FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
PRAIRIE GRASS ESTABLISHMENT STUDY
FINAL PROJECT REPORT
1998-2000

Prepared for
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The Fluor Fernald Prairie Grass Establishment Study measured the establishment and growth of both prairie grasses and weeds on a series of experimental plots. The goal of the study was to identify methods for establishing and managing prairie vegetation on sites that have had topsoil removed as part of remediation at the Fernald project site. The treatment plots were randomly distributed among the 45 spaces available (Figure 1).

Prior to the seeding in the spring of 1998, the surface soil was collected and analyzed for mineral content and organic matter to provide an initial baseline of soil quality. Plots were treated with herbicide and cultivated to remove weeds. To augment the low organic content of the disturbed areas the following amendments were applied to the designated plots: composted sewage, manure, 2 inches or 4 inches of top soil and none. To counter the lack of cover, one of three types of mulch treatments were applied to the plots: straw, wood chips or none. Initially, each test plot was seeded at a rate of 15lbs. pure live seed/acre with a seed drill. The seed mix for each plot consisted of Canada Wild Rye (*Elymus canadensis*); Little Bluestem (*Schizacrium scoparius*); Big Bluestem (*Andropogon gerardii*); Indian Grass (*Sorghastrum nutans*); Switchgrass (*Panicum virgatum*) and Side Oats Grama (*Bouteloua curtipendula*), followed by mulch application of straw, wood chips, and no mulch. The effects of soil amendments and types of mulch on establishment of prairie grass and weeds were evaluated by sampling prairie grass cover and weed cover (Greig-Smith 1964). There was no apparent pattern of position or soil effect in the overall data (Figures 2a and 2b, plot orientation, South to North and left to right). The current detailed evaluation was carried out at the end of the third growing season to allow the prairie grasses to become established on a marginal site.

In the fall of 1998, the amount of weed growth and the degree of success in establishing prairie grass were measured for each plot. On the basis of this evaluation, the 28 plots with high weed cover and low prairie grass establishment were prepared to be reseeded in the spring of 1999. Preparation consisted of selective hand application of Roundup herbicide and the addition of wood chips to the plots in order to control the weeds. From our earlier measurements of the plots, we concluded that wood chips lessen weed establishment and improve prairie grass establishment. Wood chips were applied in the fall of 1998 to 17 of the plots to be reseeded. Five of the remaining reseeded plots and 10 of the original plots already had wood chips, bringing the number of these plots to 32 of the 45 total plots. Wood chips were added in the fall to become seasoned and stabilized. The reseeded plots that received wood chips are indicated with cross-hatching. Data from the 28 reseeded plots are shown in white while the 17 unchanged original plots are in black in Figure 1. Management of the reseeded plots consisted of mowing and herbicide application. In the fall of 2000, after three seasons of growth, we measured the percent cover of prairie grass and weeds in all 45 plots (Daubenmire 1959).

Methods

The scoring of cover was done in the following manor:

% Cover	Value
0 to 5	1
5 to 25	2
25 to 50	3
50 to 75	4
75 to 100	5

A value for prairie grass and weed cover was assigned for each treatment based on the average score shown in the above table. Indicated on the picture labels in the far right column is the prairie grass and weed coverage value (G_-W_).

Key to Labels on Picture:

Plot #		
Amendment-Mulch-Seeding	Prairie Grasses	Grass-Weed Ranking

Indicated in the middle column is the prairie grasses present on the plot.
I = Indian Grass; B = Big Bluestem; W = Wild Rye; S = Side Oats Grama; L = Little Bluestem

Amendment Label: M = Manure, C = Composted Sewage Sludge, N = None
2 = 2'' of topsoil, 4 = 4'' of topsoil

Plot #		
M-__-__	_-_-_	_-_

Mulch Label: W = Wood chips, SW or NW = 2nd Application of Wood chips,
S = Straw, N = None

Plot #		
__-W-__	_-_-_	_-_

Seeding Label: O = Original Plots, R = Reseeded Plots

Plot #		
__-__-O	_-_-_	_-_

Results and Discussion

Original Plots and Plots Reseeded in Spring 1999

The results of the plots that were reseeded in the spring of 1999 are shown in Table 1. After one year of growth the 28 reseeded plots had prairie grass cover of 2.5 based on a scale of 5 while the 17 original plots that were not reseeded had a prairie grass cover of 2.1 (Figures 3 and 3a). The two sets of plots did not differ in weed cover. The reseeded had a value of 1.9 while the plots not reseeded had a value 2.0 in weed coverage. Of the 45 original plots 37.8% had satisfactory prairie grass establishment and weed control and so were not reseeded; 62.2% were reseeded. No marked difference in prairie grass establishment and weed cover was found between the original and reseeded plots. Note that the values for grass cover and weediness from the original plots are biased because the data for the low quality plots that were reseeded, are not included in the calculations.

Mulch Treatments

The levels of prairie grass establishment and weed invasion for the different mulch treatments are shown in Table 2. All 15 of the straw plots, which had low coverage of prairie grass and high weed content, needed to be reseeded. Plots with wood mulch, both the initial plots and those receiving fall application in 1999, had higher prairie grass establishment and lower weed cover than did the other mulch treatments. The degree of prairie grass establishment and weed coverage is shown in Figure 4, for individual plots and in figure 4a, for group averages. Among the individual wood chip plots, plot 17, reseeded, and plot 18, original, had a high percentage of prairie grass cover and essentially no weed cover. Wood chips covered the remaining area. Presumably, the high success rate resulted from the protective action of the wood chips and lack of an amendment that contains weed seeds. In the original seeding, the plots with straw had the lowest establishment of prairie grass, likely due to weed dominance.

Amendments

The levels of prairie grass establishment and weed invasion under the different amendments are shown in Table 3. There were 9 plots for each amendment except for the topsoil, where there were 18 because the 2- and 4-inch topsoil treatments were combined. The plots with no amendments (none) had the lowest weed coverage and the composted sewage sludge had the highest weed coverage. The manure plots have the highest coverage of prairie grasses and the second lowest average of weed species. The degree of prairie grass establishment and weed coverage is shown in Figure 5, for individual plots and in figure 5a, for group averages. The analysis of the amendments showed little difference among the four treatments in terms of prairie grass cover. The range among the weed coverage values for the amendments was slightly higher. The plots with no amendment had the lowest weed coverage, indicating that amendments likely are a source of weeds. There is no clear pattern in the degree of satisfactory establishment in any of the original amendment plots.

Conclusions

The levels of prairie grass establishment and weediness in plots that were reseeded in the Spring of 1999 were similar to those of the originally seeded plots that remained (Table 1). Note, however, the level of success for the 17 original plots is biased high because the unsatisfactory plots were reseeded and the data of these plots did not contribute to the averages. The reseeded plots as a group performed equally as well as the best of the original plots. The need to reseed the 28 plots was due to a number of factors including, lack of mulch, introduction of weed seeds through the amendments, and the occasional clogging of the Truax drill used on the original seeding. The plots with the different soil amendment treatments showed little variation in prairie grass establishment (Table 2), indicating that low soil fertility was not a critical factor. However the composted sewage sludge plots showed increased weed coverage in comparison to the other treatment plots. Of all the different treatments applied to the plots, both amendments and mulches, the addition of wood chips showed the highest favorable effect on both prairie establishment and weed control (Table 3). The favorable effect of wood chips was observed for both initial and second seeding.

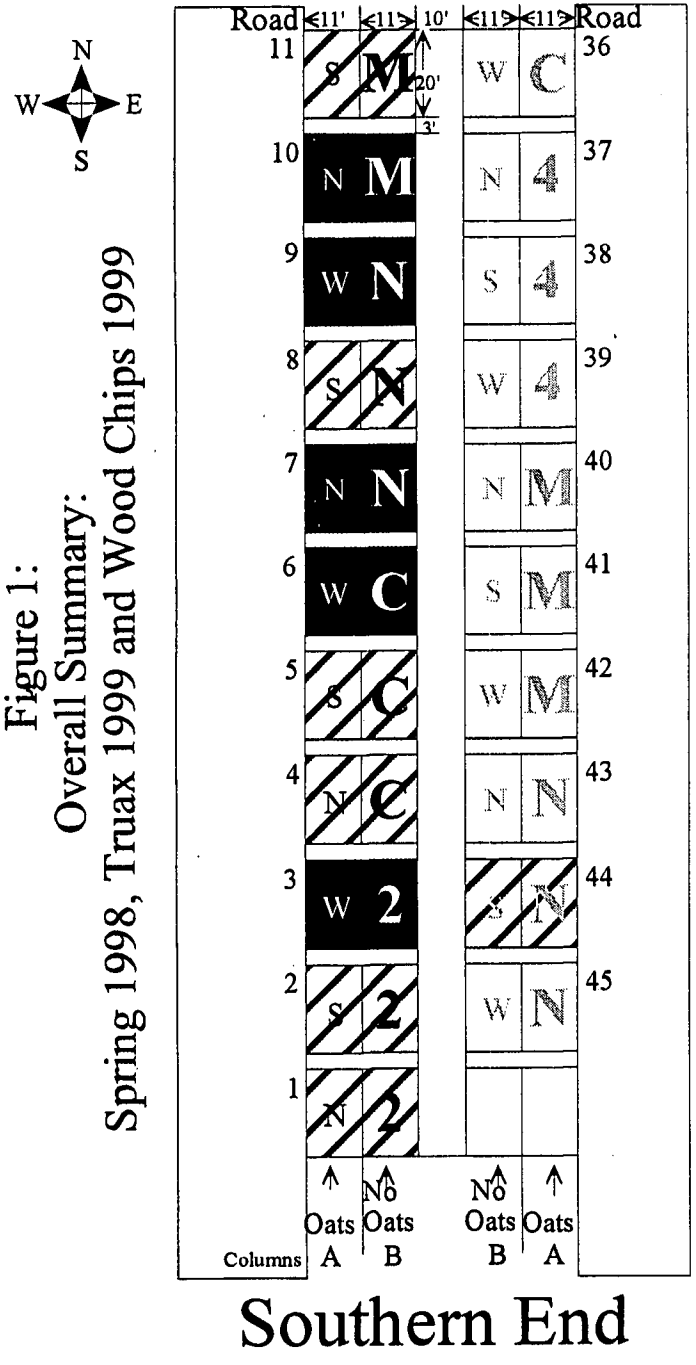
References:

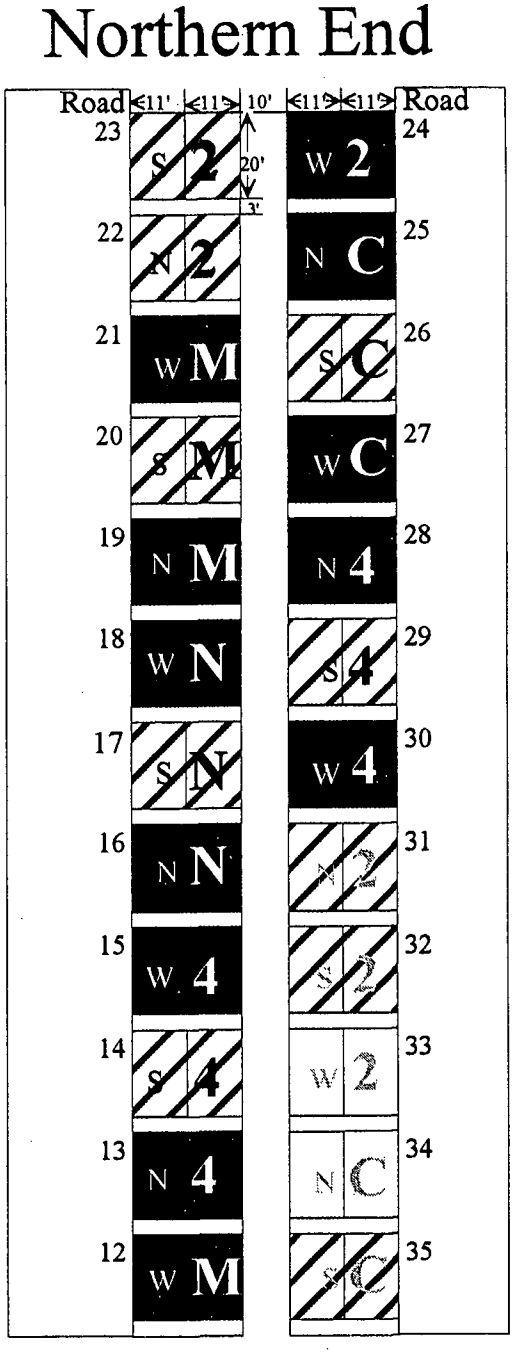
Daubenmire,R. 1959. "A Canopy-Coverage Method of Vegetational Analysis." *Northwest Science* 33, no.1: 43-63

Greig-Smith, P.1964. *Quantitative Plant Ecology*. London: Butterworths.

Packard, S. and Mutel, C. 1997. *The Tallgrass Restoration Handbook*. Washington, D.C.: Island Press.

Figure 1:
Overall Summary:
Spring 1998, Truax 1999 and Wood Chips 1999





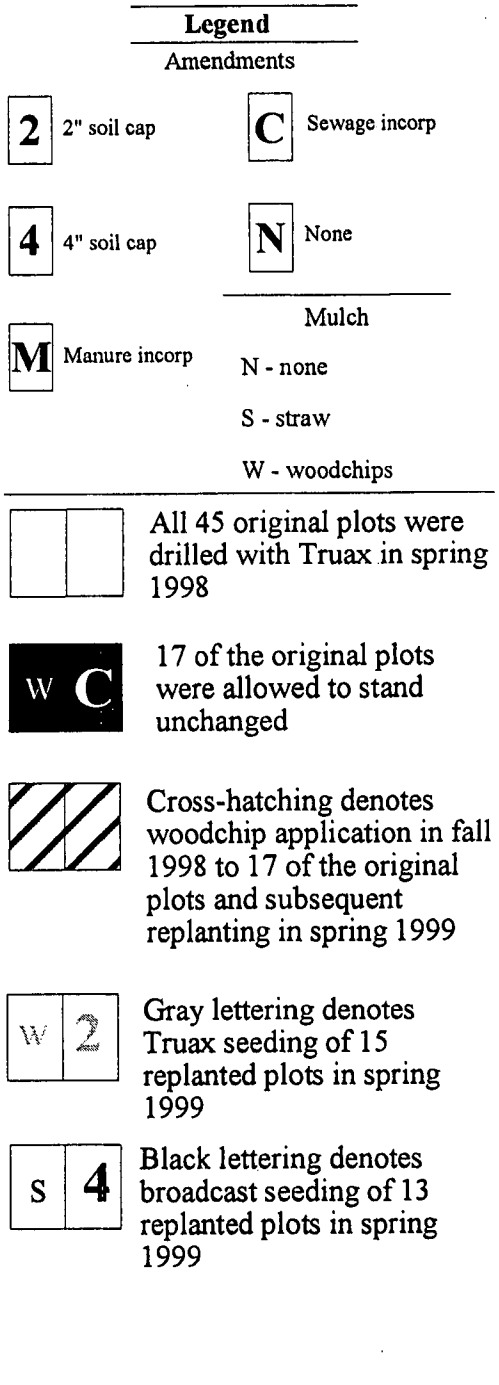


Figure 2a. Test of Possible Plot Position Effect on Prairie Grass Establishment. Results indicate lack of bias.

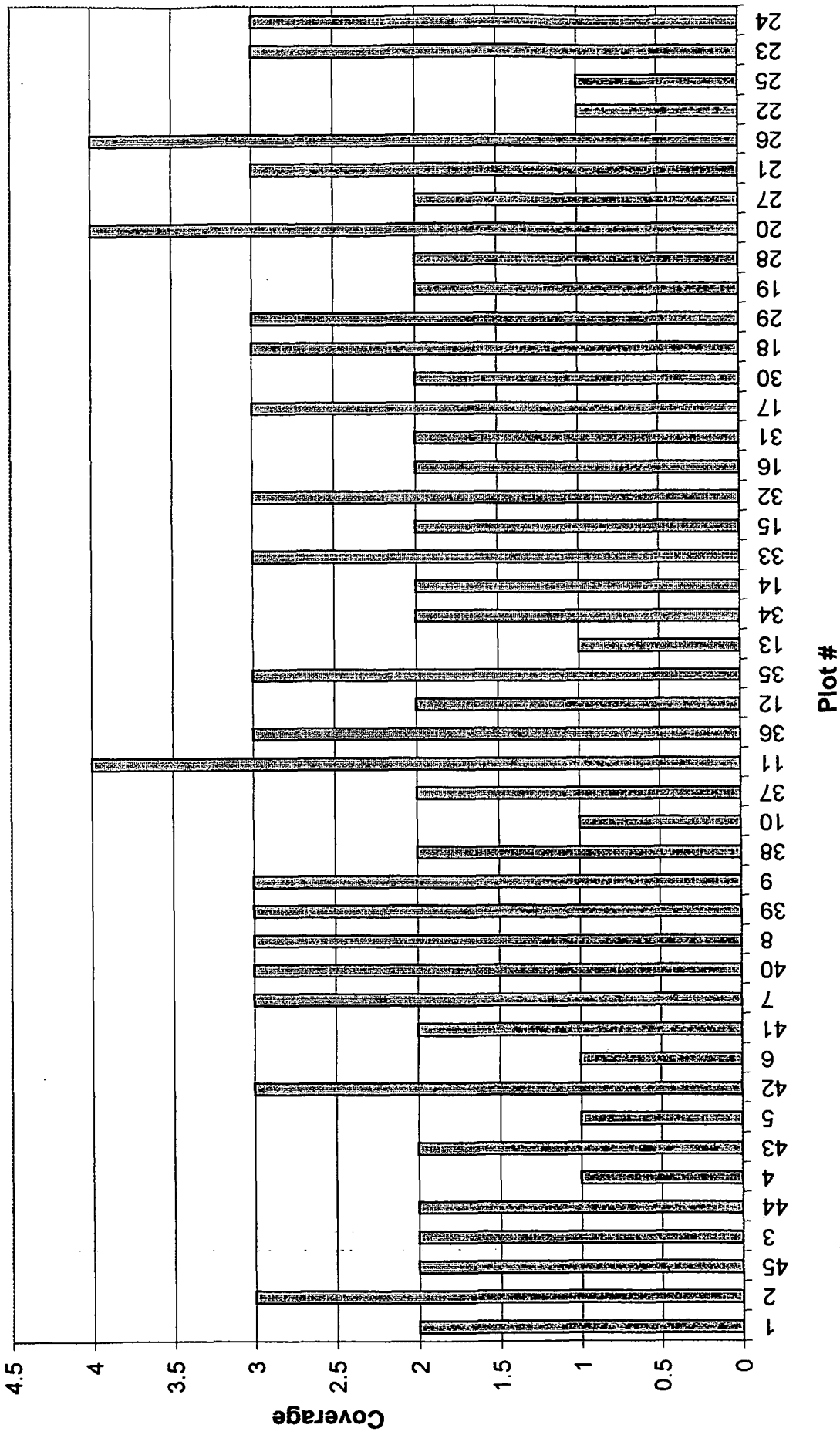
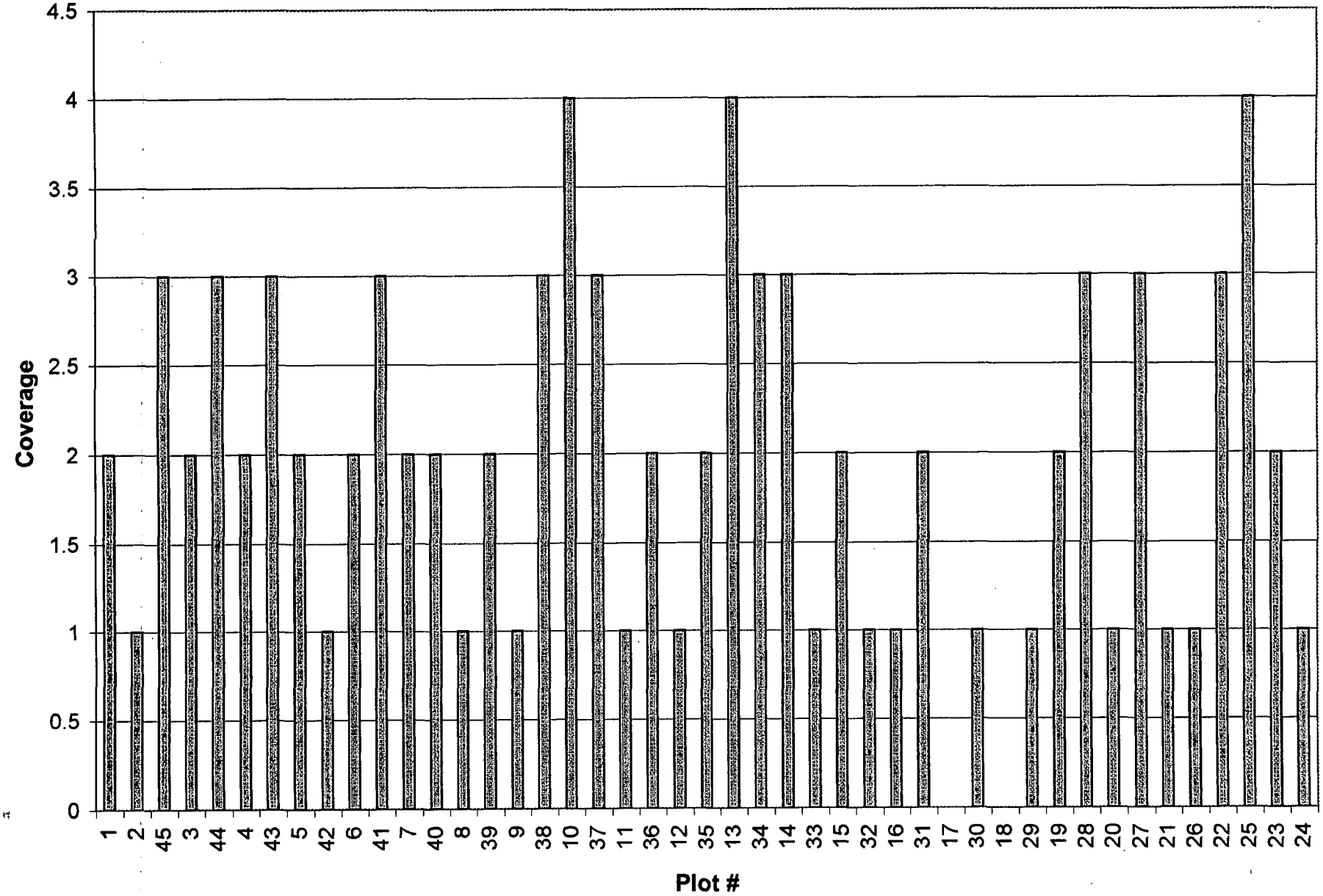


Figure 2b. Test of Possible Plot Position Effect on Weediness. Results indicate lack of bias.



Tables

Table 1. Comparison of Prairie Grass Establishment and Weed Invasion Among Original and Reseeded Plots. In this and the following tables the coverage values for prairie grass and weeds are represented by the average percent cover value ± standard deviation. Below each value is the number of plots the average is taken from. Satisfactory plots are the originally seeded that are based on relatively high prairie grass coverage and low weed establishment.

Prairie Grass Coverage

	Reseed	>	Original
Average	2.54 ± .84	>	2.06 ± .75
	n = 28		n = 17

Weed Coverage

	Reseed	<	Original
Average	1.93 ± .9	<	2.00 ± 1.22
	n = 28		n = 17

Initial Degree of Establishment	Satisfactory	Reseed	% Satisfactory
Original Seeding	17	28	37.8%

Table 2. Comparison Between Three Types of Mulch Treatments.

Prairie Grass Coverage

	2nd Wood	>	Wood	>	Straw	>	None
Average	2.59 ± 1.00		2.47 ± .64		2.00 ± 0.0		1.91 ± .70
	n = 17		n = 15		n = 2		n = 11

Weed Coverage

	Wood	<	2nd Wood	<	None	<	Straw
Average	1.53 ± .83		1.64 ± .86		2.82 ± .98		3.0 ± 0.0
	n = 17		n = 15		n = 2		n = 11

Initial Degree of Establishment	Mulch	Satisfactory	Reseed	% Satisfactory
Original Seeding	None	7	8	46.7%
	Straw	0	15	0%
	Wood	10	5	66.7%

Table 3. Comparison of the Four Soil Amendments.

Prairie Grass Coverage

	Manure	>	None	>	Soil	>	Composted Sewage Sludge
Average	2.67 ± 1.0		2.56 ± .53		2.28 ± .67		2.0 ± 1.12
	n = 9		n = 9		n = 18		n = 9

Weed Coverage

	None	<	Manure	<	Soil	<	Composted Sewage Sludge
Average	1.56 ± 1.24		1.78 ± 1.09		2.06 ± .94		2.33 ± .87
	n = 9		n = 9		n = 18		n = 9

Initial Degree of Establishment	Amendment	Satisfactory	Reseed	% Satisfactory
Original Seeding	2''	2	7	22.2%
	4''	4	5	44.4%
	C	3	6	33.3%
	M	4	5	44.4%
	N	4	5	44.4%

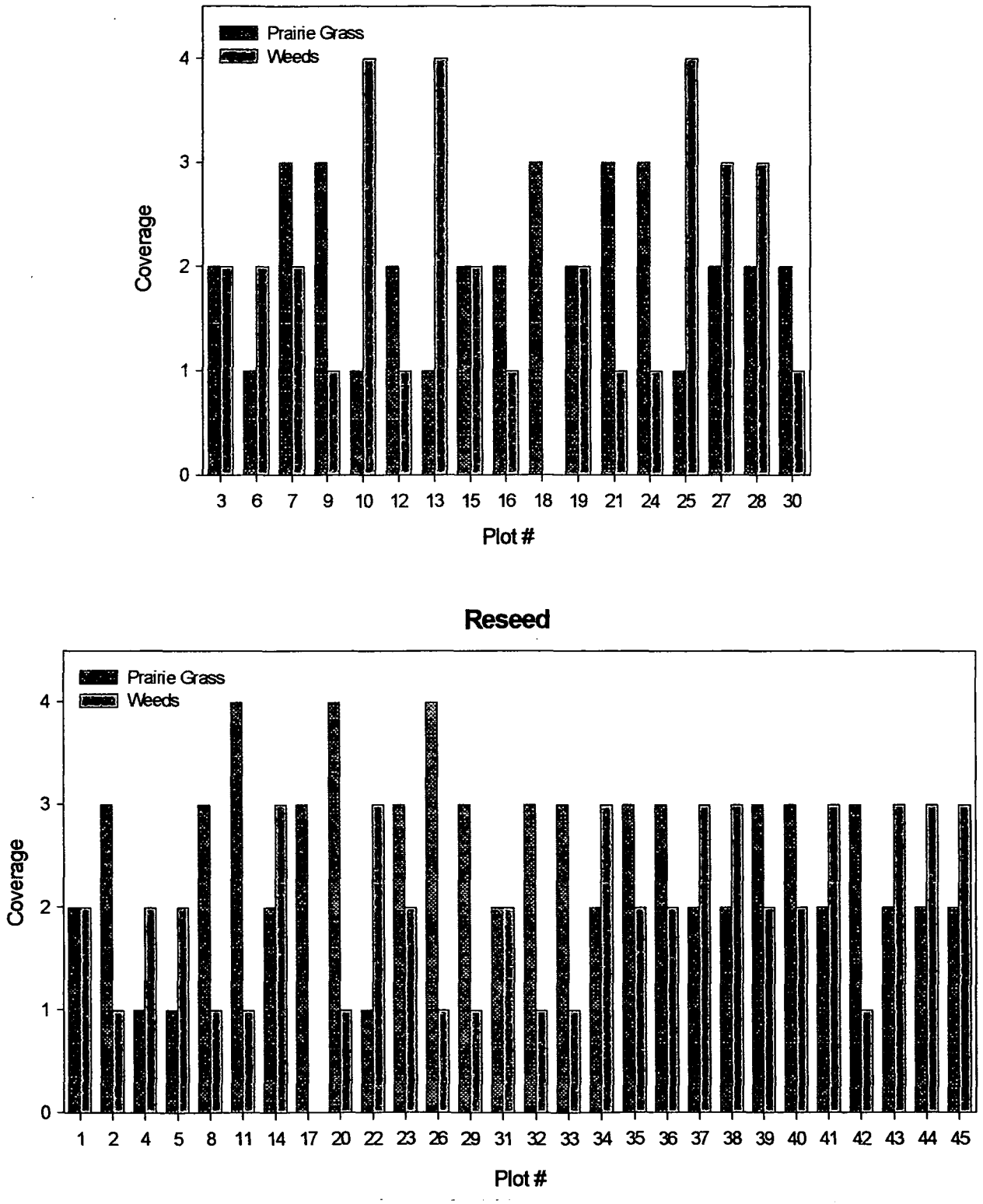


Figure 3. Prairie Coverage for Original and Reseeded Plots. For this and all figures the coverage values were assigned on the 5-point scale described in the Methods section.

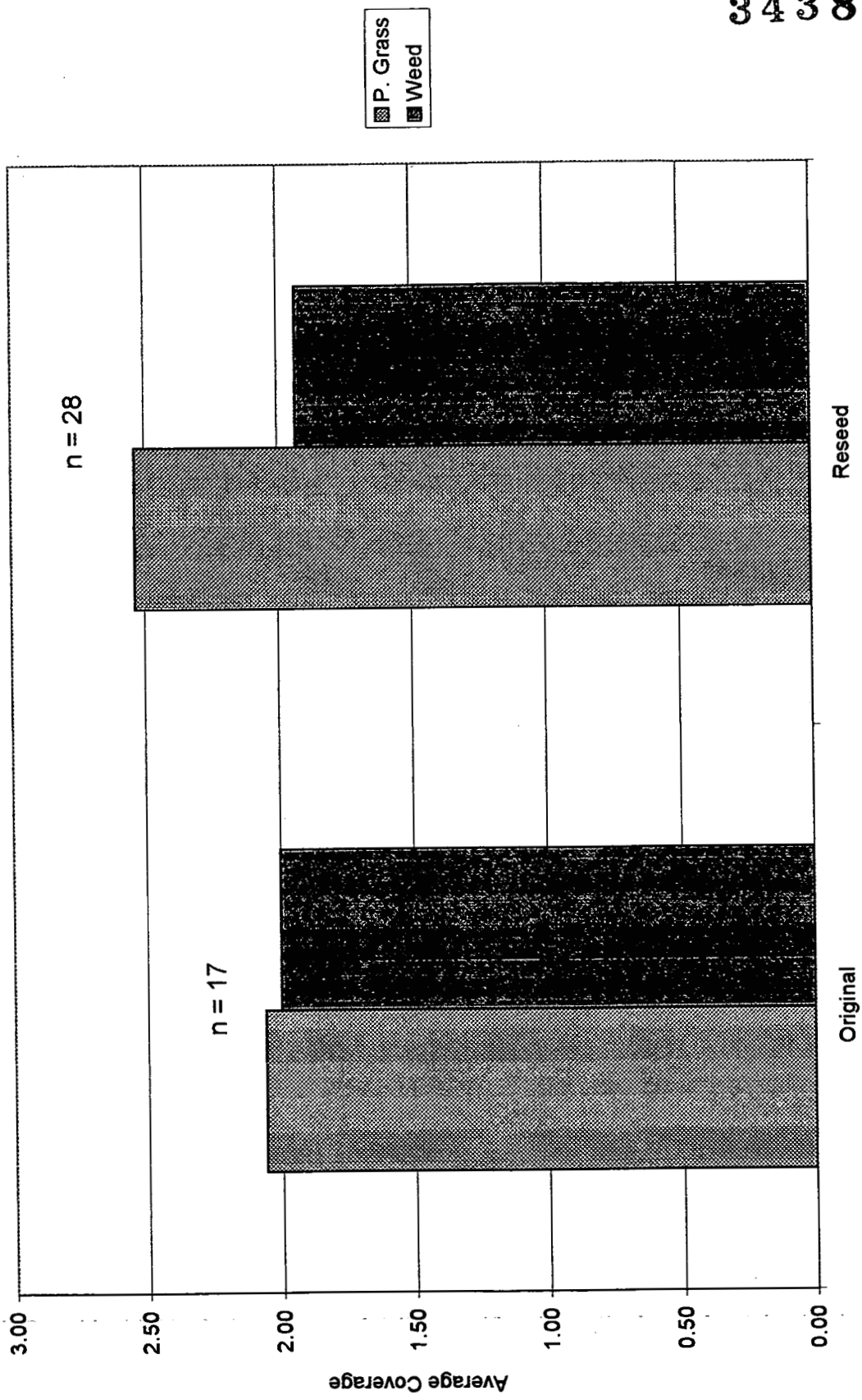


Figure 3a. The Effect of Reseeding on Establishment of Prairie Grasses and Weeds.

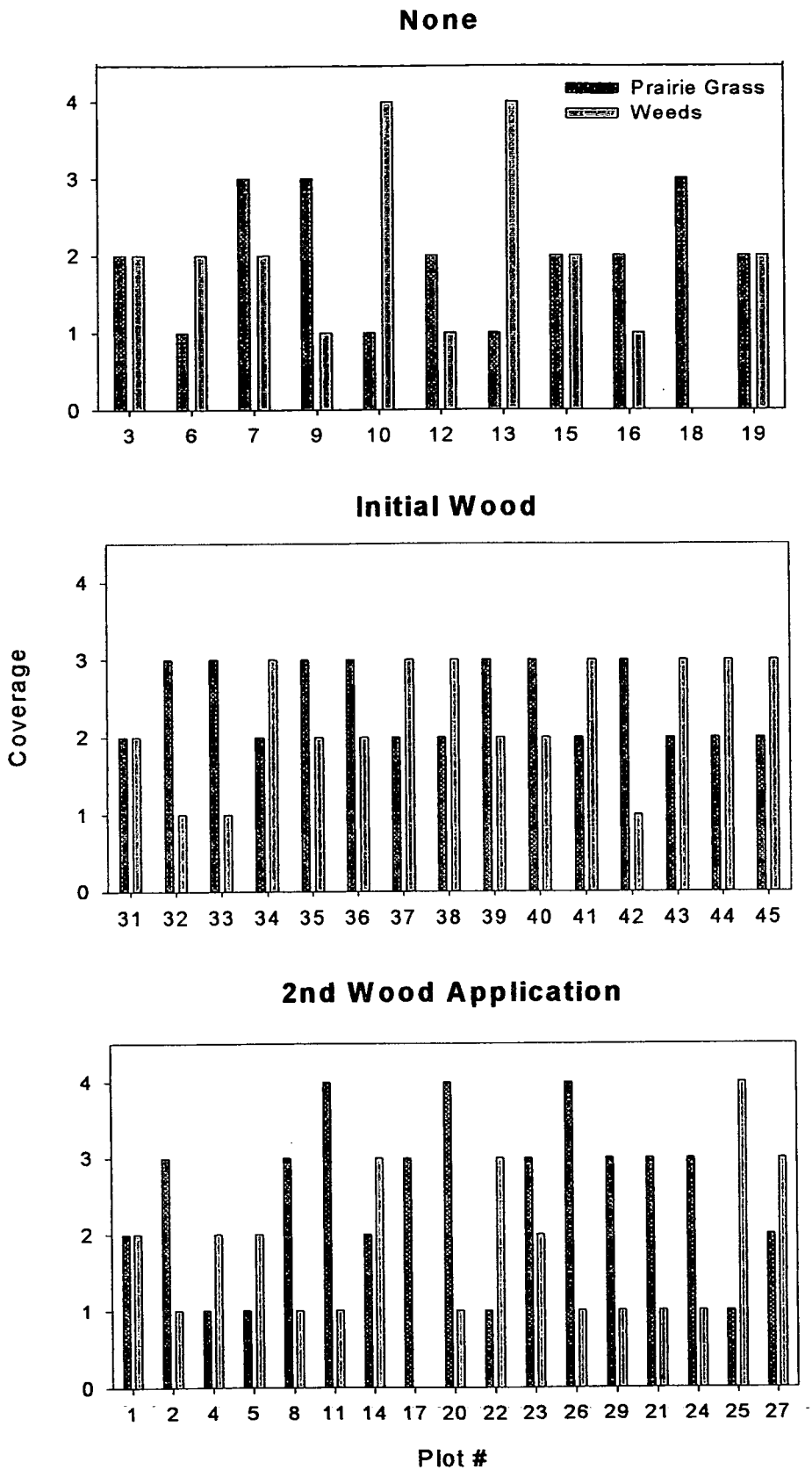


Figure 4. Prairie Grass and Weed Coverage of the Different Mulch Treatments.

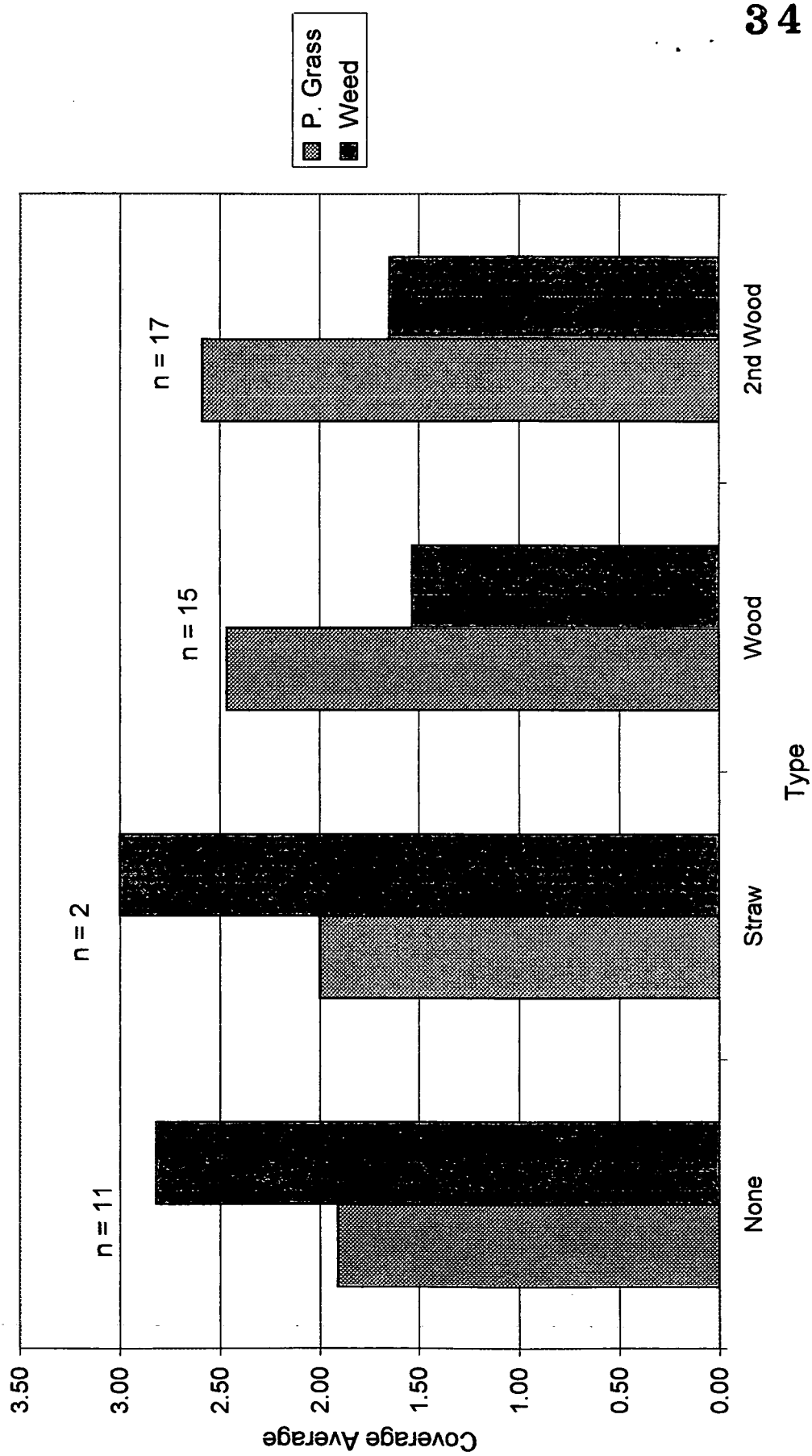


Figure 4a. The Effect of Mulch Types on Establishment of Prairie Grasses and Weeds.

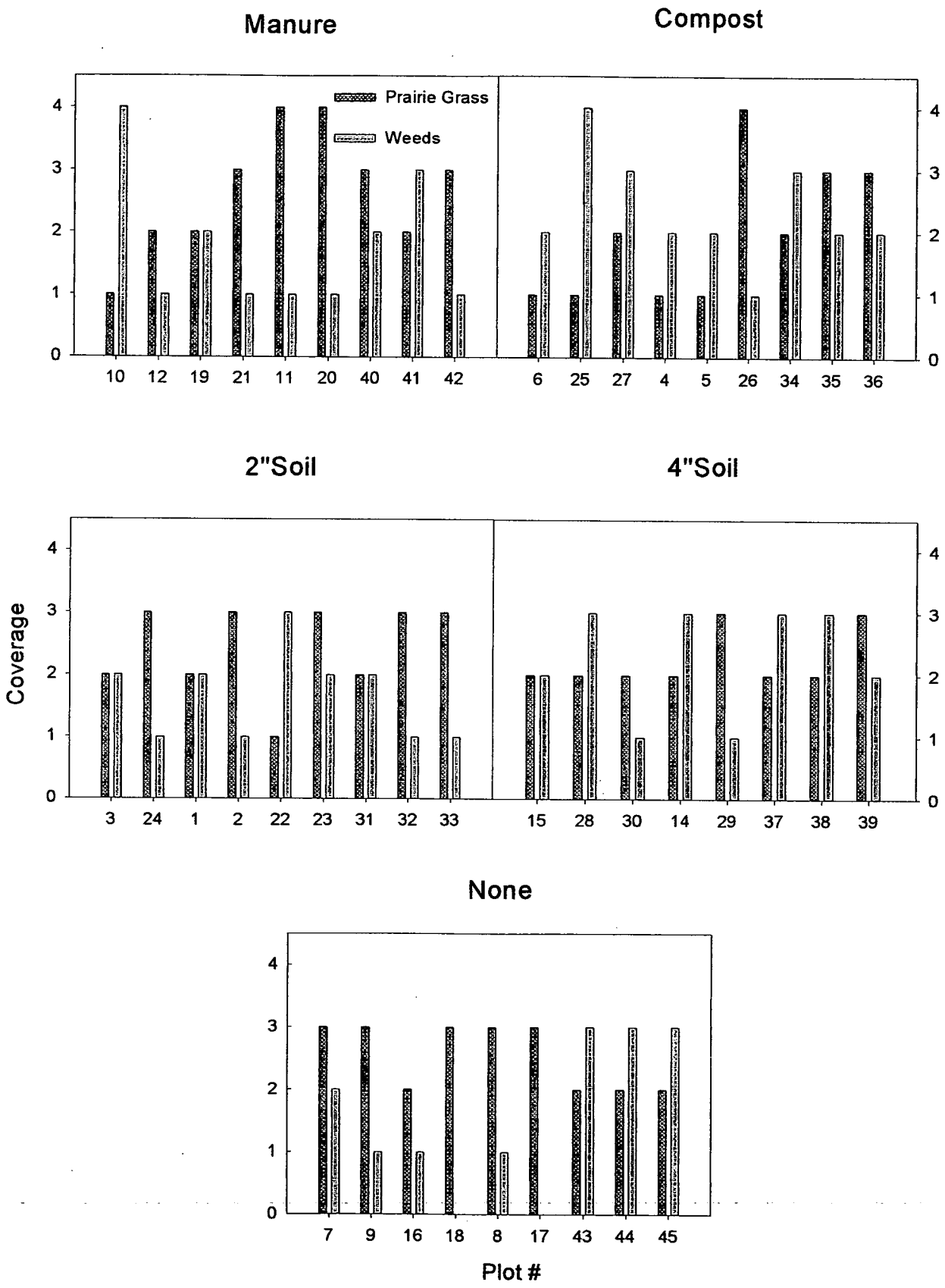


Figure 5. Average Prairie Grass and Weed Ranking per Plot for Each Amendment Treatment.

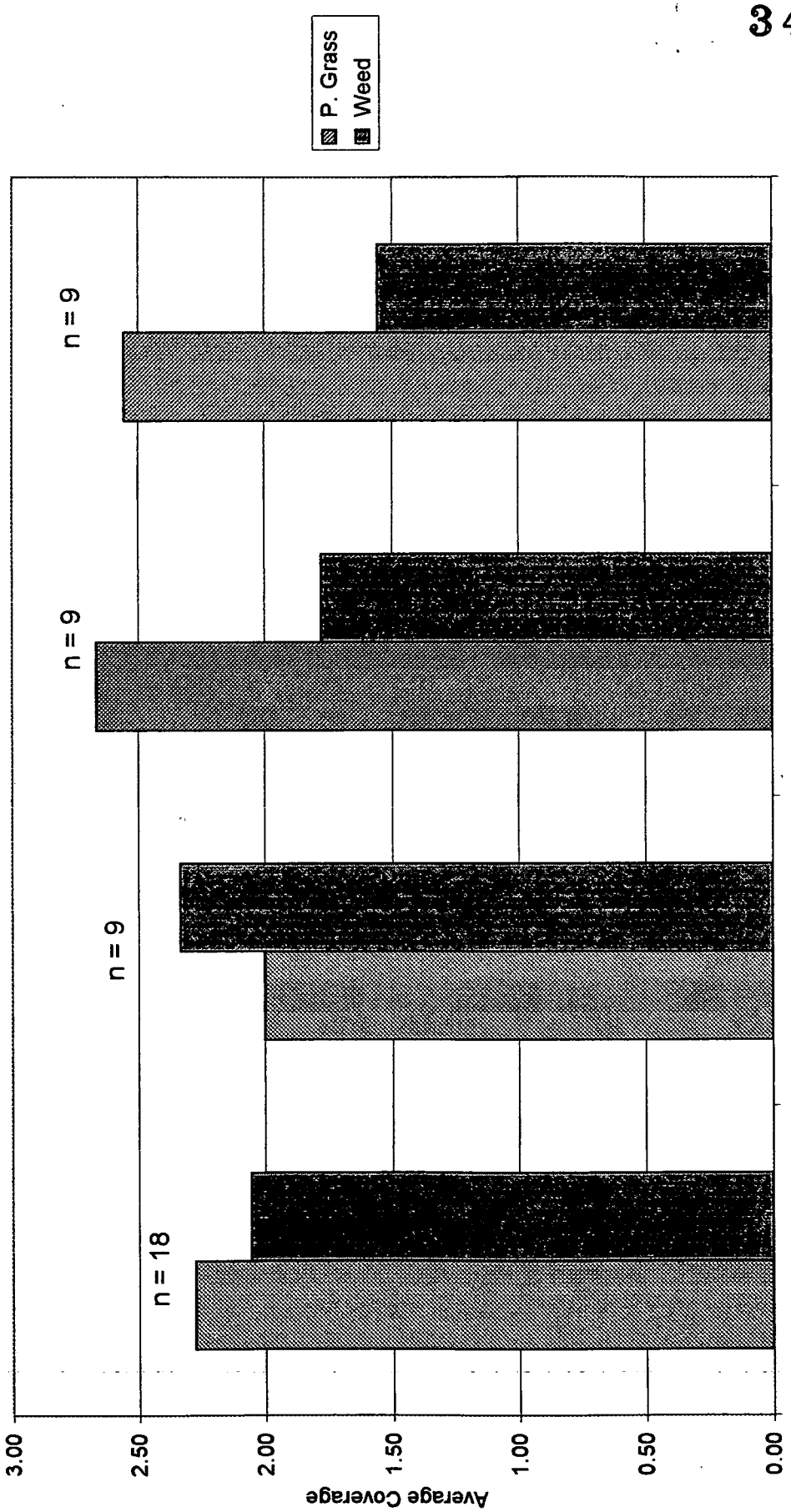
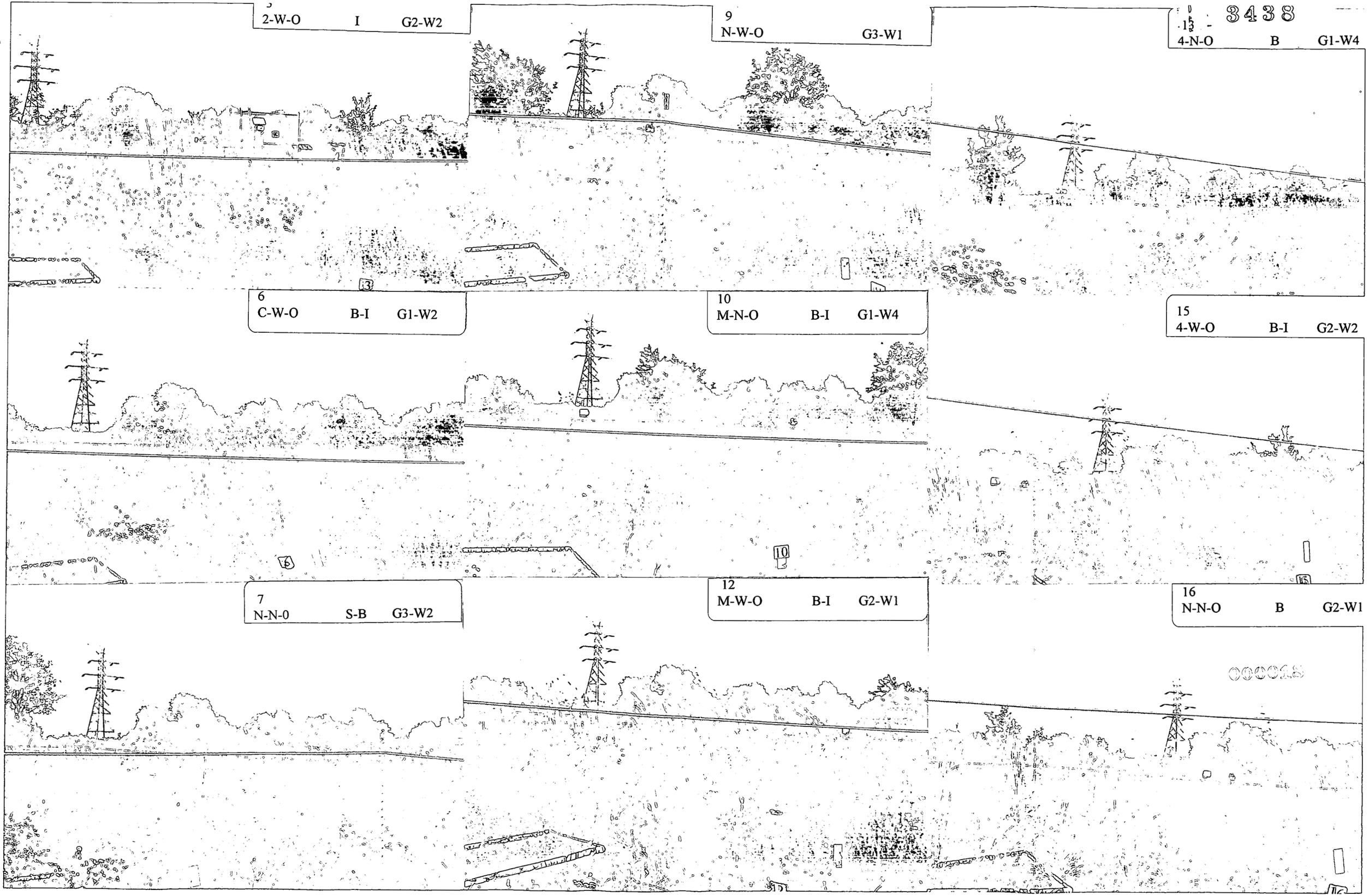


Figure 5a. The Effect of Amendment Treatments on Establishment of Prairie Grasses and Weeds.

Seeding

O = Original

R = Reseeded


3438
2-W-O I G2-W2
9
N-W-O G3-W1
4-N-O B G1-W4
6
C-W-O B-I G1-W2
10
M-N-O B-I G1-W4
15
4-W-O B-I G2-W2
7
N-N-0 S-B G3-W2
12
M-W-O B-I G2-W1
16
N-N-O B G2-W1

N-W-O I-B G3-W0

2-W-O B-I G3-W1

28
4-N-O I-B-W G2-W3

3438

19
M-N-0 B-I-W G2-W2

25
C-N-O I-B-W G1-W4

30
4-W-O B-I-W G2-W1

21
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1
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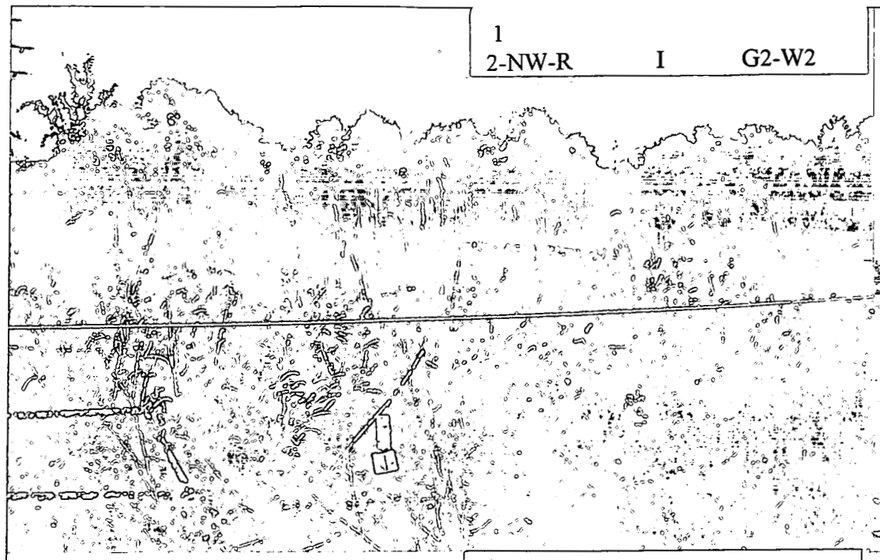

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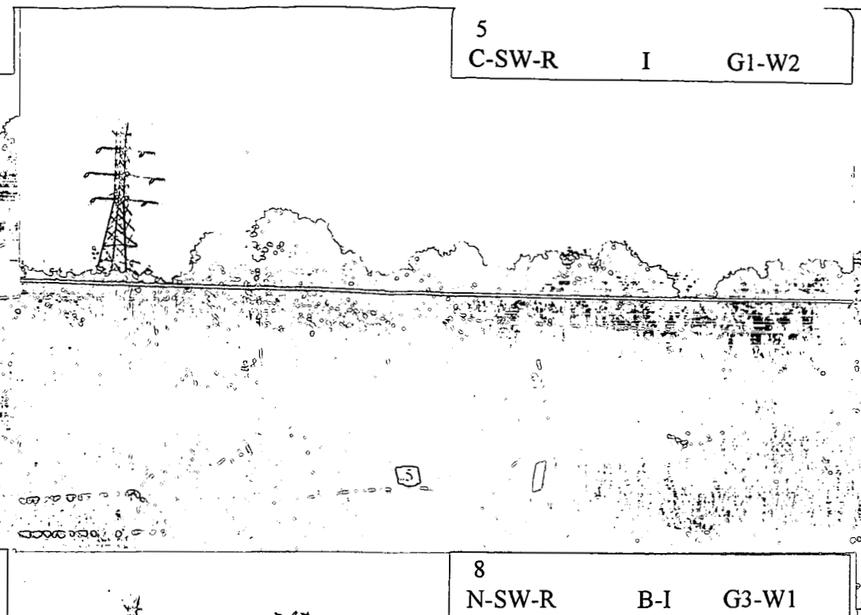

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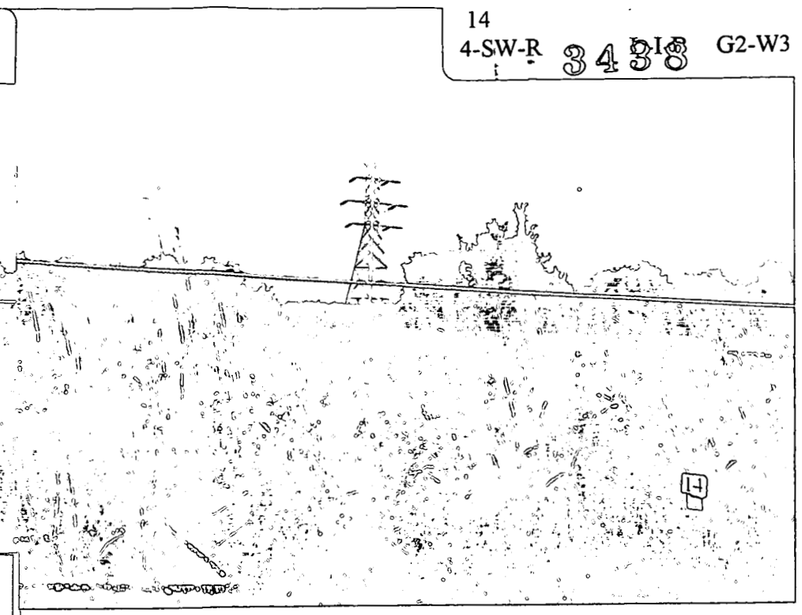

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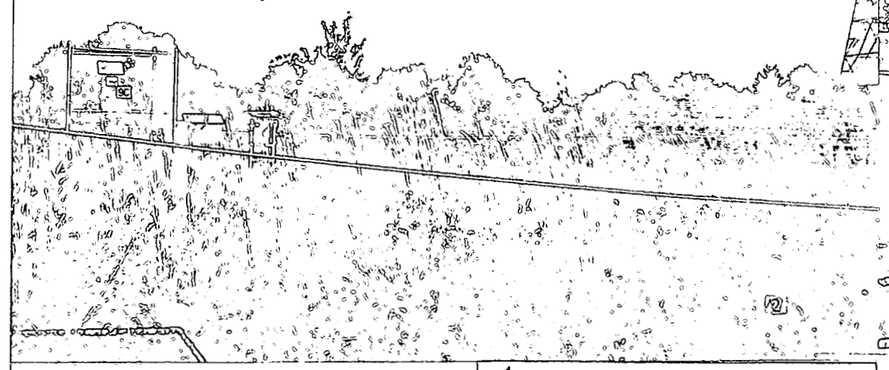

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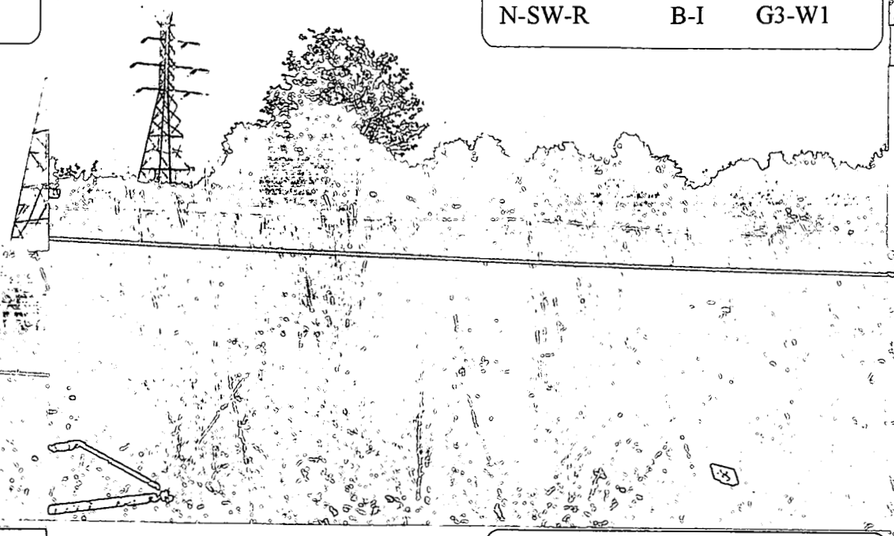

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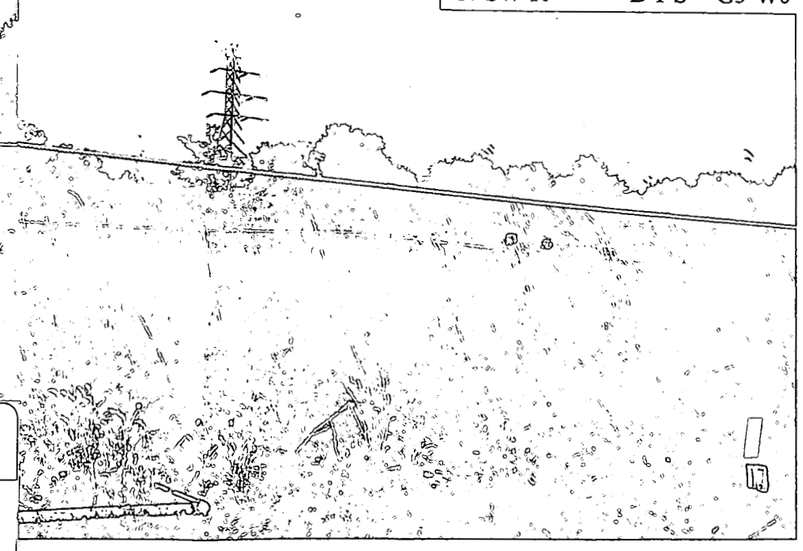

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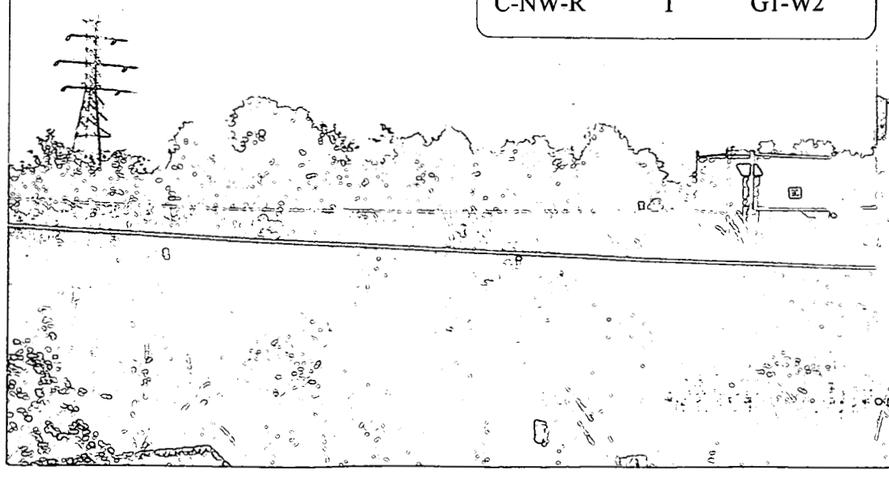

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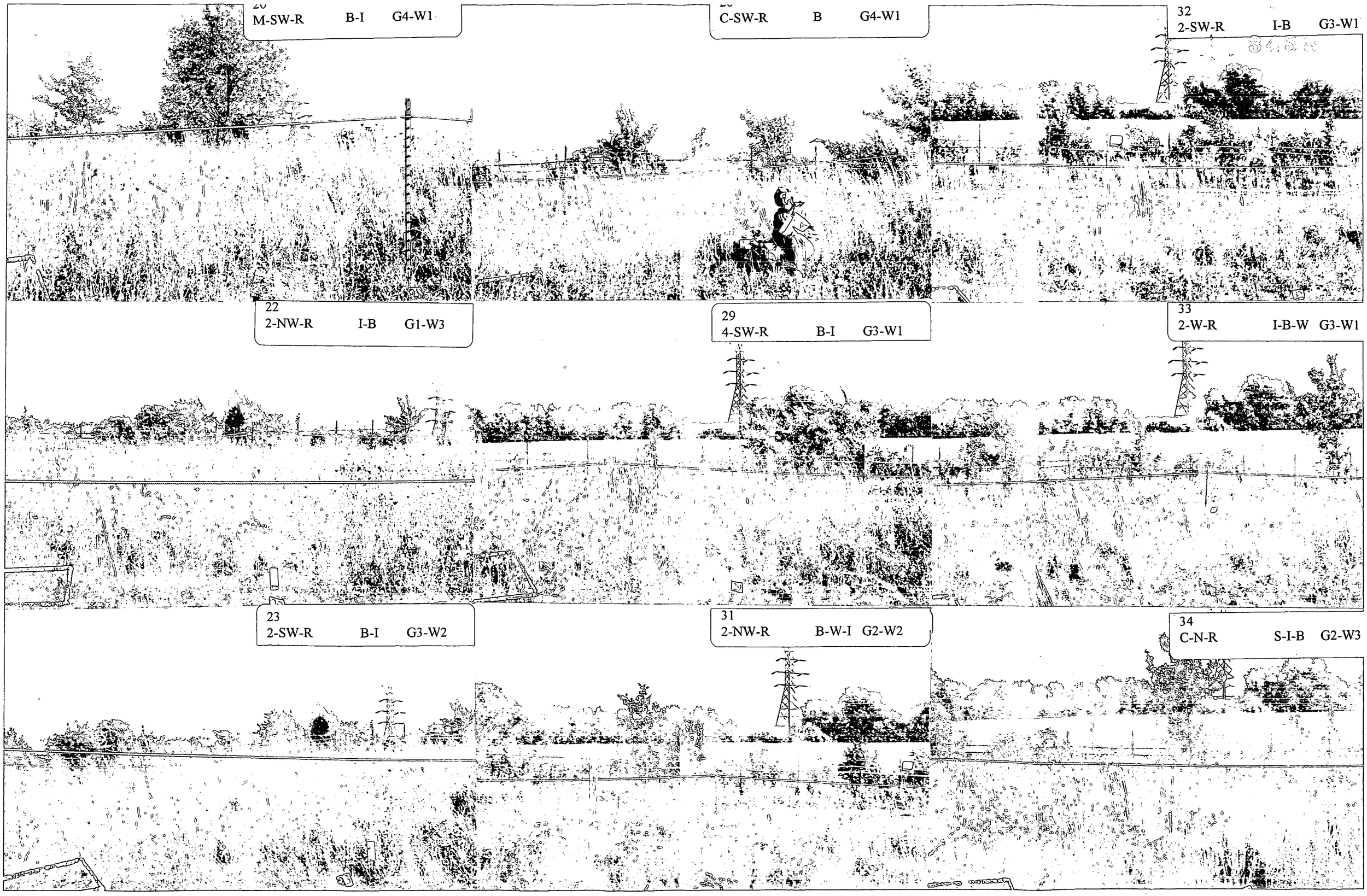
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4-SW-R B-I G3-W1
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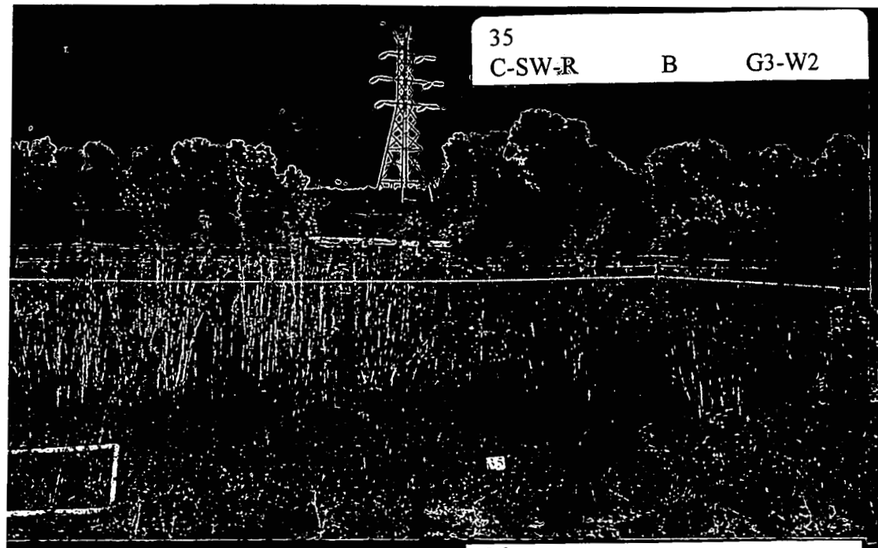
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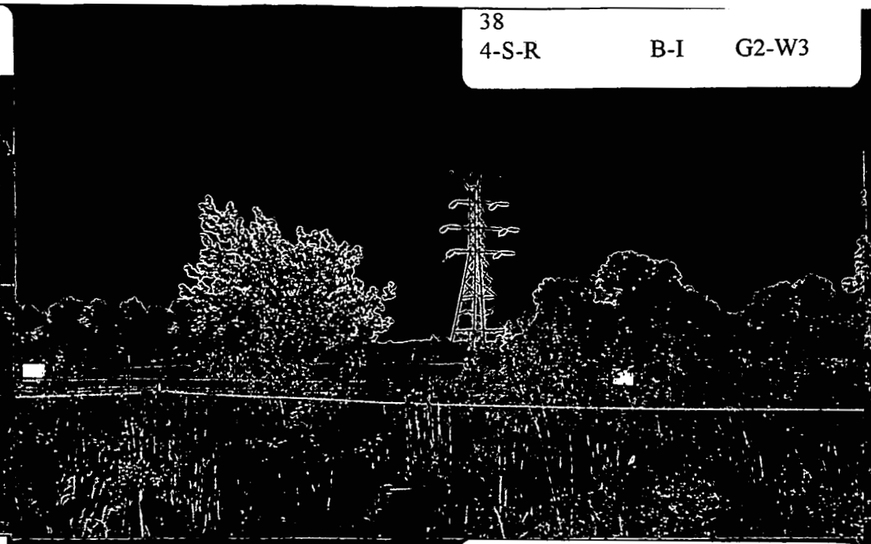
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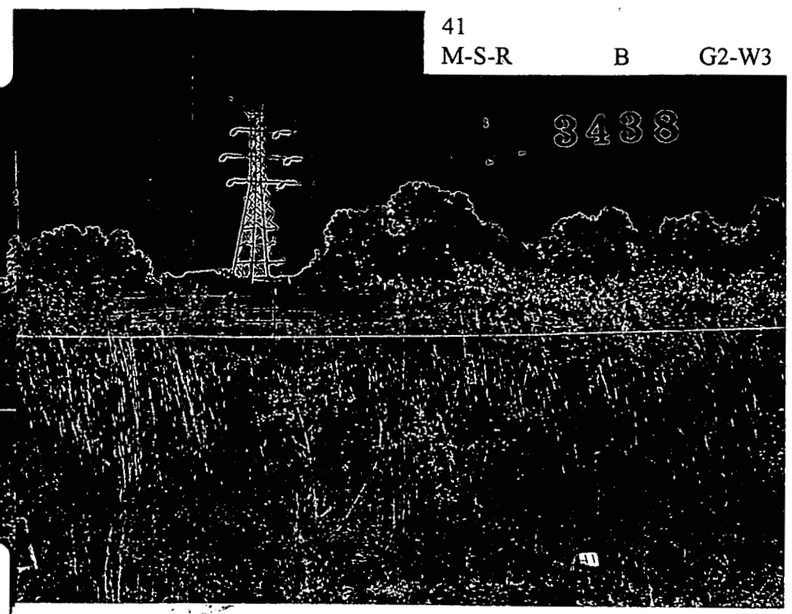
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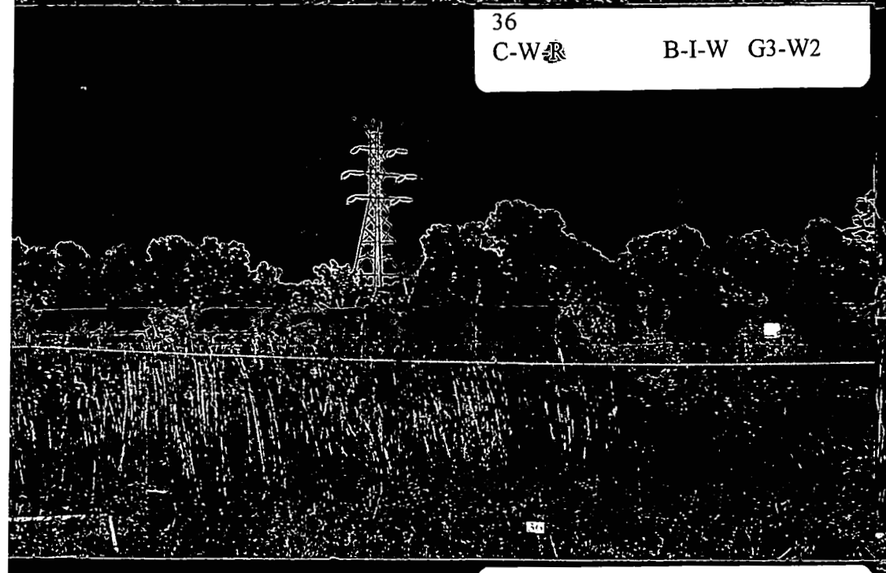
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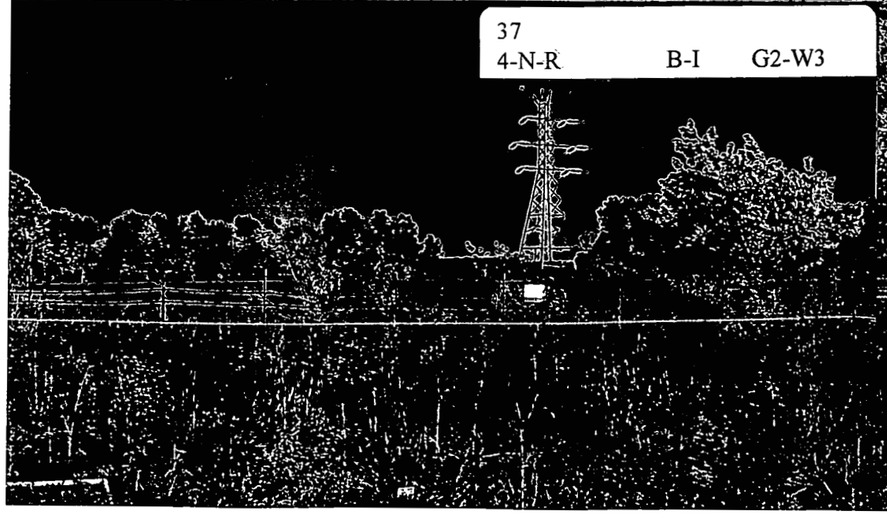
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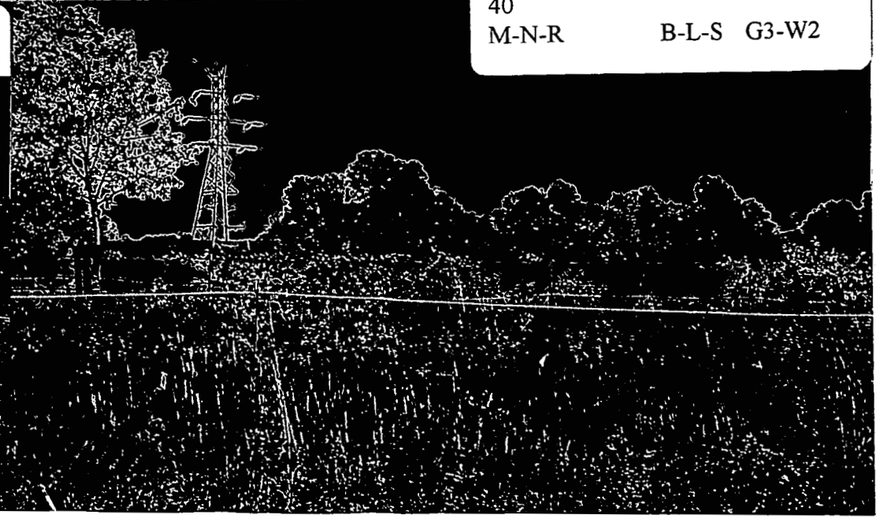
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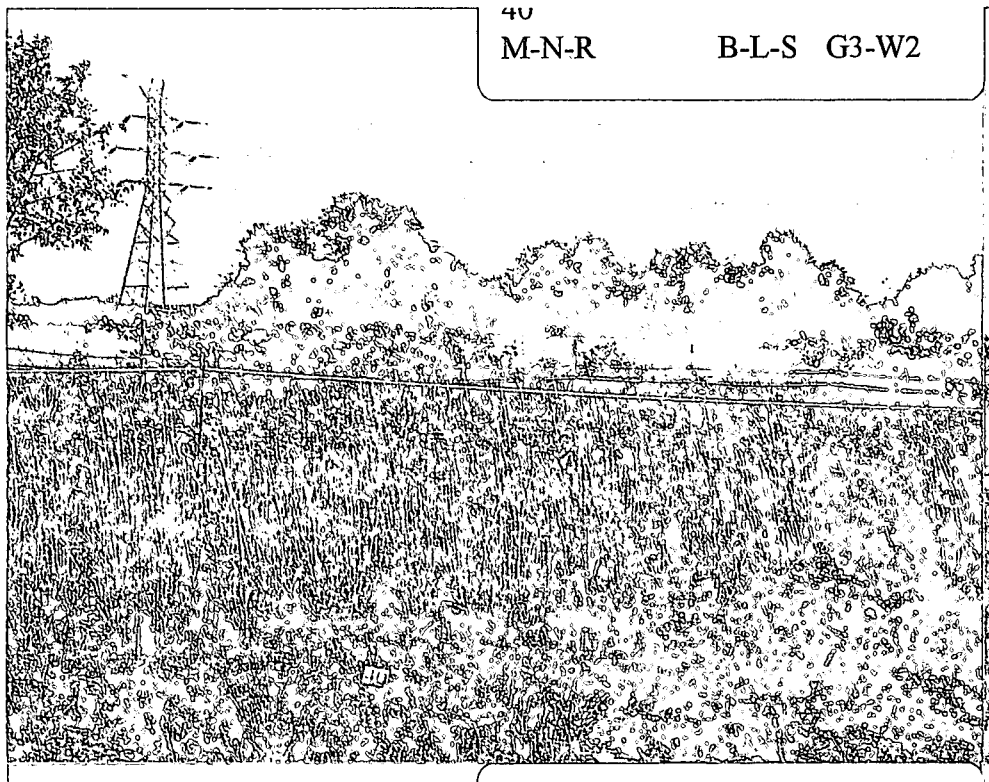
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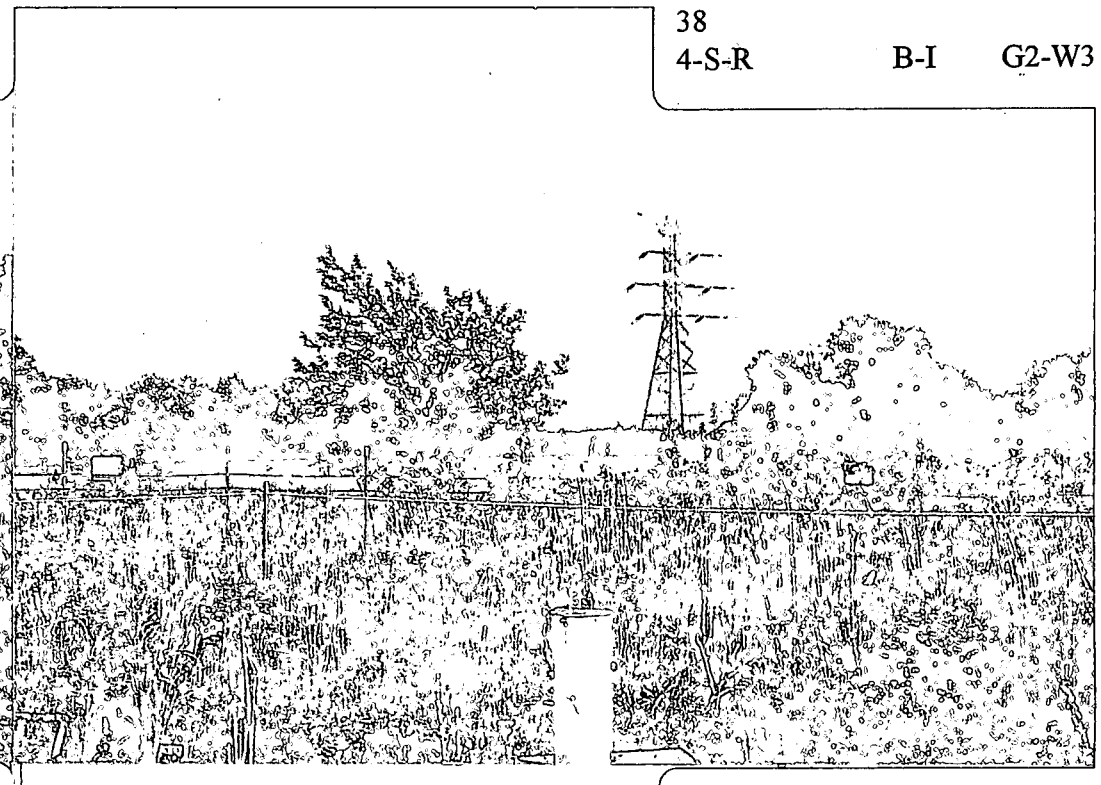
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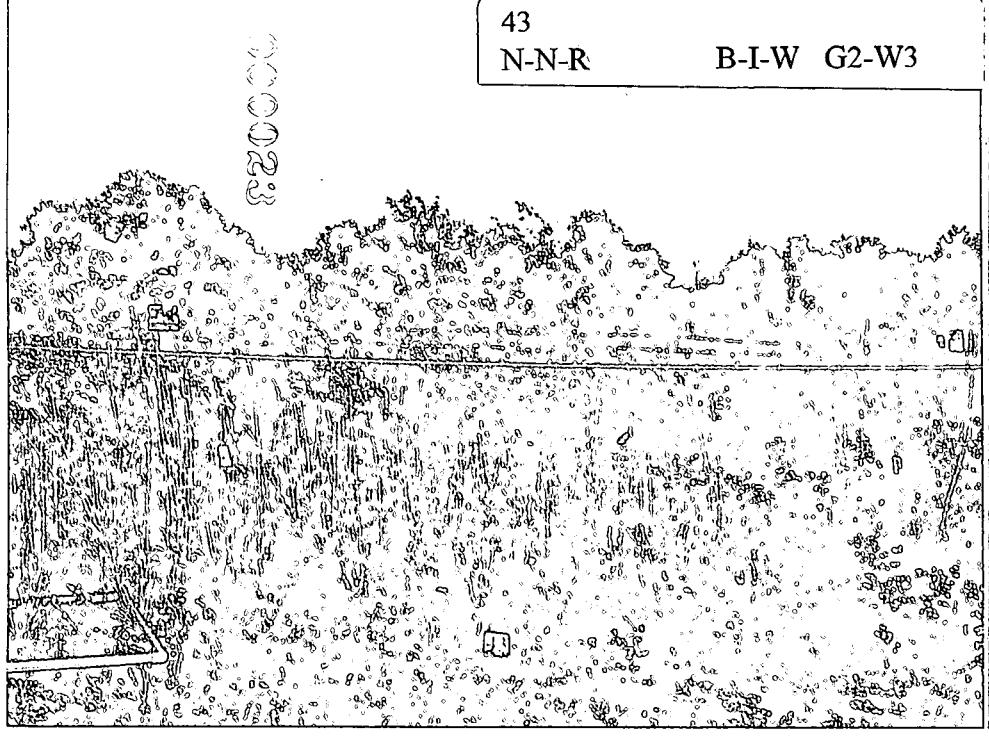
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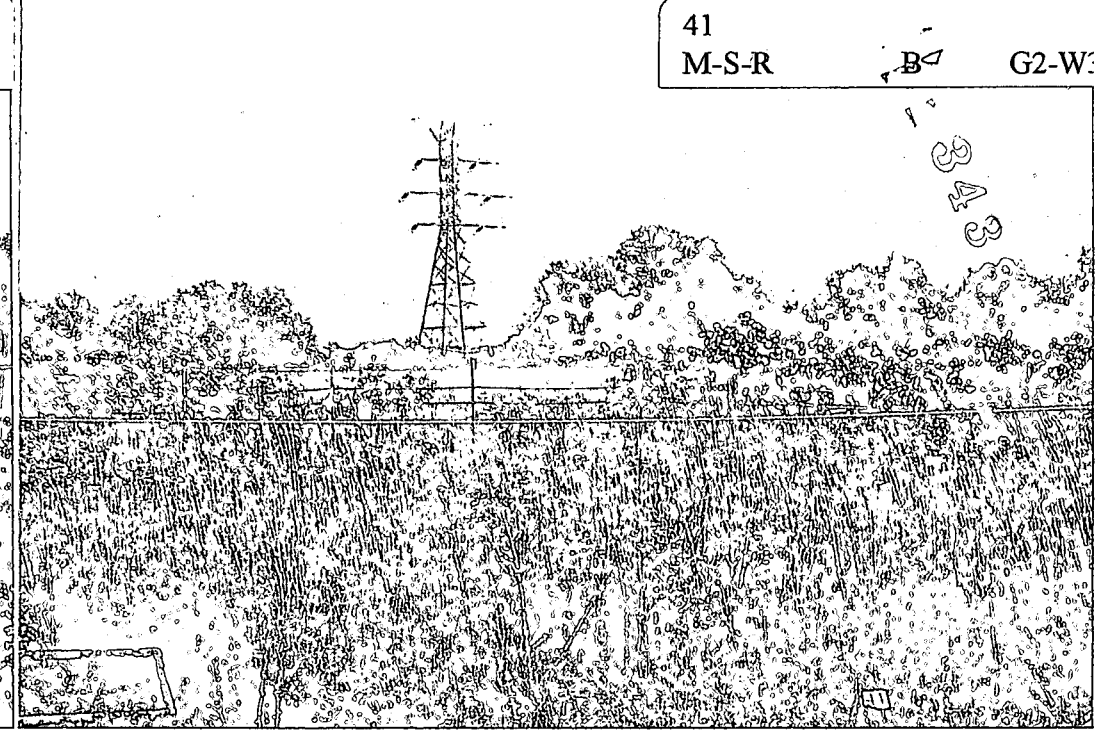
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M-S-R B G2-W3

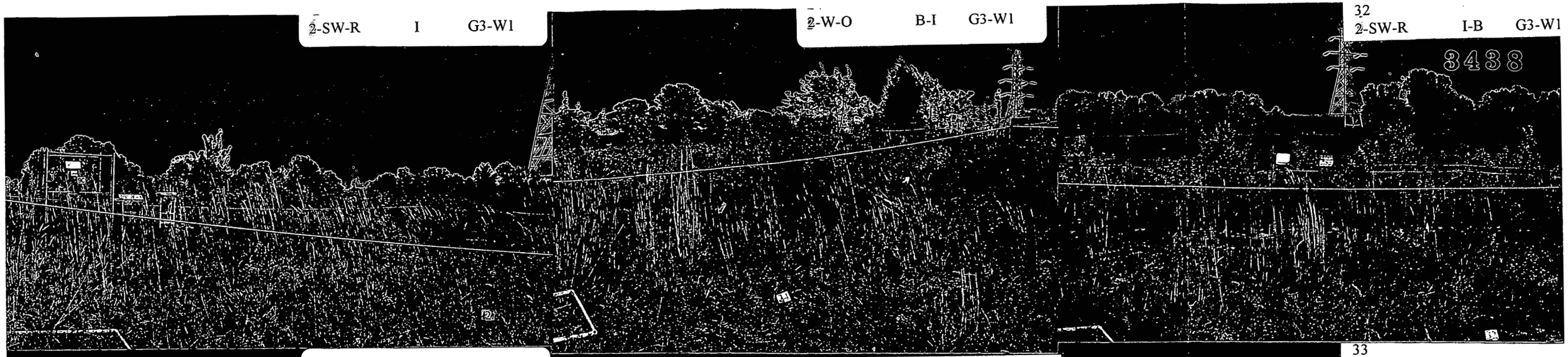
Amendment Treatments

M = Manure

2 or 4 = Soil

C = Composted Sewage Sludge

N = None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2-W-O B-I G3-W1
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2-SW-R I-B G3-W1
3438
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31
2-NW-R B-W-I G2-W2
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2-W-R I-B-W G3-W1
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2-SW-R B-I G3-W2

1
2-NW-R I G2-W2

N-W-O G3-W1

N-W-O I-B G3-W0

3438

7
N-N-0 S-B G3-W2

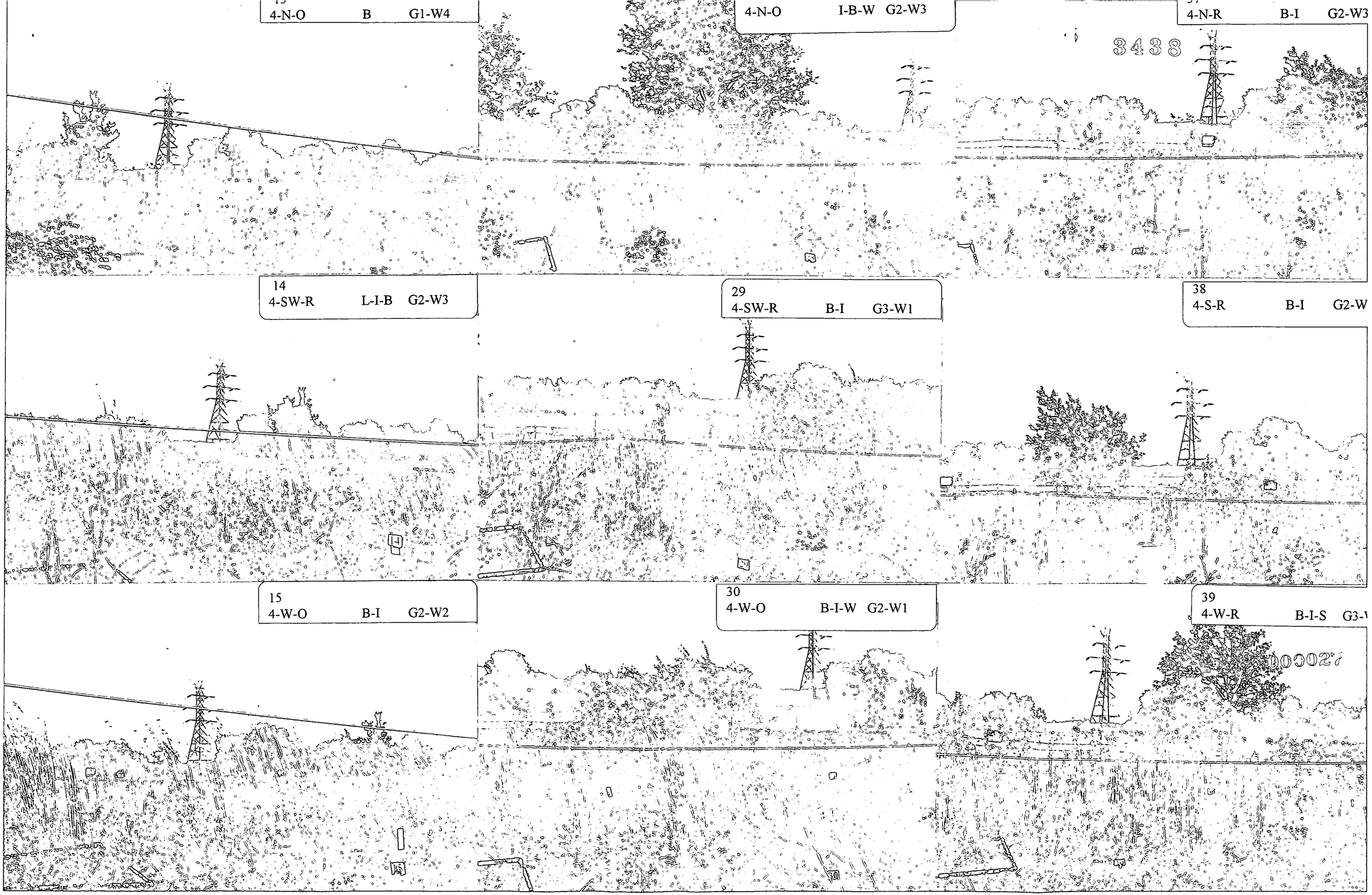
16
N-N-O B G2-W1

22
2-NW-R I-B G1-W3

8
N-SW-R B-I G3-W1

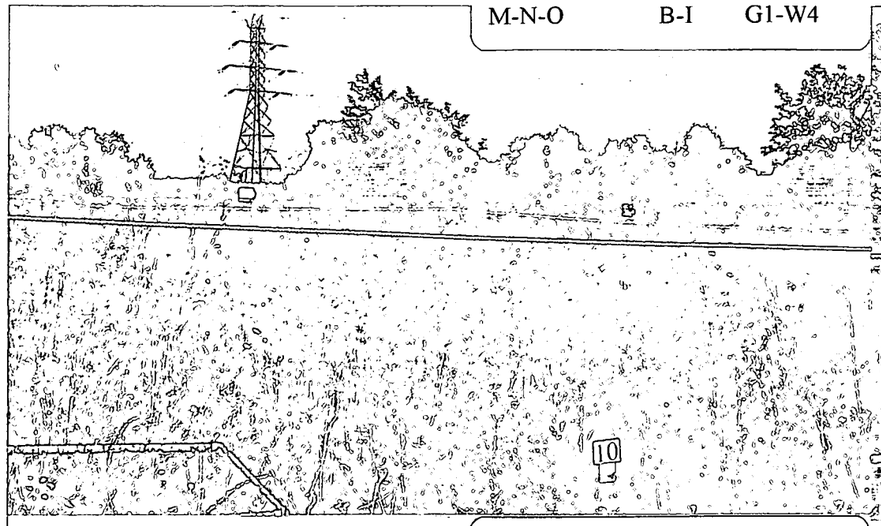
17
N-SW-R B-I-S G3-W0

000026

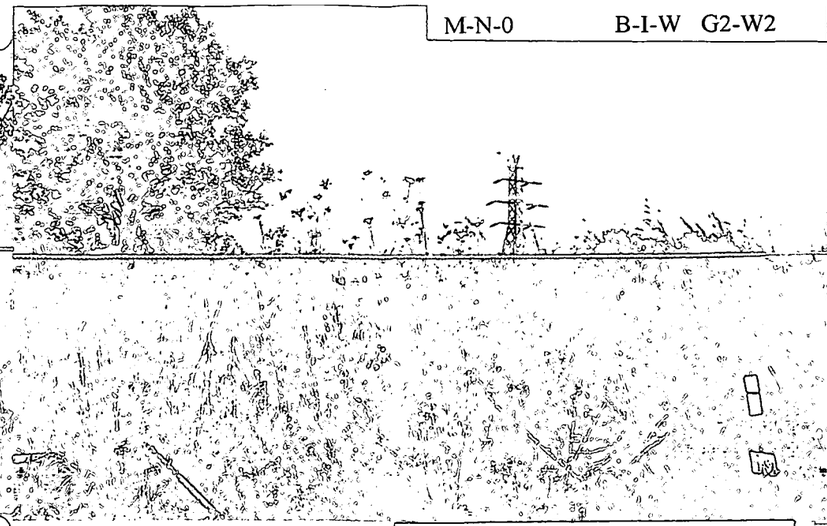

4-N-O B G1-W4
4-N-O I-B-W G2-W3
4-N-R B-I G2-W3
3438
14
4-SW-R L-I-B G2-W3
29
4-SW-R B-I G3-W1
38
4-S-R B-I G2-W
15
4-W-O B-I G2-W2
30
4-W-O B-I-W G2-W1
39
4-W-R B-I-S G3-


C-NW-R I G1-W2
23
C-N-O I-B-W G1-W4
34
C-N-R S-I-B G2-W3
5
C-SW-R I G1-W2
26
C-SW-R B G4-W1
35
C-SW-R B G3-W2
6
C-W-O B-I G1-W2
27
C-W-O W-I-B G2-W3
36
C-W-R B-I-W G3-W2

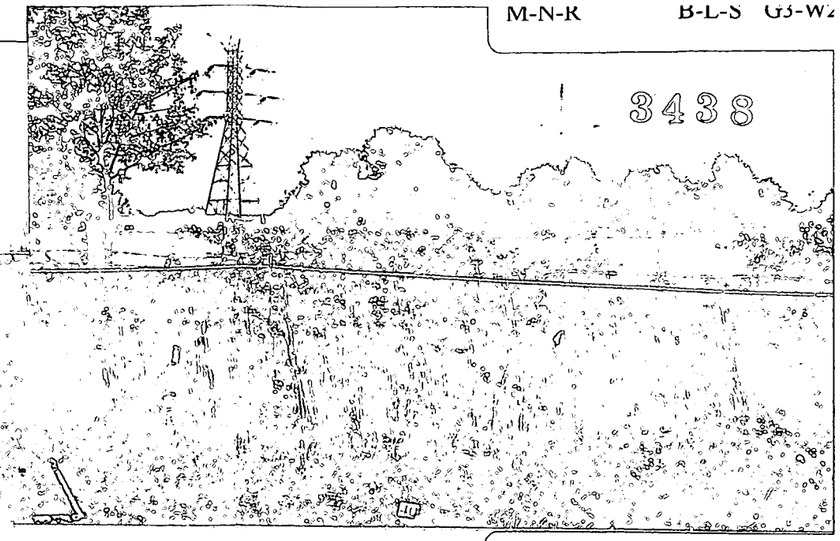
M-N-O B-I G1-W4



M-N-0 B-I-W G2-W2



M-N-R B-L-S G3-W2



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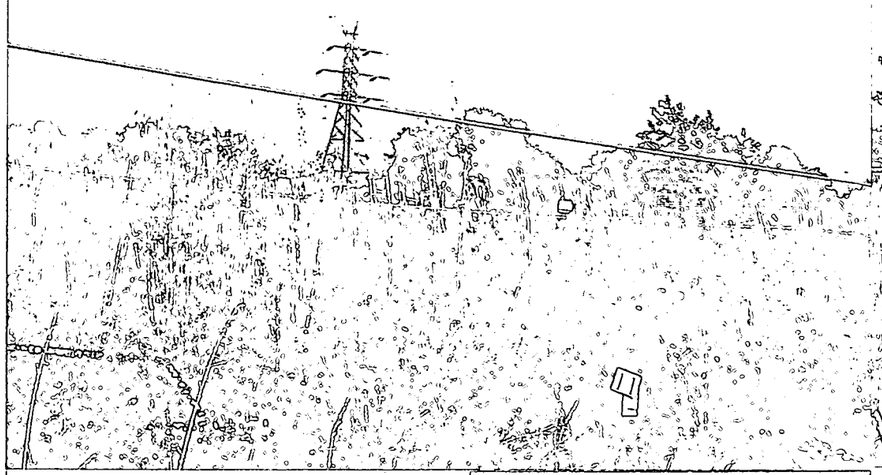
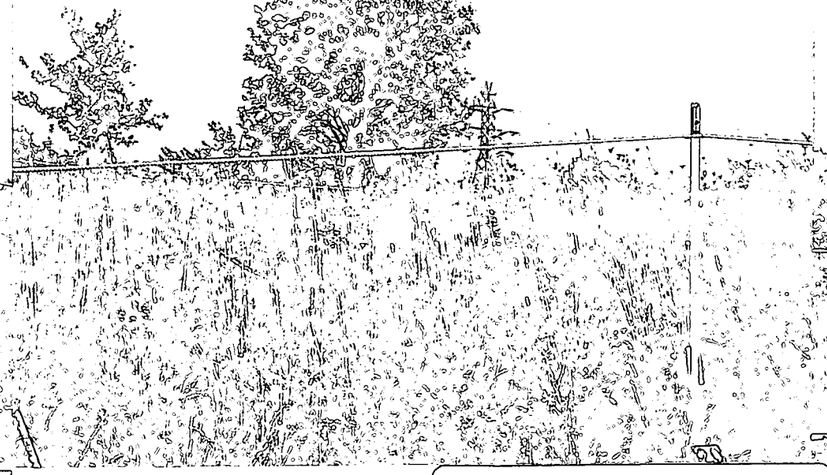
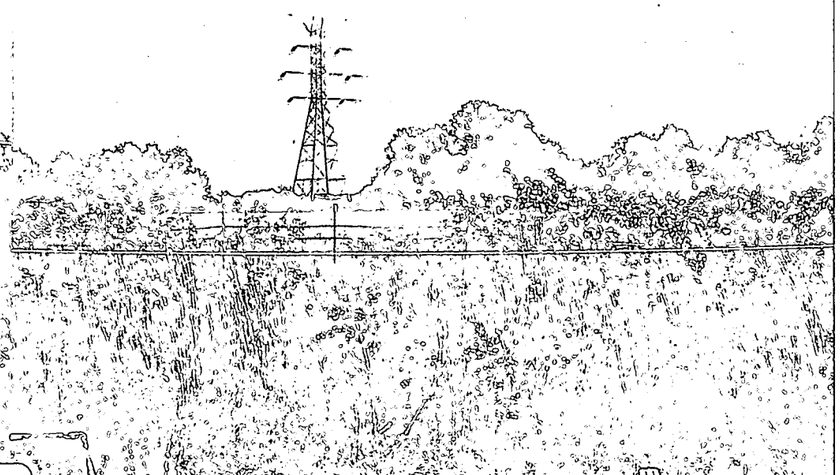
11
M-SW-R B G4-W1



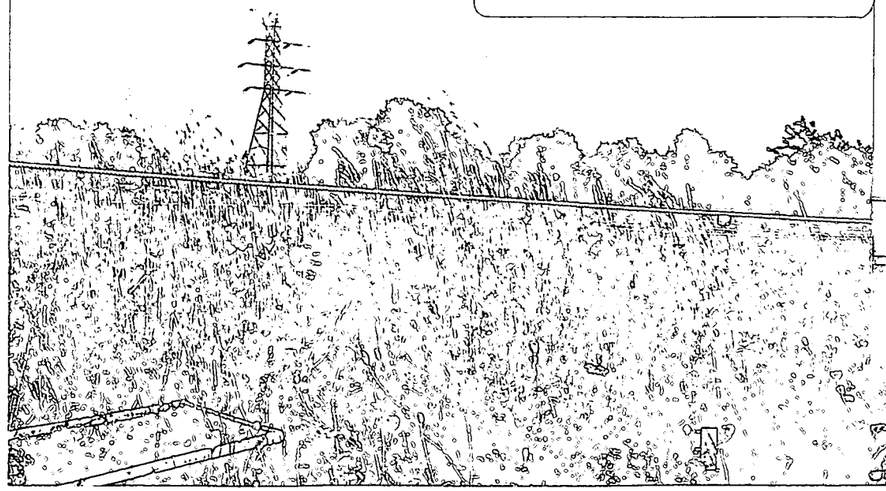
20
M-SW-R B-I G4-W1



41
M-S-R B G2-W3



12
M-W-O B-I G2-W1



21
M-W-O B-I-W-L G3-W1

000029

Mulch Types

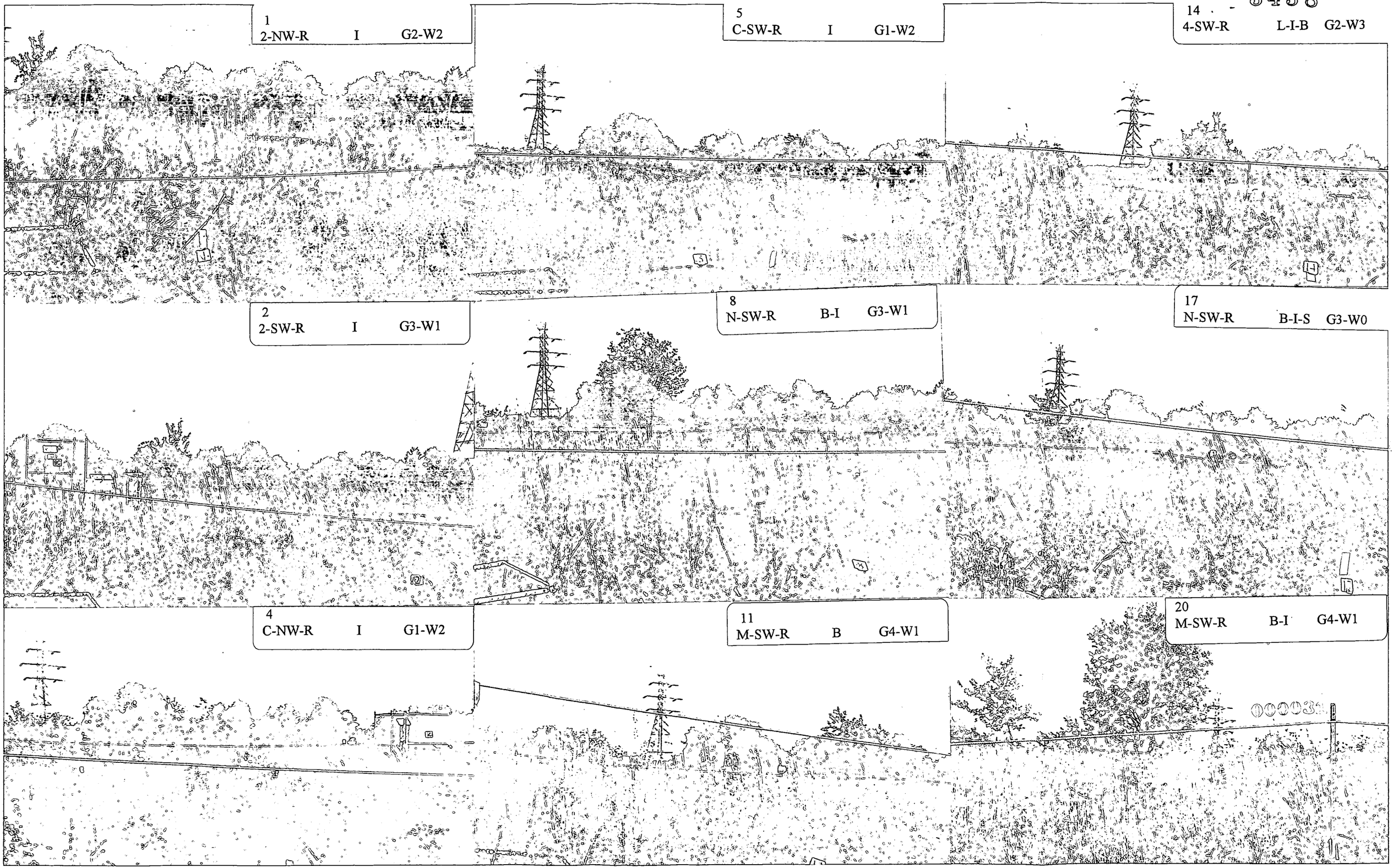
W = Wood

S = Straw

N = None

SW or NW = 2nd Wood Application

3438


1
2-NW-R I G2-W2
5
C-SW-R I G1-W2
14
4-SW-R L-I-B G2-W3
2
2-SW-R I G3-W1
8
N-SW-R B-I G3-W1
17
N-SW-R B-I-S G3-W0
4
C-NW-R I G1-W2
11
M-SW-R B G4-W1
20
M-SW-R B-I G4-W1

22
2-NW-R I-B G1-W3

29
4-SW-R B-I G3-W1

35
C-SW-R B G3-W2

3438

23
2-SW-R B-I G3-W2

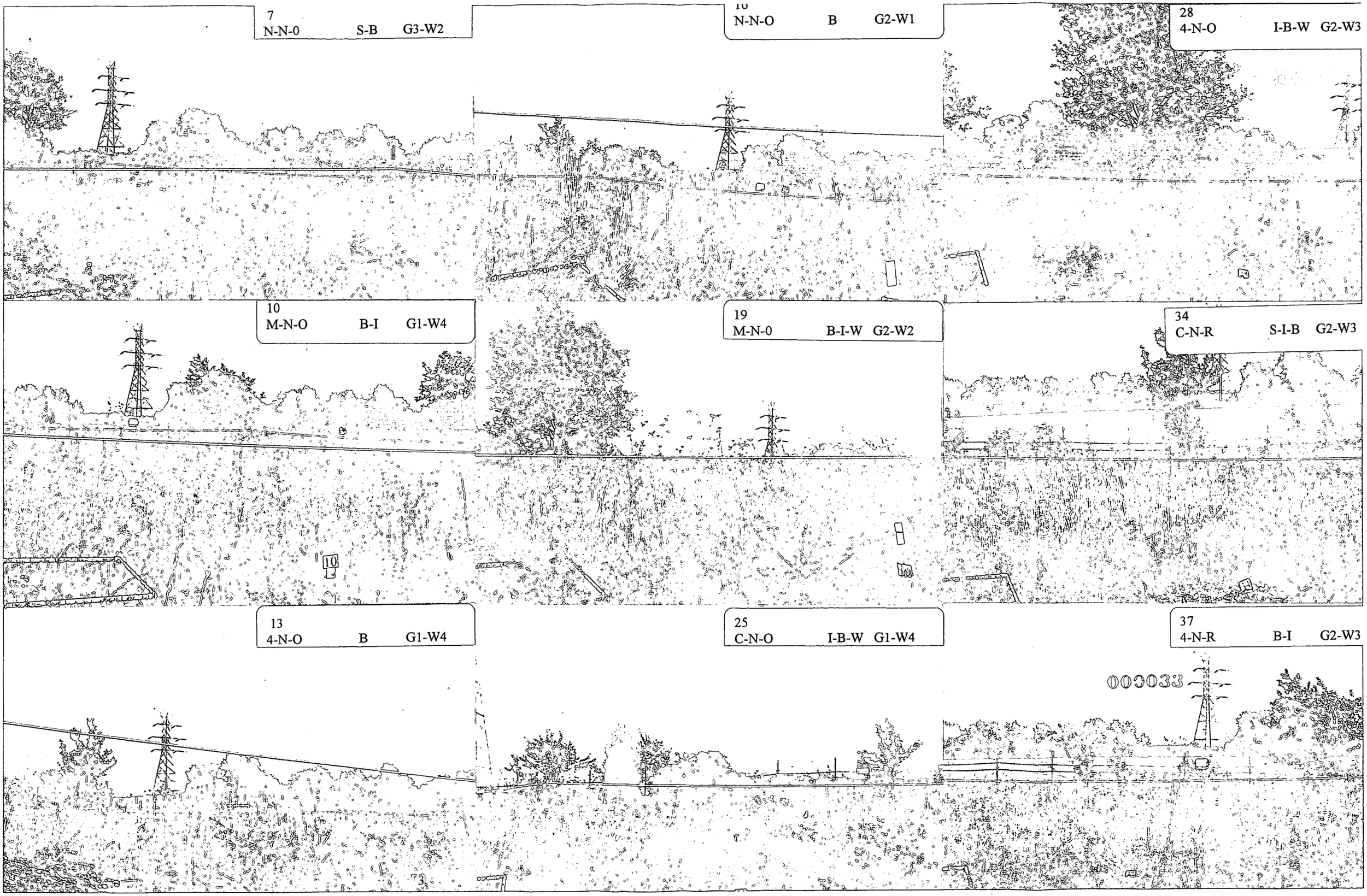
31
2-NW-R B-W-I G2-W2

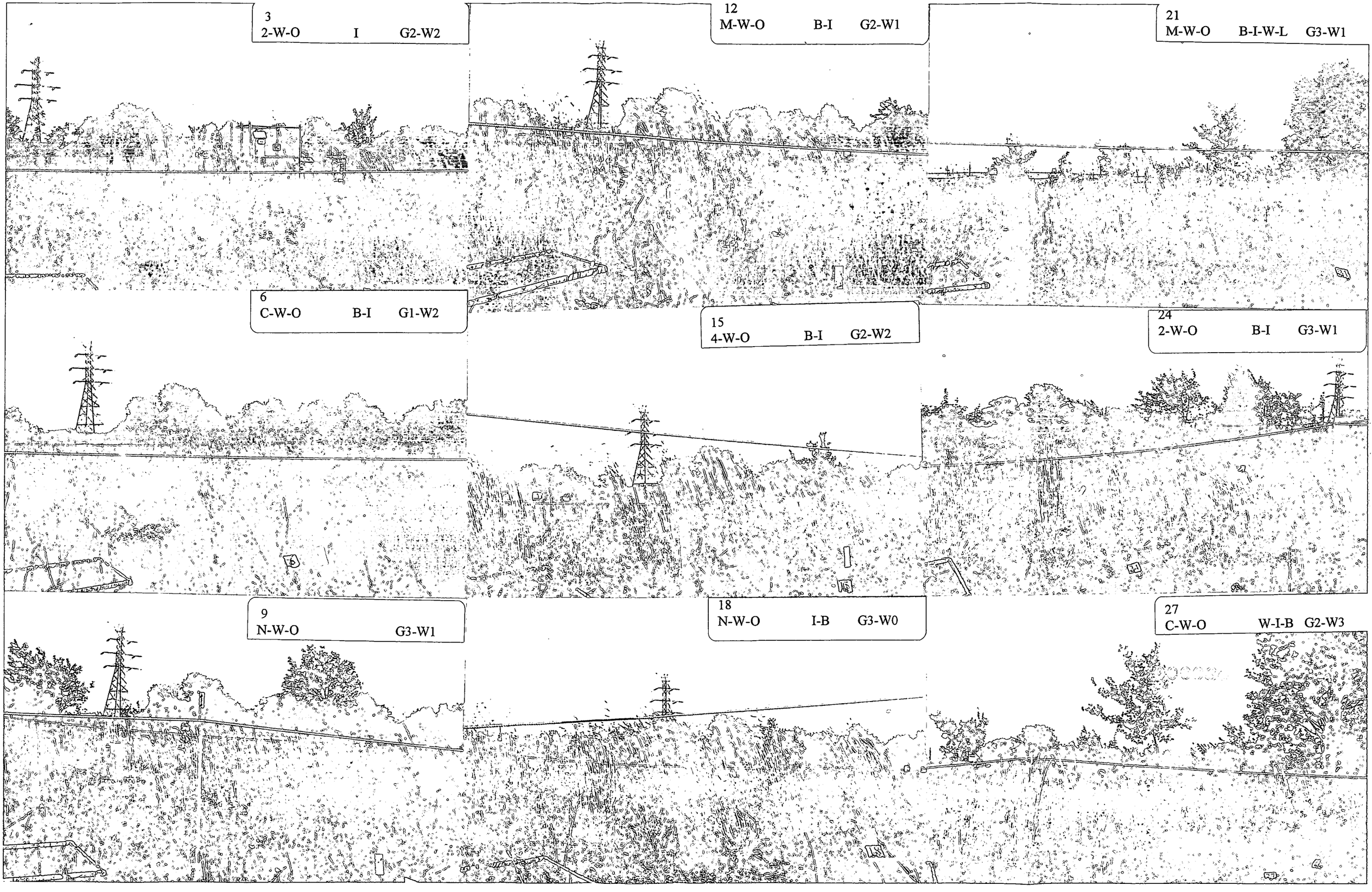
44
N-SW-R B G2-W3

26
C-SW-R B G4-W1

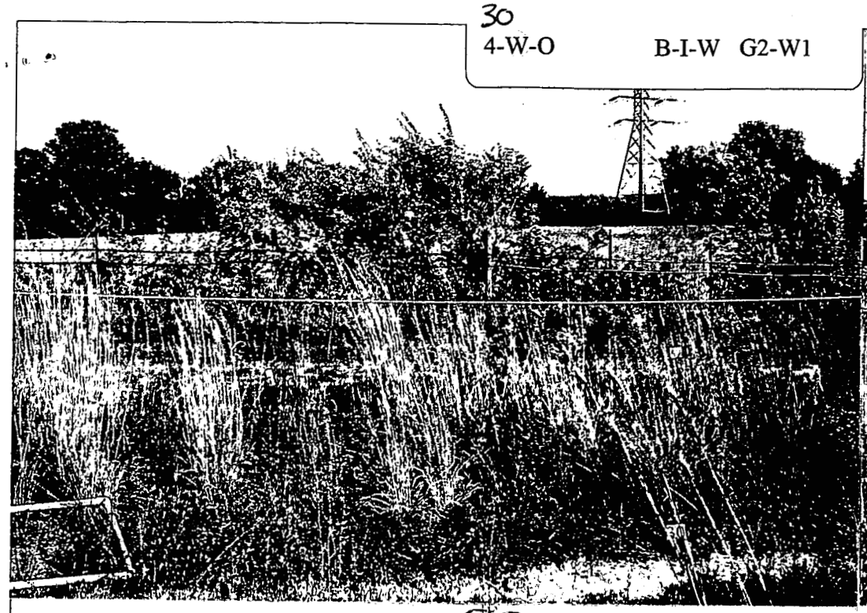
32
2-SW-R I-B G3-W1

000032


7
N-N-0 S-B G3-W2
16
N-N-O B G2-W1
28
4-N-O I-B-W G2-W3
10
M-N-O B-I G1-W4
19
M-N-0 B-I-W G2-W2
34
C-N-R S-I-B G2-W3
13
4-N-O B G1-W4
25
C-N-O I-B-W G1-W4
37
4-N-R B-I G2-W3

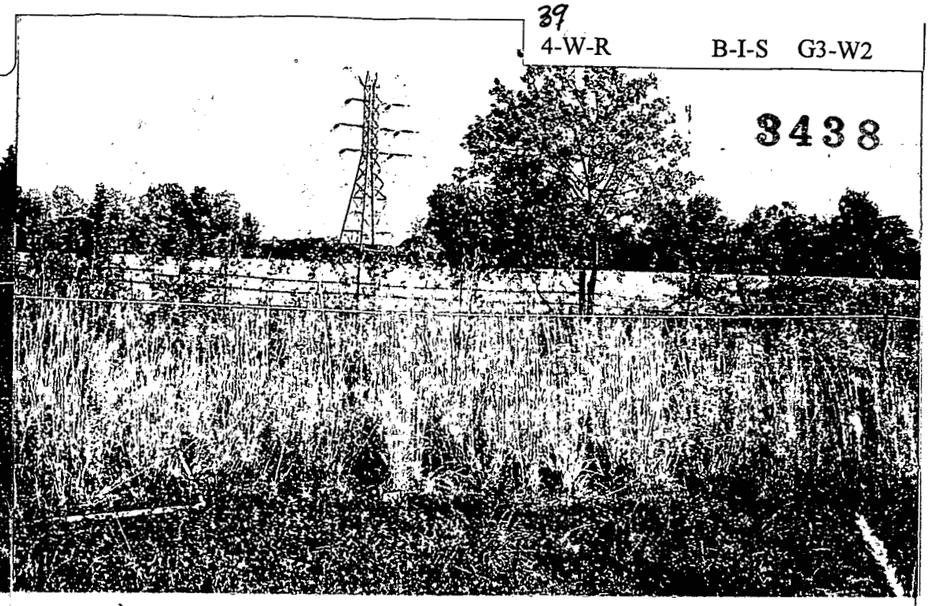

3
2-W-O I G2-W2
12
M-W-O B-I G2-W1
21
M-W-O B-I-W-L G3-W1
6
C-W-O B-I G1-W2
15
4-W-O B-I G2-W2
24
2-W-O B-I G3-W1
9
N-W-O G3-W1
18
N-W-O I-B G3-W0
27
C-W-O W-I-B G2-W3

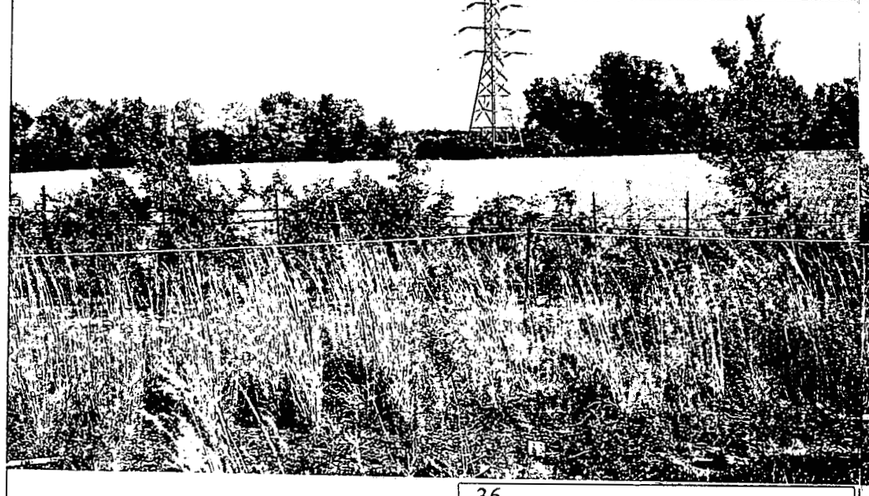
30
4-W-O B-I-W G2-W1



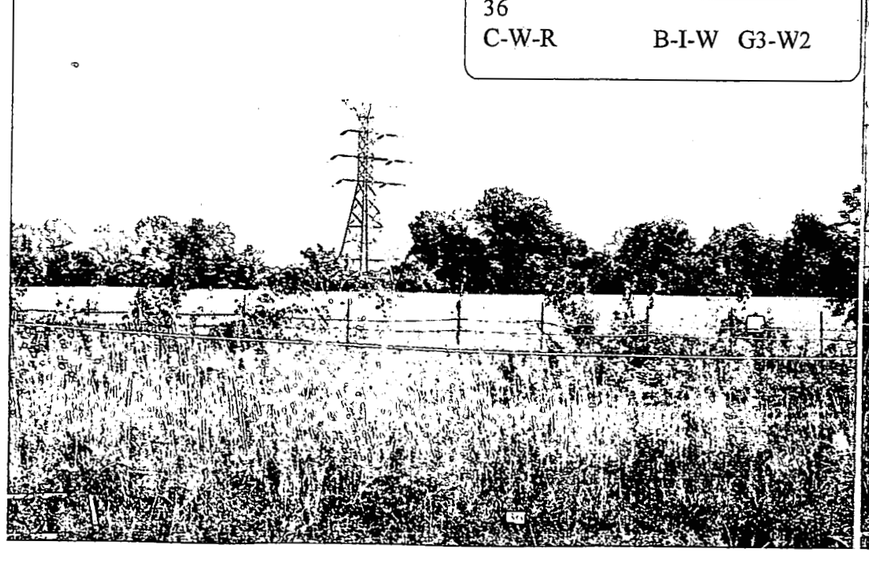
39
4-W-R B-I-S G3-W2

3438





36
C-W-R B-I-W G3-W2



45
N-W-R B-I-S-W G2-W3

000035