Weed Emergence Pattern in Vegetable Garden

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Summary

Weed emergence pattern in vegetable garden was recorded for one year from April, 1992 to April, 1993 to establish effective weed control programs. In April, 1992, the top 10cm of soil from vegetable garden was put into three $32 \times 25 \times 7 cm^3$ plastic trays kept in a greenhouse. Watering was done as needed. Emerged seedlings were identified and counted on every Monday until April, 1993. A total of 1,396 seedlings of 28 (or 29) species was recorded. Two conspicuous emergence peaks were observed in spring and fall. Predominant species whose seedlings emerged in spring included *Portulaca oleracea, Digitaria ciliaris, Galinsoga ciliata* and *Amaranthus lividus* var. *ascendens*. In fall, on the other hand, *Erigeron canadensis, E. philadelphicus* and/or *Stenactis annuus* were the predominant ones.

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Key words : emergence pattern, vegetable garden, weed.

Introduction

Farmlands usually contain a vast number of weed seeds and large numbers of weed seedlings can emerge over a long period each year. Brenchley and Warington[1] estimated the size of seed bank of arable land at 34,000 to 75,000/m^2. The size and composition of weed seed bank are greatly influenced by environmental and many other factors such as the kind of crops planted in the past, and therefore both the size and composition differ among fields and among years[2].

Each annual weed in temperate area has an emergence peak in spring or fall and the time of emergence is characteristic for each weed species. To clarify the emergence pattern of each weed is one of the most important subjects to establish effective weed control programs, especially for the minimum use of herbicides. Seasonal emergence patterns of several annual weeds in U. S. and Europe were clarified under the condition in which collected seeds were sown and mixed into soil[3,5–7], but very little information is available on the weed emergence pattern in vegetable garden in Japan.

This research was done to determine the patterns of weed emergence in vegetable garden.

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Materials and Methods

In April 6, 1992, the top 10cm of soil from vegetable garden in the Research Farm, Shinshu University was put into a 32 cm width×25cm depth×7cm height plastic tray. The tray was kept in a greenhouse to avoid surface erosion by heavy rainfalls. Both sides of the greenhouse were left open throughout the study and no temperature control was made. Watering was done as needed.

Emerged weed seedlings were identified by species, counted and removed on every Monday from April 13, 1992 to April 5, 1993. Three replications were made and results were compiled.

Results and Discussion

A total of 1,396 seedlings of 28 (or 29) species including 21 (or 22) annual weeds, five perennial weeds and two escaped crops emerged in a year from April 16, 1992 to April 5, 1993 (Table 1). As it was very difficult to distinguish seedlings of *Erigeron philadelphicus* L. from those of *Stenactis annuus* (L.) Pers., they were expressed as *Erigeron* sp. in the table. Among summer annual weeds, *Portulaca oleracea* L. was the most predominant species and 223 seedlings emerged. *Digitaria ciliaris* (Retz.) Koel. had 62 seedlings, *Galinsoga ciliata* (Raf.) Blake did 40 and *Amaranthus lividus* L. var. *ascendens* (Lois.) Thell. did 39. Seedlings of these four species occupied 96.8% of the total of those of summer annuals. Seedlings of *Erigeron* sp., *E. canadensis* and *Stellaria media* (L.) Villars, whose numbers were 581, 380 and 31, respectively, occupied 98.3% of the total of annual weeds emerged in fall. *P. oleracea, A. lividus* var. *ascendens* and *S. media* are considered to have relatively less dormant seeds than other annual weeds, while seeds of *Persicaria*

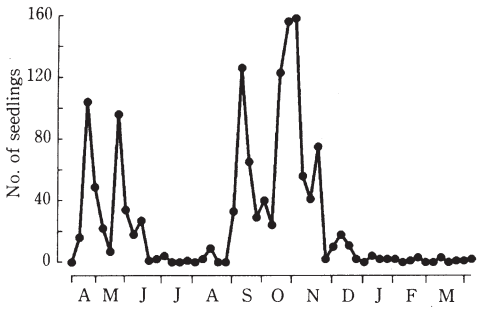

Fig. 1. Emergence pattern of weed seedlings from vegetable garden soil during April, 1992 to April, 1993.

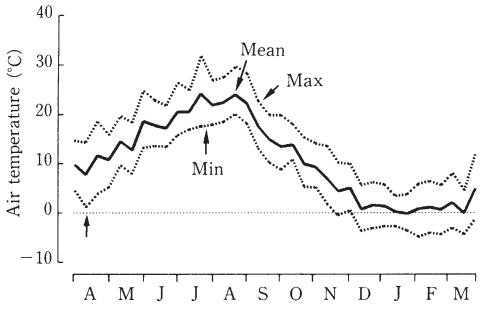

Fig. 2. Seasonal change in air temperature during the study.

Table 1. Species of plants emerged from vegetable garden soil

Species	Number of Seedlings
A. annual summer weeds	
Portulaca oleracea L.	223
Digitaria ciliaris (Retz.) Koel.	62
Galinsoga ciliata (Raf.) Blake	40
Amaranthus lividus L. var. *ascendens* (Lois.) Thell.	39
Echinochloa crus-galli (L.) Beauv. var. *crus-galli*	3
Setaria viridis (L.) Beauv.	3
Persicaria longiseta (De Bruyn) Kitag.	2
Chenopodium album L.	1
Commelina communis L.	1
Sarothra laxa (Blume) Y. Kimura	1
Solanum nigrum L.	1
B. annual winter weeds	
Erigeron sp.*	581
Erigeron canadensis L.	380
Stellaria media (L.) Villars	31
Gnaphalium affine D. Don	8
Vicia angustifolia L.	3
Cerastium glomeratum Thuill.	2
Poa annua L.	2
Capsella bursa-pastoris Medicus	1
Veronica persica Poir.	1
C. other annual weed	
Senecio vulgaris L.	1
D. perennial weeds	
Rorippa indica (L.) Hiern	3
Imperata cylindrica (L.) Beauv.	2
Agropyron tsukushiense (Honda) Ohwi var. *transiens* (Hack.) Ohwi	1
Oxalis corniculata L.	1
Taraxacum officinale Weber	1
E. escaped crops	
Fagopyrum esculentum Moench.	1
Lycopersicon esculentum Mill.	1
Total	1396

* *Erigeron* sp. includes *Erigeron philadelphicus* L. and/or *Stenactis annuus* (L.) Pers.

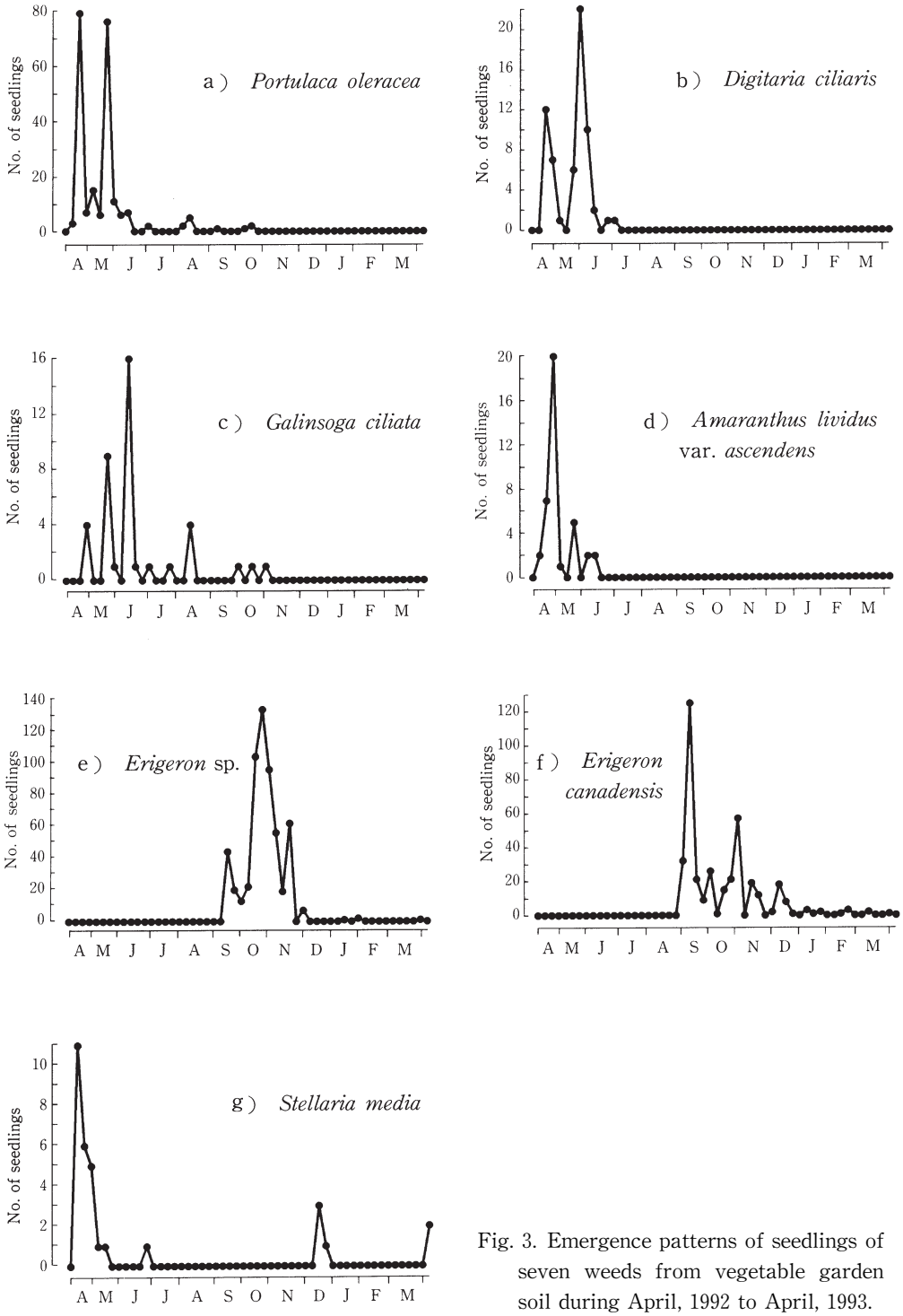

Fig. 3. Emergence patterns of seedlings of seven weeds from vegetable garden soil during April, 1992 to April, 1993.

longiseta (De Bruyn) Kitag., *Chenopodium album* L. and *Commelina communis* L., of which seedlings were observed very rarely, are the most dormant ones[4]. This difference in seed dormancy may be one of the reasons for the abundance of seedlings of the former three species. The results mentioned above agreed well with the weed species composition in the vegetable garden where soil was sampled.

Five perennial weeds were found in the study. *Imperata cylindrica* (L.) Beauv. and *Taraxacum officinale* Weber are not permanent and stable members of vegetable garden weed communities in our research farm. Three seedlings of these perennials might be of the seeds come from some place other than the vegetable garden, because these perennials produce anemochores. Of two crop seedlings, seed(s) of *Fagopyrum esculentum* Moench. might be brought unconsciously to the vegetable garden and a seedling of *Lycopersicon esculentum* Mill. might come from the seed of the crop planted in the garden previously.

Two conspicuous emergence periods were observed in spring and fall (Fig. 1). A temporary decrease in the number of emerged seedlings in May was probably caused by a temporary drop in temperature at the period (arrow in Fig. 2). Of two emergence peaks in fall, the first one was those of *E. canadensis* and the second was of *Erigeron* sp. Annual weeds are generally classified into two groups on the basis of their life cycle, namely, summer annual weeds and winter ones as shown in Table 1. Summer annual weeds emerge in spring, flower in summer and die in fall, and winter ones emerge from fall to early spring, flower in spring and die in summer. The seedling emergence pattern of weeds in the vegetable garden observed in this study showed a typical weed emergence pattern in temperate area. Seedling emergence was scarcely observed during summer, late June to August, and winter, January to March. This result suggests that seeds of summer annual weeds were in the induced dormant state in summer and those of the winter annuals were in the state in winter, respectively.

Fig. 3 shows emergence patterns of seven troublesome annual weeds for the maintenance of vegetable garden. Fig. 3-a) represents the pattern of *P. oleracea* and 3-b) is of *D. ciliaris*. Both species exhibited a similar emergence pattern. A temporary decrease in the number of seedlings emerged in May might be caused by low temperature in early May as described above. *D. ciliaris* did not emerge after early July and seemed to be in the induced dormant state after this period. *G. ciliata* continued to emerge over a longer period (Fig. 3-c) than above noted two species. *A. lividus* var. *ascendens* showed a typical emergence pattern of the summer annual weed (Fig. 3-d).

Erigeron sp. including *E. philadelphicus* and *S. annuus* had emergence peaks in late October (Fig. 3-e) and *E. canadensis* (Fig. 3-f) had in early September. *Erigeron* sp. emerged more simultaneously than *E. canadensis*. *S. media* is classified into winter annual weeds, but its emergence pattern observed in this study did not show the typical one of the winter annuals (Fig. 3-g). The species had an eminent peak of emergence in early

April, just after the start of this research, and a small peak in December. It is assumed that seeds of *S. media* in the vegetable garden had been in the induced dormant state at the start of the study, but by the disturbance of soil at its sampling they were exposed to light, and then their dormancy was broken[8] and germination was facilitated.

Seed germination and emergence are largely influenced by temperature. Soil moisture and light are also important factors for the germination. Although these environmental factors fluctuate from year to year, the emergence pattern of a given weed species seems to be similar year by year. Results obtained here must be useful for predicting the time of weed emergence and then for planning the effective weed control systems, such as the combination of tillage and pre- or post-emergence application of herbicide.

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野菜畑における雑草の出芽パターン

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要　　約

野菜畑における効果的な雑草防除体系を確立するために，雑草の出芽パターンを1992年４月から1993年４月の１年間観察した。1992年４月に信州大学農学部附属農場の野菜畑で土壌を表層10cm から取採し，幅32cm，奥行き25cm，深さ７ cm の育苗箱に詰めた。育苗箱をガラスハウスに設置し，適宜灌水した。設置後，１週間毎に出芽した実生を同定し，数を記録した。３反復の合計で28（あるいは29）種の1,396個体が調査期間中に出芽した。春及び秋に顕著な出芽のピークが認められた。春に出芽した主な雑草は，スベリヒユ，メヒシバ，ハキダメギク及びイヌビユで，秋に出芽した主な雑草はヒメムカシヨモギ，ハルジオン及びヒメジヨオンであった。

キーワード：雑草，出芽パターン，野菜畑