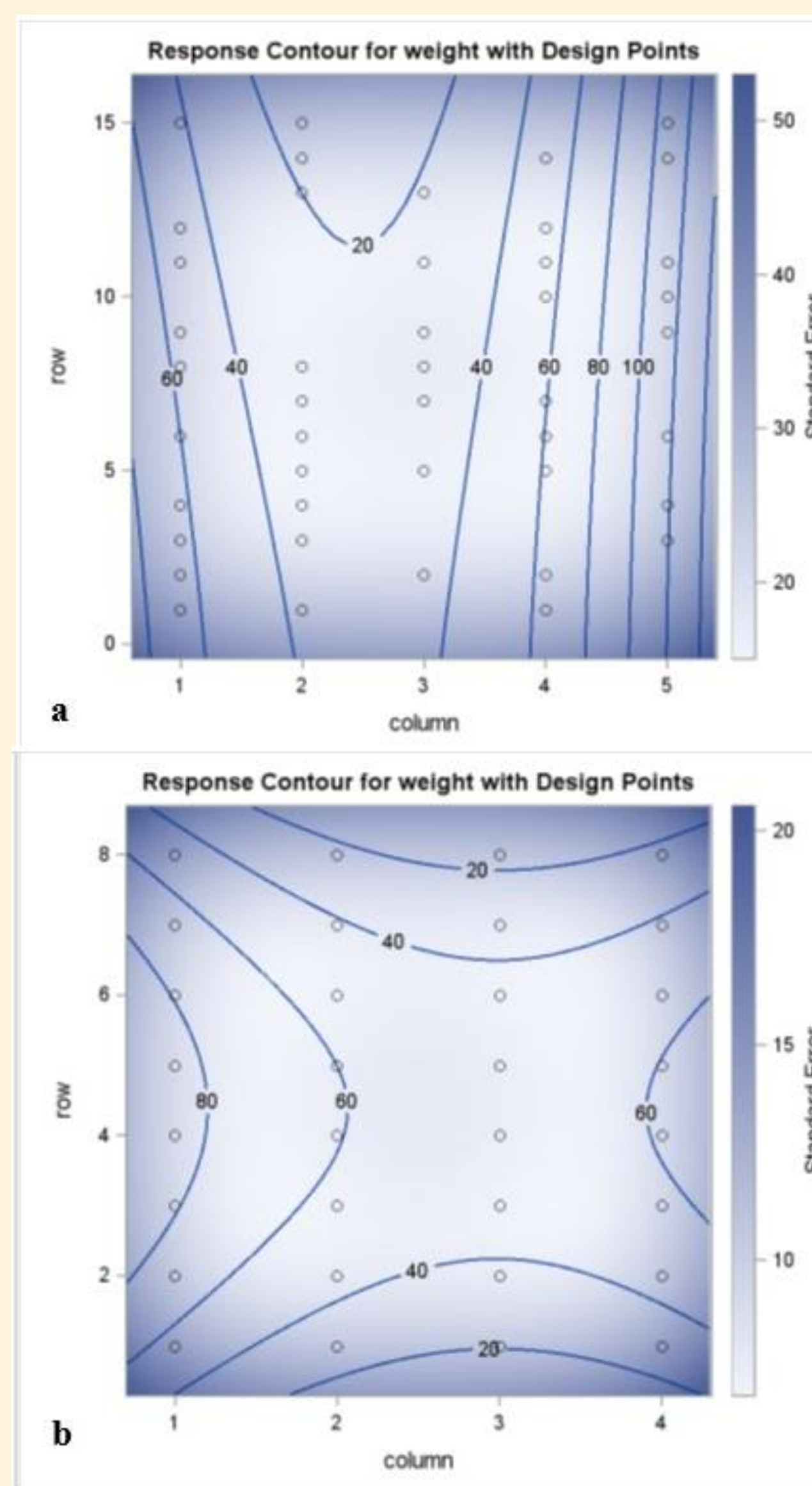


Fig. 5. Distribution of mulch fragments as shown by contour lines (number along the lines indicate area of mulch, cm² per sample at respective area in the plot) in the field post soil-incorporation in Experiments 2 (a) and 3 (b) at Mount Vernon, WA in 2016. Closely spaced lines indicate more concentration of mulch, while widely spaced lines indicate less concentration of mulch.

CONCLUSIONS

- The weight method was found to be most accurate for measuring area of mulch fragments.
- More mulch was found on the side of the plots than in the center or ends.
- At least 50 soil core samples are needed to obtain stable results on the amount of mulch in the field
- High variability between samples in the amount of mulch recovered indicates the soil core sampling method is not accurate, and new methods are needed.

ACKNOWLEDGEMENTS

