Poster Session | Postharvest/Food Technology and Process Engineering

[5-1130-P] Postharvest/Food Technology and Process Engineering (5th)

Thu. Sep 5, 2019 11:30 AM - 12:30 PM Poster Place (Entrance Hall)

[5-1130-P-12] Temporal Transition of Spatial Dependence of Weeds in Grassland

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Keywords: Spatial Modeling, Rumex obtusifolius.L, Grassland

Grasslands with high yield have a large percentage of grass as the main component and a low percentage of weeds and bare land. Especially, Broad–Leaved Bock (*Rumex obtusifolius.*L) has high seed productivity and regeneration ability and is recognized as a highly harmful weed. In order to control the amount, it is necessary to grasp the growing point. In this study, we clarified changes in spatial dependence by examining the spatial modeling by using the time-series distribution survey data from 2015 to 2018.

Temporal Transition of Spatial Dependence of Weeds in Grassland

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ABSTRACT

Grassland with high yield are characterized as the high composition of grass and low composition of weeds and bare land. Among the weed, especially, Broad−Leaved Bock (*Rumex obtusifolius.*L) has high seed productivity and regeneration ability and is recognized as a highly harmful weed. In order to control the amount of Broad−Leaved Bock, it is necessary to grasp the growing point effectively.

In this study, we clarified the temporal changes in spatial dependence of weeds occurrence by examining the semi-variogram model to multi temporal vegetation survey dataset, observed from 2015 to 2018. As the result, the significant trend of spatial dependence was indicated. From these results, this study proposed the practical and effective strategy for weeding in grassland, that is, preferential spot weeding to large individual or the cluster controlling for the dense crowded area within the range of space dependency

Keywords: Forage corn UAV, Precision Agriculture Remote sensing

1. INTRODUCTION

Grassland with high yield are characterized as the high composition of grass and low composition of weeds and bare land. To rid of these noxious weeds from grassland, it's growing spot is need to be identified first. However, the growing spots of these noxious weeds is not constant, and often appears in completely different place after harvesting. Therefore, the field manager needs to identify these weeds one by one on site to proceed the weeding works, which requires a great deal of labor and time.

There are many studies aimed at efficient weed control, focusing on weed detection(Ayumi Nakatsubo et,al, 2013), but few studies focus on the dynamics of weeds expansion inside grassland.

Therefore, this study aims to clarify the change of spatial dependence in weed occurrence in the grassland using semi-variance analysis, which is a method of spatial statistics. In this study, the *Rumex obtusifolius*.L which has especially high seed productivity and regeneration ability are targeted among several weeds which appears in grassland.

2. MATERIALS AND METHODS

2.1 Study Site

The study site is established in the second field of Field Science Center (FSC) Towada Farm, Kitasato University Faculty of Veterinary Medicine. 50m survey zone was established in the both north-south and north-south directions, respectively, and divided by a 2 m square mesh, providing a total of 2500 small sections.

2.2 Vegetation Survey

The distributing position of *Rumex obtusifolius.*L (hereinafter, referred to as RO) in settled test site was identified using quadrats divided into 1.0m x 1.0m. Table 1 shows the survey dates for each fiscal year. According to the weighted scoring method depends on the diameter (R) of the equivalent circle including the tip of the leaf, each sampling point have been divided into three categories, that is, small ($0 \leqq R < 0.2$ m), middle (0.2 ($R < 0.4$ m), large ($R \geqq 0.4$ m), and is scored 1,3,5 respectively. Then the scores were counted by each section which is consists of 0.5 m square mesh to standardize.

Table 1. Date of survey in each fiscal year

Fiscal year	First harvest	Second harvest	Third harvest
2015	30-April	7-July	3-September
2016	30-April	7-July	9-September
2017	26-April	5-July	15-September
2018	21-May	16-July	17-November

2.3 Semi-Variance Analysis

The spatial dependence was examined by applying semi-variance analysis to the standardized score for each small mesh. Semi-variogram was calculated by using the definition of two-dimensional analysis. After that, a sphere model was applied for the semi-variogram to find three semi-variogram parameters, which is nugget, sill and range. Nugget is the parameter which shows the variation that appears even when the distance between the two becomes zero. The value of the semi-variance (γ) at the point of semi-variance (γ) becomes constant is called the sill. Range is the spatial distance when the semi-variance (γ) becomes constant. The range shows the limit of space dependence. Therefore, in this study, the spatial dependence of RO is indicated as the semi-variance parameter of range.

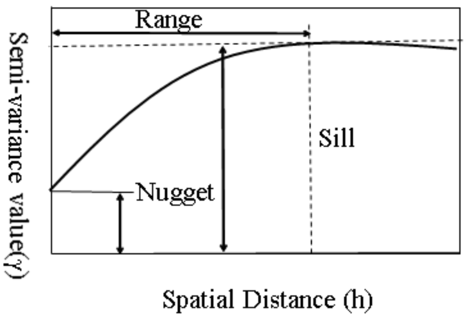

Figure 1. General semi-variogram model

2.4 Statistic Test

In order to check if there is spatial dependence within the range, each section have been categorized to 3 groups by the centered score as shown in Table 2. Then each group were examined by the following two examination methods. Firstly, the significant difference between the mean of expected values of weighted scores within 2 spatial distances segments, that is, 3 m from the center, 3 m to 10 m from the center, was examined by a t-test. Second, when the score of the center in the 3m range is different, the significant difference in the mean value of each expected t-value was examined by the t-test. For examining these two statistical tests, the 500 section sample data was randomly extracted from total 2,500 sections.

Table 2. 3 Groups categorized by the centered score

Group	Centered score
G1	0
G2	1~2
G3	3~12

3. RESULTS AND DISCUSSION

3.1 Distribution Plot

The result of vegetation survey in each fiscal year have been plotted to the map by categorizing to three types by the diameter size. Figure 2 shows an example from the survey result of 3rd crop in 2018.

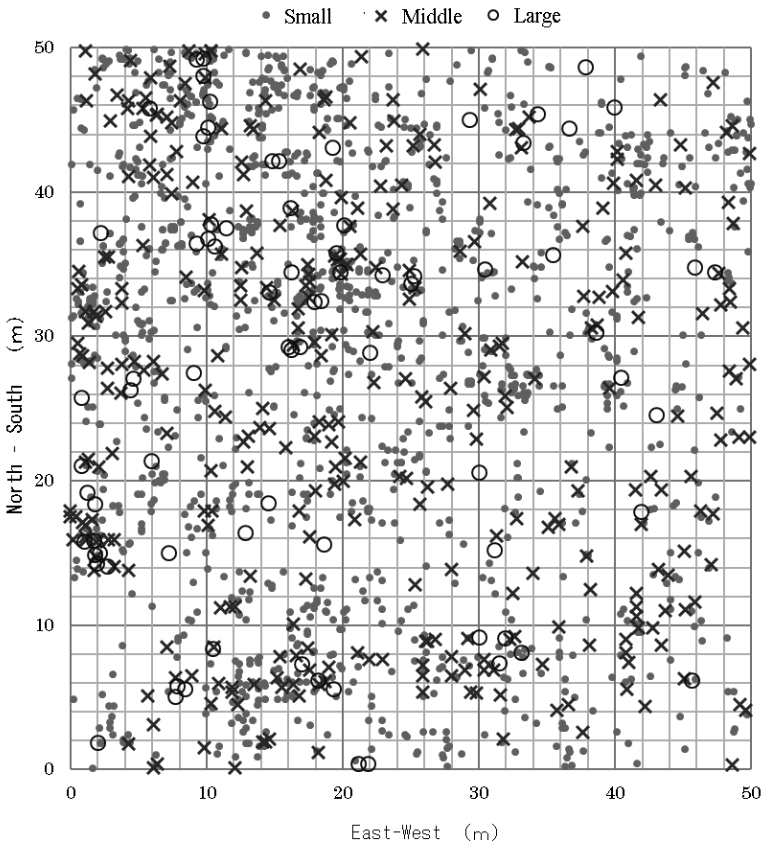

Figure 2. Distribution plot of RO (3rd crop, 2018)

3.2 Temporal Change of Spatial Dependence

Figure 3 shows the temporal change of spatial dependence (range) over the past 4 years. The a, b, c in the figure represent the harvest timing of each year, and the numerical values indicate the range values. Range increased from the first to the second crop, and decreased from the third to the first crop of following year. On the other hand, in the period of second to third crop, the both trend of increase and decrease was observed. The average value of the range from 2015 to 2018 was 3.51 and the standard deviation was 1.11, and it was found that the range was not constant but varied for each grass of each year (coefficient of variation = 0.316)

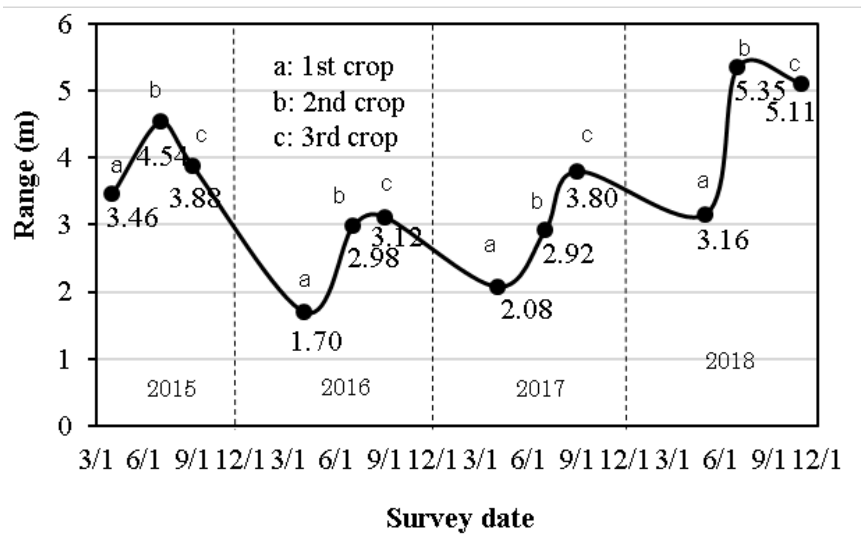

Figure 3. Temporal change of range value from 2015 to 2018

3.3 Statistic Test

Table 3 shows the results of first statistic test. As a result of t-test (significance level of 5%), the expected score of peripheral value showed the significant difference between within and outside the range in all score groups except for G1.

Table 3. Result of t-test (1)

Center	Peripheral range (m)	Mean	Degree of Freedom	t-value	p-value
G1	3	0.392	822	-1.77	0.0775
	10	0.567			
G2	3	0.460	683	4.88	1.34 e^{-06}
	10	0.662			
G3	3	0.682	693	5.87	6.76e^{-09}
	10	0.535			

Table 4 shows the results of second statistic test. There were significant differences in the expected values among the central scores within the 3m range. Therefore, in within range, the smaller the central score, the smaller the peripheral score was observed, and vice versa, the larger the central score, the larger the peripheral score was observed. Therefore, the space dependence was confirmed within the range value.

Table 4. Result of t-test (2)

Center	Peripheral range (m)	Mean	Degree of Freedom	t-value	p-value
G1	3	0.392	922	-7.00	5.05e^{-12}
G2	10	0.567			
G1	3	0.567	983	-3.75	1.84 e^{-04}
G3	10	0.682			
G2	3	0.392	862	-10.62	7.51e^{-25}
G3	10	0.682			

4. CONCLUSION

The temporal changes of the range value showed the increasing trend in the period which is from the first crop to the second crop, and the decreasing trend in the period which is from the third crop to the first crop of the following year regularity. The results of t-test showed that within the range where spatial dependency was observed, the total amount of RO tended to increase in the vicinity of the point where the amount of RO is large.

From these results, this study proposed the practical and effective strategy for weeding RO in grassland, that is, preferential spot weeding to large individual or the cluster controlling for the dense crowded area within the range of space dependency.

REFERENCES

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