Environmental Effects of the Seed Growth on Germination Traits of Invasive *Ulex europaeus*

Mika Hozawa[1] and Eiji Nawata[1]

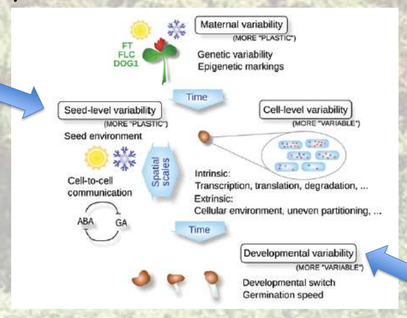
[1]Laboratory of Tropical Agriculture, Graduate School of Agriculture, Kyoto University, Japan

cathynoel1991@gmail.com

Introduction

Ulex europaeus…strong invasiveness from vigorous seed production and seed banks →100 noxious species by IUCN

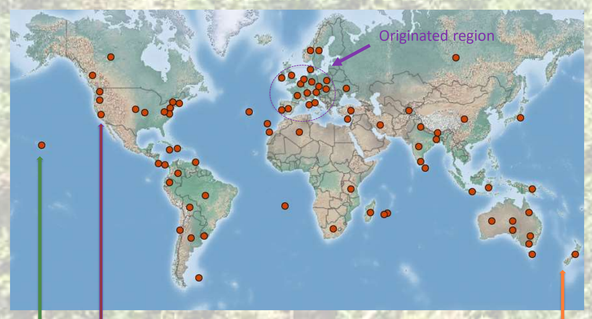
Plant invasiveness is greatly related to seed variability shown as below



(Mitchel et al. 2016)

Two phases of the variability of seed, 1 & 2 were focused in this study

Materials and Methods



Seed sampling sites

Distribution in the world by Invasive Species Compedium (https://www.cabi.org/isc/datasheet/55561, browsed on 9/20/2019)

California/1 mother tree

Hawaii/4 and Maui/3 mother trees

New Zealand North and South Island /2 mother trees each

*260 seeds were tested (10 seeds each X duplicated)

Treatment for the seeds…… 4months at 4℃ to break dormancy
soaked in 90℃ and left for 24 hours

23℃ + light for 12 hours/17℃ + darkness for 12 hours incubated 28days

↓

Germination rate (%) and germination speed ($G50^{-1}$, reciprocal number of the days of 50% germination) and seed dry mass were recorded

Results

Table 1. Germination rate and speed of each mother tree.
H: Hawaii, M: Maui, C: California, NN: New Zealand North Island, NS: New Zealand South Island, GR: Germination rate (%), GS: Germination speed (reciprocal number of the days taken to be 50% of germination). ※ For the seeds whose germination rate did not exceed 50%, reciprocal number of 29 was given as germination speed which is longer than the test days, 28 days

	H1	H2	H3	H4	M1	M2	M3	M4	C	NN1	NN2	NS1	NS2
GR1 (%)	100	100	10	80	100	100	100	60	40	30	40	80	100
GR2 (%)	90	100	30	30	90	90	60	40	40	20	70	70	90
Mean GR	95	100	20	55	95	95	80	50	40	25	55	75	95
GS1	0.063	0.1	0.034	0.063	0.067	0.083	0.067	0.063	0.034	0.034	0.034	0.04	0.125
GS2	0.048	0.125	0.034	0.034	0.083	0.1	0.067	0.034	0.034	0.034	0.048	0.048	0.1
Mean GS	0.056	0.113	0.034	0.049	0.075	0.092	0.067	0.049	0.034	0.034	0.041	0.044	0.113

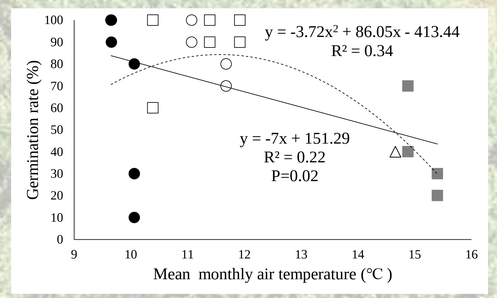


Fig. 1 The correlation of the germination rate and the mean monthly air temperature that the seeds were grown. Quadratic function graph is added to show the tendency of the preferable temperature range during seed growth for the best germination rate. ●: seeds from Hawaii Island, □: seeds from Maui Island, △: seeds from California, ▫: seeds from New Zealand North Island and ○: seeds from New Zealand South Island.

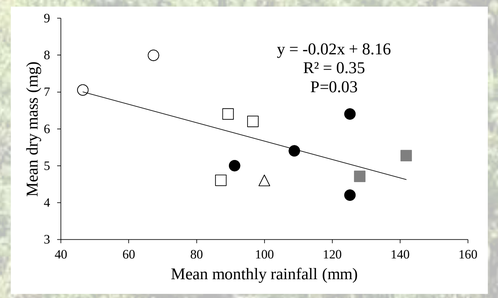


Fig. 3 Correlation of the mean dry mass and the mean monthly rainfall that the seeds were grown.

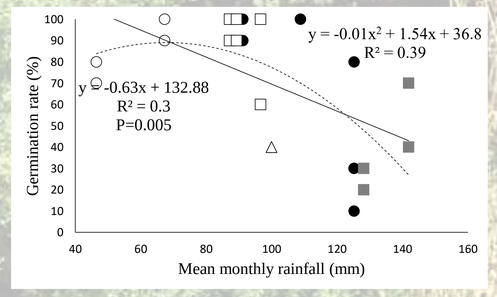


Fig. 2 Correlation of the germination rate and the mean monthly rainfall that the seeds were grown. Quadratic function graph is added to show the tendency of the preferable rainfall range during the seed growth for the best germination rate.

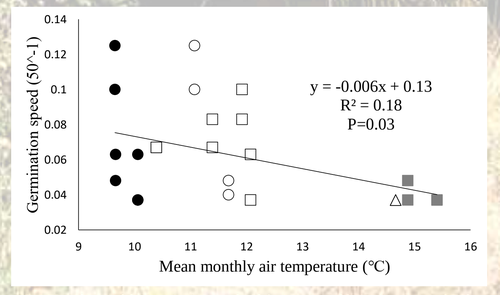


Fig. 4 Correlation of the germination speed and the mean monthly air temperature that the seeds were grown.

Results of correlations

Germination rate ….. negatively correlated significantly with mean monthly air temperature and mean monthly rainfall (Fig. 1 and 2)

Seed dry mass ….. negatively correlated significantly with mean air temperature (Fig. 3)

Germination speed ….. negatively correlated significantly with mean monthly air temperature (Fig. 4)

Germination rate (GR) and Germination Speed (GS) both seemed to relate to the air temperature and rainfall….multiple regression analyses were used to examine the relations

GR=187.37-0.53R-5.56T (GR: germination rate, R: mean monthly rainfall, T: mean monthly temperature) (r^2=0.42, P=0.01, 0.06 for R and T, respectively).

GS=0.15-0.0003R-0.005T (GS: germination speed) (r^2=0.25, P=0.16, 0.07 for R and T, respectively)

↓ How about the quadratic function?

GR=124.8-0.003R^2-0.19T^2 (r^2 =0.44, P=0.008, 0.07 for R^2 and T^2 respectively)

GS=0.11-0.0000015R^2-0.1112T^2 (r^2=0.27, P=0.1, 0.09 for R^2 and T^2 respectively)(default value =0.1)

◆ Germination rate of the seeds grown up to 12℃ and in the precipitation range between approximately 70 and 110 mm was higher, and it was lower out of that range (Fig. 1 & 2).

◆ Germination speed of the seeds grown up to 12℃ was faster (Fig. 4).
(Germination speed did not negatively correlate significantly with mean monthly precipitation (P=0.06), but it also showed the tendency that the seeds with fast germination speed were grown in the precipitation range of approximately 70 to 110mm.)

Discussions

Dry mass of the seeds negatively correlated significantly with the mean monthly rainfall (Fig. 3)

➢ = *U. europaeus* seeds are morphologically adapted to the new environment

➢ *U. europaeus* successfully invaded into all the sampling sites for this study changing its seed morphology for better seed production, but it was inferred that there were the suitable air temperature and rainfall at seed growth for better germination rate and speed

☐Discovering the most favorable climatic conditions of the invasive species to adapt and propagate is very useful information for future study on predicting possible invasion sites

Literature cited

Matsuo, K., & Kubota, T. (1994). Analysis of Seed Germination of Upland Summer Annuals in Tohoku District - Relationship between Temperature and Germination rate-. *Journal of Weed Science and Technology*, *39*(1), 40–45. https://doi.org/10.3719/weed.39.40

Mitchell J, Johnston IG, Bassel GW (2017) Variability in seeds: biological, ecological, and agricultural implications. Journal of Experimental Botany 68:809–817. doi: 10.1093/jxb/erw397

Udo N, Tarayre M, Atlan A (2017) Evolution of germination strategy in the invasive species *Ulex europaeus*. Journal of Plant Ecology 10:375–385. doi: 10.1093/jpe/rtw032

Acknowledgements

I would like to thank to the staffs of the organizations for giving me advice and enabling me to sample in the US and New Zealand:

Dr. J.B Friday of UH Manoa

US Fish and Wildlife Service

Mauna Kea Watershed Alliance

Department of Hawaiian Homelands

Haleakala Ranch

Landcare Reseach (NZL)

AgResearch (NZL)