1984

Ecology of skeleton weed (Chondrilla juncea) in Western Australia

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Recommended Citation

Panetta, F D. (1984), *Ecology of skeleton weed (Chondrilla juncea) in Western Australia*. Department of Agriculture and Food, Western Australia, Perth. Report.

Department of Agriculture

Western Australia

Experimental Summary 1984/85

The ecology of skeleton weed (*Chondrilla juncea*) in Western Australia

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1. The ecology of skeleton weed

1.1 Determination of forms

Objectives

To determine what forms of skeleton weed are present in Western Australia and to map their respective distribution.

Experimental

The technique of starch gel electrophoresis was used to match seedlings and mature leaf material with collections of known identity.

Results

For the first time a laboratory for conducting this type of research has been established in South Perth, and it has been possible to type plants from mature leaf material. This obviates the necessity of waiting for plants to seed to be able to identify them. A total of six new collections were identified as belonging to either the broad-leaf or narrow-leaf forms, the locations for which are given in Table 1.1.

Table 1.1. Seed production by field-grown skeleton weed plants during 1983/84

Site	Form*	Number of plants	Number of seeds	Number of viable seeds	Percentage viability
North Miling	A	1	23,300	18,100	77.7
Moorine Rock	A	3	9,300	3,000	32.2
Merredin	C	4	17,500	7,100	40.6
Narembeen	C	2	16,900	15,400	91.1
Narembeen	C	2	55,100	39,500	71.7
Moorine Rock	C	1	4,300	2,300	53.5

* Form A = narrow-leaf, C = broad-leaf.

Results

1.2 Seed viability

Objectives

To determine the amounts, viability and dormancy status of seeds produced by field-grown plants during summer and autumn months.

Experimental

Mature seed was collected fortnightly from plants enclosed in nylon bags and was tested for germinability in the laboratory.

Seed production was high generally for both forms of skeleton weed at a number of sites in the wheatbelt, although seed viability levels varied between approximately 30 and 90 per cent (Table 1.1). Values for viability levels given in Table 1.1 have been averaged over the entire summer/autumn season and hence do not highlight the trend of decreasing seed viability which occurred towards the end of the season at most sites. It appears that for at least three sites (two at Narembeen and one at north Miling) seed production would not limit the expansion of skeleton weed populations. It is believed that where plants have produced low seed yields with low seed viability this may be due to incomplete root development and this situation would possibly change if the plants were allowed to mature.

Table 1.2. Time course of seed production by field-grown skeleton weed plants during 1983/84

Site	Number of viable seeds produced per plant during peak period	Period of peak production	Period of greater than 50% peak production (weeks)	Duration of seed production (weeks)
North Miling	4,000	19 Jan - 3 Feb	6	17
Moorine Rock	630	25 Jan - 8 Feb	2	10
Merredin	750	8 Feb - 22 Feb	4	11
Narembeen	2,650	26 Jan - 9 Feb	4	18
Narembeen	7,200	26 Jan - 9 Feb	2	22
Moorine Rock	1,900	8 Feb - 22 Feb	2	8

Most of the viable seed was produced between mid-January and the end of February, although in some cases plants continued to produce viable seed for more than four months (Table 1.2). It is of considerable ecological significance that a substantial proportion of the season's seed production occurred in the absence of appreciable rainfall. In other words, summer rainfall does not appear to be a necessary condition for mature plants of skeleton weed to produce large numbers of viable seed.

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Table 1.3. Time course of production of dormant skeleton weed seeds for two field-grown plants for which this component was greater than 5% on more than one sampling occasion

District	Form	Date of collection	Weeks of lab storage before testing	Percentage of dormant seeds
North Miling	Narrow-leaf	5/1/84	5	16.5
		19/1/84	3	2.0
		3/2/84	1	35.5
		17/2/84	2	11.0
		2/3/84	3	1.5
		16/3/84	2	0.5
		30/3/84	4	1.0
		13/4/84	3	0.5
		27/4/84	1	0
Narembeen	Broad-leaf	11/1/84	4	0
		26/1/84	2	20.5
		9/2/84	1	29.0
		23/2/84	2	10.0
		8/3/84	2	3.0
		22/3/84	2	5.9
		5/4/84	3	1.0
		19/4/84	3	0

It appears that in field situations dormant seeds are produced in greater amounts at the beginning of the reproductive season (Table 1.3). Only three out of 13 plants produced significant quantities of dormant seed, however. Because seed dormancy was lost fairly rapidly during laboratory storage, differing times of storage may have had an effect upon the trends which were observed. It remains to examine the effects of high soil temperatures upon after-ripening in the seeds of this species. The occurrence of seed dormancy has considerable field significance, as the dormant component of the seed population is not likely to be depleted by isolated summer rainfall events.

1.3 Germination under simulated rainfall conditions

Objectives

To be able to predict how readily seed populations of skeleton weed would be reduced in size following unseasonal rainfall of varying amounts and durations.

Experimental

In a pot experiment, both surface-sown and buried (1 cm) seeds were exposed to different total amounts of simulated rainfall then protected from drying for periods of 24, 48 or 72 hours. Following this, pots were placed outside under conditions of high evaporative demand until totally dry. Seed populations were then retrieved and their fates determined.

Results

Table 1.4. Percentage germination of skeleton weed seeds in response to simulated rainfall events. Results given for both the broad-leaf and narrow-leaf (in parentheses) forms

Days of lab storage	Days to median germination percentage	Amount of rainfall (mm)	Number of applications	Percentage germination
16	1.92 (1.92)	2.69	1	0 (0)
			2	0.6 (0)
			3	0 (0.6)
47	0.57 (0.64)	5.00	1	72.7 (43.2)
			2	50.6 (18.7)
			3	38.3 (20.4)
16	1.92 (1.92)	5.46	1	1.7 (2.5)
			2	18.2 (18.8)
			3	10.2 (6.6)
32	0.74 (0.78)	7.12	1	33.4 (41.1)
			2	88.7 (94.6)
			3	96.2 (61.7)
42	1.09 (1.09)	8.75	1	26.8 (26.0)
			2	76.2 (40.8)
			3	78.8 (37.7)
47	0.57 (0.64)	10.0	1	100 (74.6)
			2	100 (92.7)
			3	100 (92.5)
42	1.09 (1.09)	17.5	1	99 (81.9)
			2	100 (98.2)
			3	100 (98.1)

It can be seen from Table 1.4 that the potential rate of germination (estimated by the number of days to median germination at 20/30°C and with water not limiting) is an important determinant of germination response at low to intermediate, but not high, total amounts of rainfall. Although buried seeds of both forms responded similarly to high (17.5 mm) and low (5.46 mm) amounts, at an intermediate amount (8.75 mm) of rainfall, germination of the broad-leaf form increased markedly in response to increasing durations of rainfall, in contrast to the behaviour of seeds of the narrow-leaf form. Germination of surface-sown seeds did not occur or was minimal under all conditions, and occurred only to moderate levels when pots were covered in order to increase the relative humidity.

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Comments

These results indicate that, apart from any considerations of initial seed dormancy, the physiological status of the seed, which governs its potential rate of germination, will be critical in its response to particular types of summer rainfall. In addition, it is unlikely that seeds will germinate unless buried, although the degree of burial may need only to be slight, at the scale of seed size.

1.4 Summer rainfall characteristics for various sites in the Western Australian wheatbelt

Objectives

To characterize the patterns of summer rainfall and to link these with experimental measurements of germination response to simulated rainfall, in order to predict the probabilities of seed pool depletion in different sites.

Experimental

Rainfall records for twenty years from Research Stations in the wheatbelt were utilized to calculate average values for the relationships between precipitation and pan evaporation (P/E_{pan}) for the weeks between mid-December and the end of March. Results for germination of seeds of a range of dormancy characteristics under a variety of simulated rainfall conditions indicated that for buried seeds a full germination response resulted when P/E_{pan} was at least equal to 0.25. Therefore, the areas under curves for the time courses of P/E_{pan} values both less than and greater than 0.25 were integrated and compared for various sites.

Table 1.5. Integrated values for P/E_{pan} relationships from mid-December to the end of March for various sites in south-western Western Australia. Values given in frequency x weeks

Site	$0.05 \leq P/E_{pan} < 0.25$	$P/E_{pan} \geq 0.25$
Chapman Valley	169	35.4
Badgingarra	167	76.1
Perenjori	172	77.5
Salmon Gums	218	84.2
Wongan Hills	126	94.7
Merredin	178	107
Newdegate	254	127
Kojonup	170	132
Mt Barker	552	237

Results

In Table 1.5, 9 sites are ranked in order of increasing probabilities of seed pool depletion. At the extremes are Chapman Valley, with particularly dry summers, hence high chances of seed survival, and Mt Barker with a higher component of summer rainfall, which would be expected to reduce the numbers of seeds which would survive to the autumn break.

Comments

Although it is possible to rank sites according to mean values for climatic parameters and biological responses to these, it is important to consider the variation in rainfall patterns which might occur from year to year in any particular site.

Since skeleton weed is a perennial species, annual recruitment from seed might not be particularly essential to the success of the weed over time. Also, it is important to remember that rainfall events which promote germination may also stimulate the production of more seed.