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DISSEMINATION OF SEEDS OF *ERYNGIUM PANICULATUM* FROM ISOLATED PLANTS. II. RELATIONSHIP BETWEEN DISTANCE OF SEED-TRAPS AND GATHERING CAPACITY

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Abstract

Eryngium paniculatum (Apiaceae-Saniculoideae) is of great importance in the north region of Argentina where it is invading abandoned fields. The studies evaluate the dispersion of the species and present spatial orientation for the collectors of seeds of this species.

Most of the seeds, 17 6x103, around 75.46% of the disseminated total of 23.4 x 103 seeds per plant fell at a distance of 60 cm from the mother plant. A total of 2.21 x 103 seeds, 9.48%, fell at a distance of 1.00 m; the greater the distance from the mother plant, the lower the percentage, 4.23% with 989.82 seeds.

Introduction

Eryngium paniculatum Cav. et Dom ex. Delaroche is a member of Apiaceae that has an inflorescence with umbel form capable of producing 130 small floral chapters from a floral stalk of first flowering with 14,500, of which 80% seeds are viable (Chaila *et al.*, 1992). Chaila *et al.*, (1993) confirmed a population model establishing prediction from seeds with future possibilities related to territorial invasion on the basis of short and medium term. They analyzed the behavior of *Eryngium* and fixed a structural characterization of population that determines a predominance index for the different occupied sites (Chaila & Cerrizuela 1995).

Many studies that have considered the seed banks include size, distribution and dynamics (Roberts, 1981; Barralis & Chadoeuf, 1987; Roberts & Chancellor, 1988; Leck *et al.*, 1989). These studies are the basic bibliography for this area of the sciences. There are quantitative studies about the sampling of seeds from the soil with other objectives, where the important part is the remnants and their future behavior (Goyeau & Fablet, 1982). There are also studies of the reproductive potential of the weed seeds in the ploughed soil (Barralis *et al.*, 1986).

The precision in the estimation of the seed bank is influenced by various factors that must always be taken into account (Benoit *et al.*, 1989). These factors influence the quantity of seeds in the soil because they consider the variety and evolution of the adventitious floral and cultural systems (Lopez *et al.*, 1988). A real appreciation of the weed seeds in the soil and their behavior in the seed bank is obtained through spatial analysis (Dessaint *et al.*, 1991); besides a prediction of the adventitious flora can be made through the estimation of seeds in the soil (Carretero, 1977).

The growth rate of the seeds in the soil varies according to the species in the seed bank, the environmental conditions and the cultural practices (Carmona, 1992; Schweizer & Zimdahl 1984). The decrease rate is low and for most of the invaders allows new individuals to generate for many years. A way to control these invaders would be accelerating the rate through stimulus of germination (Saini *et al.*, 1986).

Some authors have studied methods of collection of seeds or fruit-seeds which a plant throws and the distance that they are moved from the isolated plant in a reservation or in an enclosure (Lallana & Elizalde 1991; Lallana *et al.*, 1991; Leguizamon *et al.*, 1985). In the present study a methodology is established for the placement of seed traps for capturing the greatest possible number of seeds disseminated by an isolated plant in order to give itself a greater opportunity of captivating water, nutrients, temperature and light without competition, from the beginning of the floral stimulus until the dispersal and death of the floral stalk.

Materials and Methods

In September 1993, five reservations were established in different sites of the state of Tucumán, Argentina: Reservation 1: El Manantial; Reservation 2: Famaill; Reservation: 3: Monteros; Reservation 4: Horco Molle; Reservation 5: El Ceibal.

In October, a plant was isolated within each reservation, with a floral stalk of 20 cm and in active growth. The terrain was cleaned throughout. With hoe and shovel all the weeds present were eliminated. Collection boxes called seed traps (treatments) were set in place. These rectangular plastic collection boxes 18x23x4.5 cm had the bottom part perforated to allow drainage; they had a plastic net with 1x1 mm openings in the grid. They were put on small stakes 12 cm long, leaving 5 cm from the bottom of the box to the ground (Fig. 1).

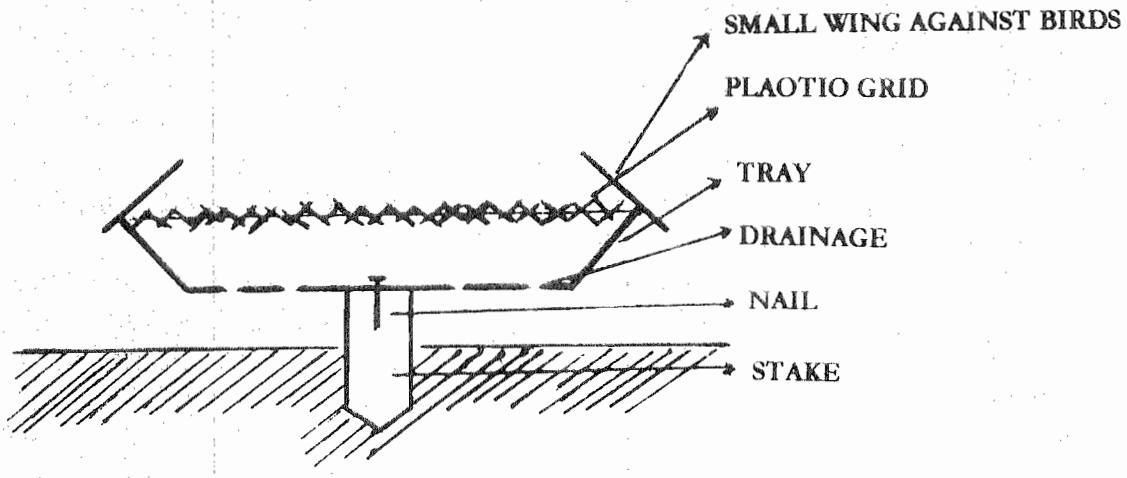

Fig 1. Distribution scheme of all the traps according to the established distance for each of them within the trial.

At each site there were six treatments with three replicates each. Fig. 2 shows the distribution of the seed traps in the field. In order to place the traps, a circle was made for each of the considered distances (0.25; 0.40; 0.60; 0.80; 1.00 and 1.30 m). Each circle had the cardinal orientation and the quadrant where the trap would be sorted; then the traps were placed equidistant within the sorted quadrant. Subsequently, they were placed on the stakes. Fig. 3 illustrates the distribution of the seed traps within the corresponding perimeter.

Seed traps were checked between 10 February and 10 March 1994 at the five sites every 10 days. Observations were made the same day at all sites. For the different sites the nonparametric test of Kruskal-Wallis was applied to determine whether there were differences among treatments. Because of the small values of "p" the Wilcoxon Sum Rank Test was applied for every pair of treatments ($p=0.02$).

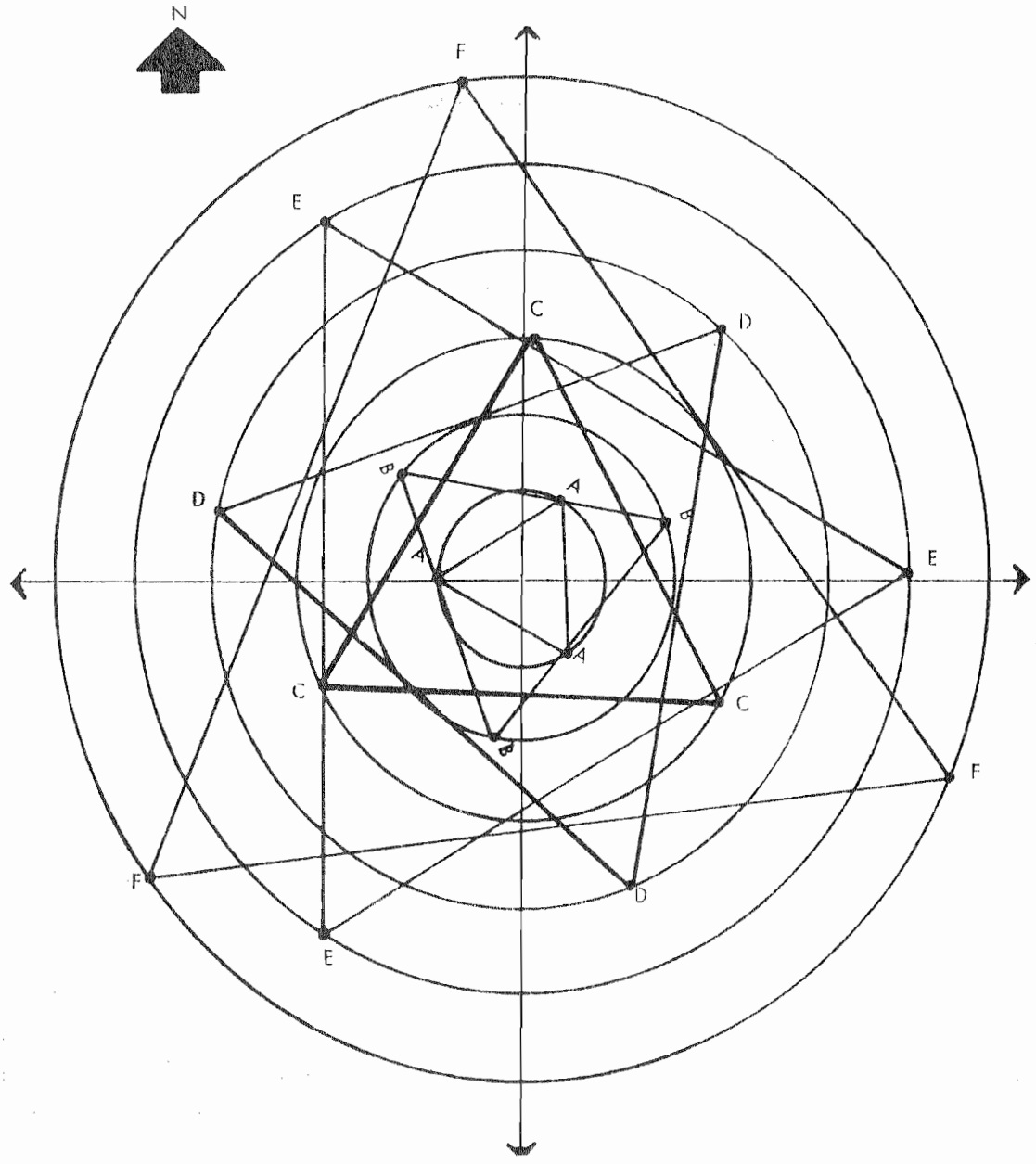

Fig. 2. Distribution scheme of all the traps according to the established distance for each of them within the trials.

Results and Discussion

The invader plants have strategies that allow them to produce a great number of seeds per plant (Mitch, 1988; Foster, 1989; Mortimer, 1990; Carmona, 1992). These strategies together with mechanisms of dissemination, longevity and dormancy allow them to survive in environments completely perturbed (Cousen & Moss, 1990; Ball, 1992; Schreiber, 1992).

Table 1 analyzes the collection of seeds for different distances. The knowledge of the production of seeds per plant together with the distance they fall from the mother plant will allow us to predict the reproductive possibilities related to the viability and germinative potential. The greater the distance from the mother plant, the fewer seeds in the traps were observed.

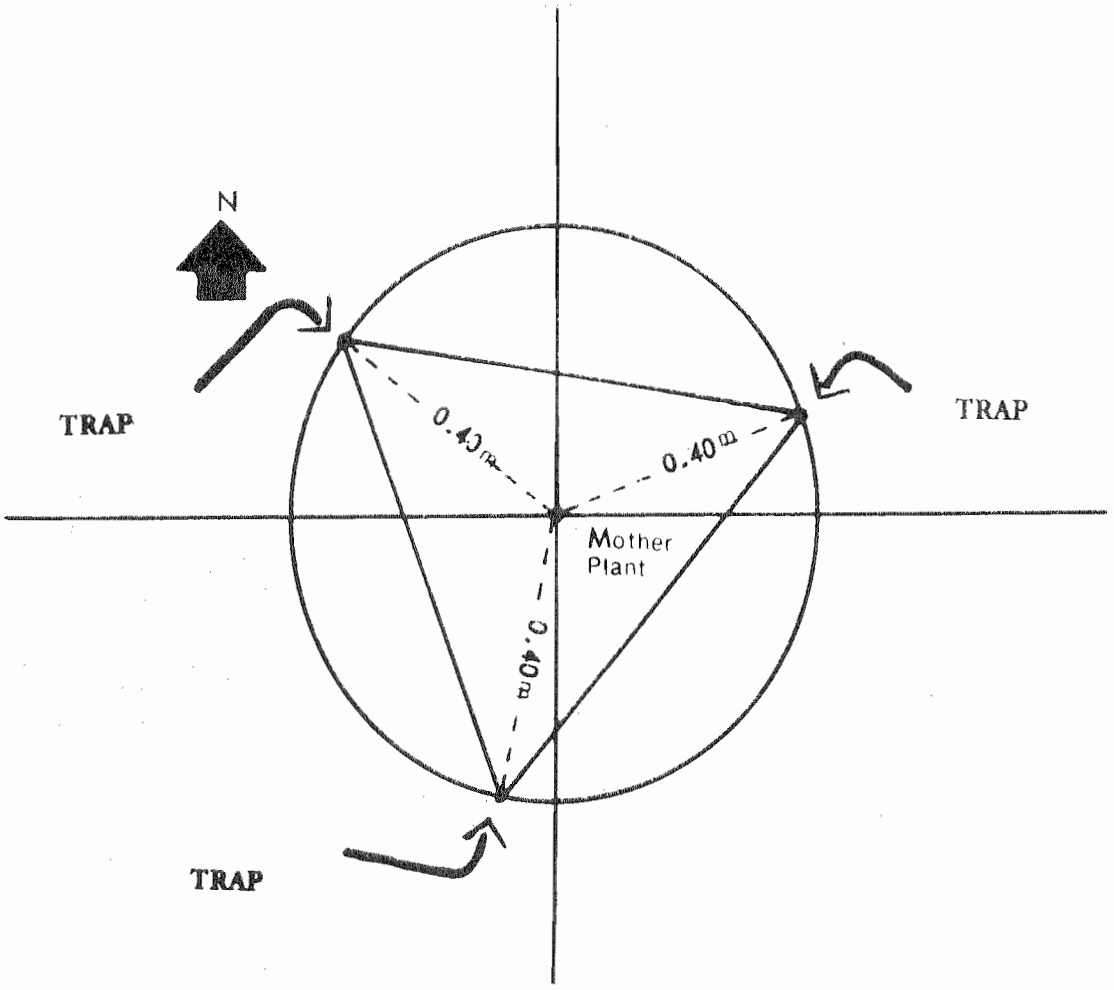

Fig. 3. Placement of the seed trap in the sorted quadrant

Below the original plants, the plants from the basal buds will emerge: they have germination and growing characteristics stronger than those that come from seeds, thus not giving the seed plants possibilities because of the coverage of the available area. The seedlings emerging from seeds occupy only the free open sites that have been cultivated.

In order to establish an average production per plant at the different sites studied, 100 inflorescences were collected at each site and 180 chapters of floral stalk were obtained. 130 fruits for each chapter, 23. 400 seeds per plant. This number is solely an approximation to reality and allows us to infer percentages according to the real drop collected in each trap (Table 2). These values establish the fact that infestation by seeds is low.

The seed do not always find the appropriate environment and has different behaviour, whether the place it occupies has the isolated weed or a community of weeds. A plant with possibilities of disseminating a great quantity of seeds to a greater distance is the one that has a bigger infesting potential and that occupies more territory in a short time.

Escarre & Thompson (1991) studied the effects of variation of the habitat in successive trials and the relationship of the time of flowering with the production of seeds (seed biomass). This variation was considered in this study. The collection was done at the same time in all the experiments, the time with the greatest drop of seeds. In a future successive stage the number of seeds per space will supposedly be lower.

Table 1. Number of seeds related to the distance from the mother plant for different sites.

Distance (m)	El Manantial	Famaillá	Monteros	Horco Molle	El Ceibal	Average
0.25	44a	61	52a	16a	35a	41.60
0.40	49a	36a	41a	27	32a	37.00
0.60	25	37a	29	17a	16b	24.80
0.80	14	28	11b	9b	12b	14.80
1.00	9b	11	8b	23	14b	13.00
1.30	10b	5	4	7b	3	5.80
p=	0.0076	0.0073	0.0058	0.0070	0.0128	

* Same letters mean on significant differences.

Table 2. Percentage of collected seeds and estimated quantity at the given distance for the different sites.

Distance (m)	0.25	0.40	0.60	0.80	1.00	1.30	Total
Percentage (%)	30.36	27.00	18.10	10.80	9.48	4.23	100
Estimated number of seeds	7,090.20	6,318.00	4,235.40	2,527.20	2,218.32	989.82	23,400.00

The obtained percentages in Table 2, show that at a greater distance the percentage related to the whole quantity produced by the plant is small, but the continuity of the species in the community is assured and its infestation potential will be maintained and will continue to increase with the passage of time occupying low density areas. Although the traps are different in size and placement, according to the literature for this particular seed type these traps are the most appropriate even if the quantity of seeds obtained is low.

For an average production of the different sites studied, of the 23, 400 seeds per plant, the greatest quantity of seeds, 75.46%, fell at a distance of 60 cm. The average quantities of 13 seeds for 1.00 m and 5.8 seeds for 1.30 m at the different sites indicate that the possibilities of territorial occupation through seeds are minimal, depending strictly on the real reproductive capacity and infestation potential. These values are conditioned to the density of the population and its greater possibility of infestation of areas will depend anthropogenic contribution to the soil subsystem with the elimination of other species to allow the germination and future development.

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