Standardizing Weed Sampling Procedures in Transplanted Rice

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ABSTRACT

The weed population in transplanted rice was estimated using various sampling frequencies and quadrat sizes and numbers. No functional relationship was determined between the quadrat size, quadrat number and coefficients of variation (CV) of weed data. When quadrat size was increased from 25 cm x 25 cm to 50 cm x 25 cm, substantial decrease in the coefficient of variation was noticed when weeds were sampled at 30 days after transplanting. The coefficients of variation (CV) of weed weight were found higher as compared to CVs of weed density for different quadrat sizes and quadrat numbers. The results show that at least one 25 cm x 50 cm quadrat per plot was necessary for weed population studies. Grasses and sedges must be sampled at 30 days after transplanting (DAT) whereas broadleaf weeds may be sampled at 90 DAT with two quadrats of 25 cm x 50 cm.

INTRODUCTION

In replicated trials, weed density data are generally, highly variable. Weed scientists observe substantial spatial variations in weed population studies from plot to plot as well as within a plot. Such a variation is not only inherent but is also caused several edaphic and biological facto Most often, a plant community do not occur uniformly throughout as the species and their distribution, th indicating considerable variabili Therefore, it becomes difficult to tain a representative sample of all members in a community. Howev with little amount of variation, a sin and relatively smaller sample might adequate.

On the other hand, the inform tion from complete count of all members in a community is neit economical nor feasible as compa to an appropriate sample capable estimating all the members in a co munity with reasonable level precision. Sufficient information the literature is not available on sa pling procedures for weed populat studies in transplanted rice. It is the fore, imperative to determine an propriate sample design in terms quadrat size and quadrat number the plant community as a whole for various weed groups. It is equally important to sample the we at correct stage of the crop grow IRRI (1977) reported that we should be sampled at maximum til ing and flowering stages of rice. Ag IRRI (1978) determined that corr tion between crop yield and we weight was almost always the high when data were collected at flowering. Kim and Moody (19

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recommended rice heading stage for mixed vegetation to obtain maximum floristic information. However, for sampling different weed species, Kim and Moody (1980a) reported that *Scirpus maritimus* L. may be sampled at 40 DAT, *Echinochoa glabrescens* Munro ex hook f. at rice heading and *Monochoria vaginalis* at rice maturity. For optimum quadrat size, IRRI (1976) determined that o.16 m^2 to 0.20 m^2 were the appropriate quadrat sizes. Also IRRI (1977) recommended quadrat sizes of 40cm x 40cm and 40cm x 60cm for the study of wet season rice weeds. Kim and Moody estimated a quadrat size of 0.30 m^2 to adequately represent the weed flora. E.D. Cruz et al. (1986) reported that five 50cm x 75cm quadrats were needed to estimate the weed population with weed weight as the parameter. Similarly, four 25cm x 10cm quadrats for grass weed weight and four 25cm x 50cm quadrats for broadleaf weed weight were found adequate. According to E.D. Cruz et al. suitable data collection stages for grass weeds and broadleaf weeds were 90-126 days after transplanting (DAT) and harvest time, respectively.

The present study was conducted to develop weed sampling techniques which provide precise estimate of the weed population in transplanted rice.

MATERIALS AND METHODS

The experiment was conducted on the farmer's field in Sialkot district (Daska) of the rice zone of the Punjab province of Pakistan. The field was under regular wheat-rice-wheat rotation. After wheat harvest, the field was harrowed twice in the second week of May, 1987. Before transplanting, the field was puddled twice with bullocks and planking was carried out. Thirty days old nursery of Basmati-370 rice was transplanted in the first week of July, 1987. Nitrogen @ 90 KgN/ ha was applied in two equal doses; at 30 DAT and at panicle initiation. All the phosphorus was applied at the land preparation stage.

A randomized complete block experimental design was used. Three weeding frequencies; no weeding, weeding once 30 DAT and weeding twice after 30 and 60 DAT were tested. The weed data was sampled at 30 DAT, 60 DAT (at maximum tillering) and 90 DAT (at panicle initiation). Seven different quadrat sizes of 25cm x 25cm, 25cm x 50cm, 25cm x 75cm, 25cm x 100cm, 50cm x 50cm, 50cm x 75cm and 50cm x 100cm were tried taking five samples for each quadrat per plot. There were six replications in the experiment.

At each sampling stage, the weeds were cut at ground level, counted by species, dried at 100°C for 48 hours and dry weights recorded. Grain yield could not be estimated accurately because of the lodging of the crop. Hence, grain yield data were not subjected to statistical analysis. Mean, standard deviation and CV of the weed count (combined and different weed groups) were computed. Appropriate quadrat size, frequency and sampling stage were determined on the basis of CVs.

RESULTS AND DISCUSSION

The CVs of the total weed count and weed weight are presented in table 1. The CVs of total weed density ranged from as low as 12.1 percent to as high as 56.9 percent. Weed density data collected at three stages of crop growth (30 DAT, 60 DAT and 90 DAT) indicated mixed trend. There was a marked decrease in the CV of weed density by increasing the quadrat size from 25cm x 25cm to 25cm x 50cm, when weeds were sampled at 30 DAT. However, no considerable improvement in the CVs was observed with a further increase in the quadrat size. Similarly, when weeds were sampled at 60 DAT, the lowest CV was given by the quadrat size of 25cm x 50cm with two samples from each plot. At third stage of sampling (90 DAT), quadrat size of 50cm x 75cm yielded the minimum CV. In general, the CVs for various quadrat sizes were lower when weeds were sampled at 30 DAT as compared to the CVs of 60 DAT and 90 DAT. Surprisingly, within a quadrat size, the CVs did not decrease with an increase in the quadrat number. The CVs of weed weight were higher as compared to CVs of weed density for different quadrat sizes and quadrat numbers.

Inconsistencies in the CVs of weed density and weed weight among quadrat sizes indicate that quadrat size depends upon the homogeneity of weed distribution (Mueller-Dumbois and Ellenberg, 1974: Kuchler, 1967). The sampling variance of the combined weed densities and weed weight exhibited the least sampling variance than those of sedges, grasses and broadleaf weed groups (Table 2). At first stage of sampling (30 DAT), the lowest CV of 44.2 percent was given by a quadrat size of 25cm x 50cm for grasses. For sedges, the minimum CV was observed for a quadrat size of 25cm x 25cm, when the data were collected at 90 DAT. Broadleaf weeds showed the minimum variance when sampled at 90 DAT with a quadrat size of 25cm x 50cm. Generally, the CVs of the broadleaf weeds decreased consistently from the first sampling stage (30 DAT) to third sampling (90 DAT) stage. Also, in case of broadleaf weeds, the rectangular plots (25cm x 100cm) were found to have lower CVs than square plots (50cm x 50cm). Kim and Moody (1983b) reported that rectangular plots have better representation of weed variation than square plots of the same area. Cruz, E.D. et al., (1986) also stated the superiority of rectangular plots over the square plots.

Transformation of weed density and weed weight data to log (x+1) significantly reduced the CVs of the individual weed groups (Table 3). The CVs due to transformation ranged from 30.7 percent to 138.5 percent for sedges, 11.1 percent to 50.4 percent for grasses, 31.5 percent to 96.4 percent for broadleaf and 4.1 percent to 20.9 percent for combined weed densities. The CVs of the combined weed weight were relatively higher as compared to the CVs of the combined weed densities for different quadrat sizes and quadrat numbers.

The results of the study indicate,

Table 1. Coefficients of variation of weed count and weed weight for different sizes and number of quadrats during Kharif, 1987.

Quadrat Size (cm)	No./ Plot	Coefficient of variation (%)					
		Weed Count			Weed dry weight		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
25 x 25	1	29.58	48.18	29.96	77.37	72.02	42.87
	2	40.24	40.34	36.59	61.64	82.02	40.92
	3	40.22	55.08	51.67	63.54	75.01	59.96
	4	47.70	54.32	54.28	58.47	70.00	79.44
	5	50.12	56.88	52.18	57.01	73.88	82.47
25 x 50	1	12.15	34.12	38.97	51.11	74.97	61.83
	2	28.66	31.53	38.29	47.77	71.42	54.30
	3	28.76	36.33	49.50	50.55	70.56	74.06
	4	35.61	35.83	46.64	48.29	66.50	77.65
	5	36.25	41.25	44.74	47.54	68.05	89.29
25 x 75	1	16.08	30.90	30.38	22.16	80.05	61.67
	2	23.62	33.03	31.06	37.69	70.97	55.03
	3	28.54	33.73	45.19	39.66	71.83	78.99
	4	26.90	32.30	41.08	39.28	66.57	77.32
	5	28.84	38.46	39.78	38.61	68.24	89.26
25 x 100	1	22.55	39.64	33.72	32.80	74.54	62.30
	2	26.60	36.55	32.78	50.97	60.51	58.90
	3	32.43	37.55	40.31	45.58	62.66	76.08
	4	28.90	34.59	36.90	41.66	57.65	82.55
	5	31.31	38.93	37.31	40.91	60.87	89.16
50 x 50	1	20.33	46.58	32.41	35.72	62.22	49.56
	2	32.61	37.03	34.18	49.21	55.27	49.39
	3	29.51	47.66	46.68	42.31	62.67	68.61
	4	31.54	45.46	43.30	39.45	60.62	70.12
	5	32.10	45.97	41.66	40.63	63.49	77.96
50 x 75	1	25.24	47.01	26.80	37.31	68.39	54.03
	2	25.55	37.32	30.16	53.02	50.34	53.87
	3	28.22	44.17	40.29	43.21	56.12	70.67
	4	25.98	40.75	37.64	38.43	53.12	75.82
	5	28.07	42.19	38.05	39.23	57.42	82.36
50 x 100	1	28.85	51.28	29.22	33.16	64.79	51.22
	2	33.32	38.14	31.11	49.30	47.76	52.91
	3	33.23	44.63	37.60	40.27	52.59	69.45
	4	28.96	40.59	34.60	36.19	51.14	73.11
	5	30.64	42.77	37.96	37.27	55.58	80.81

Table 2. Coefficients of variation of weed density of rice crop for different sizes and number of quadrats during Kharif, 1987.

Quadrat Size (cm)	No./Plot	Coefficient of Variation (%) 30 DAT			60 DAT			90 DAT		
		Sedge	Grass	B-leaf	Sedge	Grass	B-leaf	Sedge	Grass	B-leaf
25 x 25	1	111.7	46.1	113.0	126.5	81.9	105.9	55.7	88.2	37.6
	2	140.2	75.5	123.0	160.9	80.0	90.2	50.5	74.3	34.7
	3	167.2	79.1	92.0	184.8	73.0	113.4	67.1	80.6	39.5
	4	155.9	79.8	124.3	188.7	83.3	111.6	68.0	79.8	38.2
	5	169.9	79.8	124.3	172.8	89.1	108.1	67.0	84.1	41.0
25 x 50	1	89.4	44.2	70.8	137.3	61.5	93.1	62.4	83.8	33.9
	2	121.5	58.4	81.2	149.9	68.4	73.2	57.4	70.6	31.9
	3	122.5	62.6	70.8	167.7	65.8	85.6	73.7	76.9	37.1
	4	118.8	65.8	103.1	161.4	76.2	88.8	72.3	77.7	37.0
	5	126.9	64.1	100.7	158.1	85.3	92.2	69.1	84.5	40.0
25 x 75	1	91.6	50.2	86.7	114.0	59.5	79.5	64.1	88.3	39.7
	2	99.7	57.6	78.3	124.8	66.0	66.1	57.3	76.5	37.2
	3	85.8	65.6	76.6	142.9	63.7	75.3	81.4	83.1	42.3
	4	83.1	67.5	73.6	131.6	68.6	74.7	77.2	82.2	41.6
	5	89.4	65.5	73.6	129.0	72.6	77.5	74.2	86.3	43.4
25 x 100	1	61.2	57.6	87.4	103.8	50.2	82.5	54.0	85.9	44.0
	2	73.9	62.0	79.5	105.7	56.7	70.0	62.5	74.4	40.7
	3	75.8	72.0	75.8	115.0	58.8	82.4	84.0	86.1	42.3
	4	75.9	72.5	70.8	108.1	65.0	75.7	81.2	78.2	41.5
	5	77.2	72.0	68.7	110.3	69.1	77.3	78.3	83.2	43.3
50 x 50	1	56.6	45.7	89.2	99.7	53.5	78.8	84.7	80.9	39.4
	2	61.3	60.6	86.2	93.1	51.5	69.5	80.4	77.5	41.7
	3	72.2	66.7	86.7	100.1	59.9	88.6	109.5	85.5	44.0
	4	73.0	68.0	75.2	98.9	68.0	81.1	101.9	83.0	45.8
	5	75.5	67.6	72.7	102.8	70.8	79.2	97.5	86.7	45.9
50 x 75	1	57.4	46.7	90.5	100.7	58.3	80.5	84.7	80.4	36.9
	2	59.6	62.1	87.4	92.1	47.0	69.8	79.9	81.7	41.3
	3	77.4	68.8	88.0	97.8	53.1	87.2	102.5	95.2	47.4
	4	75.6	71.6	75.8	104.6	62.0	80.7	93.2	94.8	47.7
	5	75.3	71.3	72.3	106.1	66.6	78.4	95.1	97.2	47.3
50 x 100	1	70.6	46.1	85.6	104.4	56.2	77.9	126.5	93.9	45.2
	2	70.6	59.4	88.3	87.5	44.0	67.0	118.2	92.0	52.1
	3	75.4	65.5	88.0	87.5	50.8	89.0	114.4	124.0	65.1
	4	70.4	68.0	75.2	98.3	59.8	81.9	147.0	127.5	66.7
	5	72.5	67.6	72.7	100.8	65.1	80.0	137.9	124.9	64.8

t for the combined weed density, e sampling should be done at 30 AT to describe the rice weed popula- n in transplanted rice. Weed weight owed to be a better substitute for eed densities for weed population udies as it exhibited higher coeffi- ents of variation. At least one 25cm x cm quadrat per plot is necessary for eed population studies. When sedges e dominant species, the weeds must e sampled at 30 DAT with at least e quadrat of 50cm x 50cm. For gras- s, a quadrat size of 25cm x 50cm is dequate to sample weeds at 30 DAT. ontrary to grasses and sedges, the oadleaf weeds may be sampled at 90 AT with two quadrats of 25cm x cm.

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Table 3. Coefficients of variation of weed density (30 DAT) using log (x+1) transformation for different quadrat sizes and frequencies.

Quadrat		Coefficient of variation (%)				
Size (cm)	No/ Plot	Total	Sedge	Grass	Broadleaf	Total Weed Weight
25 x 25	1	11.12	89.68	24.15	91.89	40.48
	2	17.78	105.10	39.18	96.40	31.63
	3	17.25	130.51	46.47	79.89	31.02
	4	18.85	125.51	48.65	74.77	28.44
	5	20.91	138.50	50.43	76.50	27.70
25 x 50	1	4.12	66.34	21.26	39.78	19.54
	2	11.41	89.00	30.09	57.68	20.02
	3	10.78	93.44	31.90	54.18	20.41
	4	11.66	95.91	37.45	51.95	18.95
	5	11.97	104.26	35.41	51.85	19.19
25 x 75	1	4.75	52.12	23.99	43.52	8.11
	2	6.81	66.25	30.51	35.17	13.88
	3	8.10	53.98	31.97	39.18	14.35
	4	7.88	54.80	36.98	36.55	13.48
	5	8.71	63.92	34.79	36.62	12.92
25 x 100	1	5.86	36.17	24.41	40.93	8.30
	2	7.15	40.17	27.52	34.57	13.81
	3	8.35	39.22	29.45	39.37	13.04
	4	7.82	38.76	31.79	36.05	12.01
	5	8.72	41.09	30.43	33.65	12.09
50 x 50	1	6.57	42.29	11.13	33.11	9.86
	2	9.52	58.66	21.47	49.78	16.48
	3	8.76	64.27	25.71	50.70	14.66
	4	9.16	64.45	32.83	46.87	13.17
	5	9.66	68.38	31.22	44.76	13.95
50 x 75	1	6.70	37.96	11.71	40.46	8.64
	2	6.91	49.86	17.29	34.62	12.65
	3	7.40	45.24	22.12	40.04	10.94
	4	6.72	48.45	30.20	35.61	9.68
	5	7.72	54.05	29.01	32.69	10.74
50 x 100	1	6.77	34.97	13.90	35.00	7.60
	2	7.83	36.31	18.30	32.83	11.65
	3	7.76	33.30	19.82	38.72	10.10
	4	6.82	30.74	22.44	34.20	9.02
	5	7.78	35.54	22.14	31.48	10.10