P20

Clonal variation of horsenettle (*Solanum carolinense* L.) in morphological characteristics

Huseyin ONEN and [○]Misako ITO
(Graduate School of Agriculture, Kyoto University)

Introduction

Horsenettle is a noxious perennial broadleaf weed. It is a native of southern US and introduced to Japan during 1930s. Horsenettle can be propagated by seeds and by creeping roots. Once horsenettle introduced in a new area, it extensively reproduces with creeping roots vegetatively, hence it is very difficult to control the weed. It causes weed problems in both crop and noncrop areas. Furthermore, it is poisonous to animals and human. Although some of general morphological and physiological variations in horsenettle have been reported, there is no specific research on clonal variation of horsenettle in Japan. In this study, we focused on the morphological variation of the clones.

Material and method

The creeping roots of 37 clones were collected from horsenettle populations in various habitats (27, 8 and 2 from Kyoto City, Tanbacho, Kyoto Pref. and Mie Pre. respectively). On May 5, 2003, 3 root fragments (5 cm long) per each clone were planted individually in 1/5000 a Wagner pots and the plants were allowed to grow until October 10. Two grams of composite fertilizer (8% N, 8% P, 8% K) was added to each pot. During growing period, insecticides were applied two times and the plants were watered as needed. The morphological characters observed were presented in Tables 1 and 2. Principal component analysis was used to determine morphological variations among clones. Some clones did not produce enough flower to obtain the data required, therefore floral data were analyzed separately. The presented data were the average of three replications for each clone. All computations were performed using the SPSS standard version package (SPSS Inc., 2001).

Results and discussion

Morphological differences among clones were observed for all characters measured (Tables 1 and 2). The multivariate analyses of above ground vegetative and floral traits revealed clear differences among clones tested. PCA based on the vegetative traits, exposed that the first three components accounted for 31.9%, 23.3% and 14.6% of variance respectively. Cumulative variance of them was 69.8% (Table 1). The attributes responsible for the maximum separation along the first principal component were plant height and chlorophyll contents of leaves with negative eigenvectors, number and length of branches, total leaf number, and spine densities with positive eigenvectors. The second component was related to length and node number of shoots with positive eigenvectors. Figure 1(A) represents the first two component scores where clones are divided into three groups. Group 1: spineless or little spiny, glabrous or sparsely hairy long erect dark purple stem with many internodes, few and short branches and dark green leaves; group 2: spiny, hairy, long semierect stem with many internodes and long branches, and many light green leaves; and group 3: densely spiny and hairy, short but erect green stem with few internodes, short branches and many light green leaves.

On the basis of floral traits, PCA presented that the first three components accounted for 47.7%, 25.7% and 14.7% of variance respectively. Cumulative variance for the first three components was 88% (Table 2). The attributes responsible for the maximum separation along the first principal component were, inflorescence number, total flower number and male flower rate with negative eigenvectors, and cosexual flower rate, cosexual flower diameter and anther length with positive eigenvectors. The second component was related to pistil length of cosexual flowers and corolla diameter of male flowers with positive eigenvectors. PCA divided clones into three flower colors (Figure 1-B). Generally, clones with purple flowers produced more inflorescence and flowers than those of others. But cosexual and male flowers were smaller within these clones. However, the numbers of inflorescences and flowers were fewer but the flower size was bigger in clones with white or whitish purple flowers. Therefore, floral characters were found to be very different among clones and clones varied in functional gender nearly from completely female to completely male (Table 2 and Figure 1 B). Elle and Meagher (2000) also reported similar results. Floral characters can be useful to distinguish the clones, since all floral characters are heritable in this species (Elle, 1998). From results, it was suggested that there are at least three different morphological types. Typical clones and their characters are: 1- M1: semierect, long (but

short in height), hairy and spiny stems with many long branches and leaves, and many small purple flowers; 2- K14: erect, short, densely hairy and spiny, green stems with white few short branches and large flowers; and 3- K5: erect, long, glabrous and spineless or little spiny and hairy, dark purple stems with few short branches, dark green leaves and whitish purple large flowers.

Table 1.

Character	Measurements				Principal components			
	Min.	Max.	Mean	Std. D.	1st	2nd	3rd	
Vegetative traits scored and Eigenvectors of the first three principal components for 37 horsenettle clones	Plant height (cm)	13.00	26.80	22.13	3.85	-0.737	0.393	0.177
	Length of longest shoot (cm)	13.70	29.00	24.57	3.16	-0.409	0.606	0.066
	Branch number	6.50	11.00	8.50	1.16	0.606	0.480	-0.042
	Total branch length (cm)	9.00	61.00	24.54	14.37	0.722	0.585	-0.008
	Node number on longest shoot	12.00	17.00	13.91	1.13	0.084	0.830	-0.232
	Total leaf number per plant	33.30	71.50	49.11	10.32	0.769	0.481	-0.083
	Blade length of largest leaf (cm)	8.70	13.10	11.14	0.97	-0.072	-0.036	0.909
	Blade width of largest leaf (cm)	5.30	8.20	6.78	0.58	-0.086	0.453	0.731
	Chlorophyll content (SPAD value)	34.90	53.30	46.15	3.73	-0.654	0.068	-0.304
	Spine on internode of largest leaf	0.00	8.50	4.24	1.97	0.648	-0.477	0.185
	Spine on largest leaf	2.50	21.00	10.85	4.87	0.670	-0.336	0.122
	<i>Eigen value</i>					3.506	2.567	1.601
	<i>% Variation</i>					31.877	23.339	14.554
	<i>Cumulative variance</i>					31.877	55.216	69.770

Fig. 1. Scatter diagrams obtained from the first two component scores of the morphometrical measurements of vegetative (A) and floral characters (B). K:Kyoto, M:Mie, T:Tamba

Table2. Floral

Character	Mesurments				Principal components		
	Min.	Max.	Mean	Std. D.	1st	2nd	3rd
Inflorescence number	1.00	6.30	2.54	1.23	-0.787	0.055	0.523
Total flower number	8.50	35.60	18.72	7.31	-0.836	0.239	0.402
Cosexual flower rate (%)	27.59	94.12	72.76	15.61	0.642	-0.605	0.462
Male flower rate (%)	5.88	72.41	5.88	72.41	-0.642	0.605	-0.462
Corolla diameter - Cosexual (mm)	27.90	36.20	32.42	2.38	0.831	0.376	0.163
Anther length -Cosexual (mm)	6.50	8.90	7.58	0.62	0.797	0.114	-0.255
Pistil length- Cosexual (mm)	10.40	13.90	12.30	0.88	0.384	0.709	0.462
Corolla diameter -Male (mm)	24.80	33.00	28.29	2.56	0.444	0.777	0.097
Eigen value					3.815	2.055	1.176
% Variation					47.683	25.683	14.704
Cumulative variance					47.683	73.366	88.070

References

Elle E., 1998. The quantitative genetics of sex allocation in the andromonoecious perennial, *Solanum carolinense* (L.). Heredity. Vol. 80 - 4:481-485.

Elle E. and T.R. Meagher, 2000. Sex allocation and reproductive success in the andromonoecious perennial, *Solanum carolinense* (Solanaceae). II paternity and functional gender. The American Naturalist. Vol.156, No. 6 - 622-636.