Crop Weeds

WEEDS IN SPRING SEEDBEDS

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Summary

Weed populations are described which became established at Levin in 1975 and 1976 in seedbeds prepared weekly through September, October and early November. Twenty-two species occurred regularly but only five or six accounted for most of the population both by number and weight. The early September seedbeds, when 9 or 10 weeks old, contained the highest number of weeds, about 19×10^6 /ha. The greatest total weights, of the order of 40 t/ha freshweight, occurred following seedbed preparation in late September or mid-October.

INTRODUCTION

Patterns of emergence of the weeds of temperate annual crops have been described by a number of European researchers, for example, Roberts (1964) and Chancellor (1965) working in central England and Lawson *et al* (1974) in south eastern Scotland.

It is remarkable that in the relatively short history of intensive vegetable cropping in New Zealand substantially the same European species have established and built up to high levels of infestation. On the Levin station more than 30 such adventive species are frequently recorded in seedbeds. A review of available literature (Kropáč, 1966) showed that for a number of East and West European countries the estimated weed seed content of arable land ranges from 10×10^6 to $3,000 \times 10^6$ with an average of about 600×10^6 /ha. Roberts (1970) suggests that with the usual cultivation regimes only about a tenth of the total is likely to germinate in a complete year which is consistent with our observations at Levin. In the periods covered by the two experiments reported in this paper population peaks reached 19×10^6 seedlings/ha. Unpublished results from other trials nearby show that the total viable seed population is about 250×10^6 /ha.

The present experiments were carried out in 1975 and 1976 during the main spring sowing period to describe the weed population which became established in seedbeds and to record any specific trends which might occur.

METHOD

Primary cultivation was carried out and coarse seedbeds were prepared in August each year. Randomised block layouts of nine treatments were then marked out containing plots 1.5 m wide. In 1975 there were six replications of plots 6 m long and in 1976 replication was increased to ten and plot length reduced to 3 m.

The standard final seedbed preparation treatment consisted of one pass of a p.t.o. — driven cultivator ('Lelyterra') working in low

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Crop Weeds

gear to give a good-textured, shallow seedbed. The treatments were prepared at weekly intervals from the first week in September until the first week in November (Fig. 1), those from mid-October onwards being preceded by a spray application of paraquat with diquat, 0.3 kg/ha (total), to ensure that plots were weed free at the start.

Each plot was sampled 64 days (1975 experiment) or 71 days (1976 experiment) after treatment. In 1975 two 40 x 40 cm quadrats were placed at sampling time. The technique was modified in 1976 when two 45 cm diameter wire rings were fixed in the plot just after seedbed preparation. All weeds within the sample area were cut off at ground level and transferred to the laboratory in plastic bags. They were then separated into species, counted and weighed fresh and dry.

The Levin area experiences a climate without extremes (Coulter 1966). Generally rainfall is plentiful and temperatures moderate — see Table 1. September and October rainfall totals for both experimental years and December of 1975 were near normal but December 1976 was particularly wet. Both Novembers were comparatively dry.

TABLE 1: Rainfall and temperature at Levin relevant to experimental periods

	Monthly rainfall, mm			Mean screened air temperature, °C		
	1975	1976	Normal*	1975	1976	Normal*
Sept	87	78	84	10.6	10.5	10.7
Oct	84	92	99	13.1	11.9	12.4
Nov	42	29	84	13.1	12.8	13.9
Dec	86	202	99	14.5	16.1	15.6

* Based on records 1941-1970

Mean screen air temperatures were not much different from normal in the first two months but both Novembers, and also December 1975, were cold by local standards.

RESULTS

Table 2 lists the 22 weed species that occurred regularly in both years. For convenience they are classed as 'major', 'minor' and 'other' species. In addition to these, the following species which occurred irregularly are noted:—

yarrow (*Achillea millefolium*), redroot (*Amaranthus powellii*), shepherd's purse (*Capsella bursa-pastoris*), cotula australis (*Cotula australis*), dove's foot (*Geranium molle*), small-flowered mallow (*Malva parviflora*), broad-leaved plantain (*Plantago major*), water pepper (*Polygonum hydropiper*), sorrel (*Rumex acetosa*), hedge mustard (*Sisymbrium officinale*), sow thistle (*Sonchus oleraceus*), scrambling speedwell (*Veronica persica*).

Crop Weeds

TABLE 2: Weeds occurring regularly in the experiments

Major species:—	
Fathen	(<i>Chenopodium album</i> agg)
Twin cress	(<i>Coronopus didymus</i>)
Toad rush	(<i>Juncus bufonius</i>)
Willow weed	(<i>Polygonum persicaria</i>)
Black nightshade	(<i>Solanum nigrum</i>)
Spurrey	(<i>Spergula arvensis</i>)
Minor species:—	
Scrambling fumitory	(<i>Fumaria muralis</i>)
Narrow-leaved plantain	(<i>Plantago lanceolata</i>)
Poa annua	(<i>Poa annua</i>)
Creeping buttercup	(<i>Ranunculus repens</i>)
Broad-leaved dock	(<i>Rumex obtusifolia</i>)
Catchfly	(<i>Silene gallica</i>)
Chickweed	(<i>Stellaria media</i>)
White clover	(<i>Trifolium repens</i>)
Other species:—	
Scarlet pimpernel	(<i>Anagallis arvensis</i>)
Parsley piert	(<i>Aphanes arvensis</i>)
Annual mouse-ear chickweed	(<i>Cerastium glomeratum</i>)
Scotch thistle	(<i>Cirsium vulgare</i>)
Summer grass	(<i>Digitaria sanguinalis</i>)
Oxalis corniculata	(<i>Oxalis corniculata</i>)
Wireweed	(<i>Polygonum aviculare</i>)
Dandelion	(<i>Taraxacum officinale</i>)

The symmetrical patterns in Fig. 1 show how weed establishment varied during the course of each experiment. The largest numbers of weeds, slightly more than 1,900/m², became established after preparation of the early seedbeds (treatment 2, 1975 and treatment 1, 1976). The numbers decreased with successive treatments to approximately 300/m² in 1975 and 150/m² in 1976 by the end of the experimental period.

The weight of weeds built up to a maximum in the middle period in 1975 (particularly treatments 4 and 6 which yielded the equivalent of 45 and 39 t/ha freshweight, respectively) and slightly earlier in 1976 (treatment 3). Overall, the dryweight of weeds produced from each seedbed ranged from 250–590 g/m².

Major species

The contribution of each of the major species to the total population, by percentage of total number and weight, is shown in Table 3.

Three species, willow weed, twin cress and spurrey were generally of greatest significance, particularly in early treatments but black nightshade and fathen were also important in 1975. Numerically, toad rush was important in the early part of both experiments.

Crop Weeds

Fig. 1

The patterns in Fig.1 illustrate the effect of treatment on the establishment of some of the major species. Peak populations of willow weed, twin cress, spurrey and fathen occurred in both years within the first two treatments, tending to be slightly later in 1976.

In 1975 willow weed contributed 30% of the population in treatments 2 and 3 and black nightshade was 30%–40% of treatments 4, 5, 6 and 8. Spurrey provided 30% of the total numbers in treatment 9. Toad rush numbers (not illustrated) increased through the first three treatments, then stopped abruptly. Willow weed also gave the greatest proportion of total weed weight in treatments 2 and 3 (60 and 57%) and was the main species by weight in all except treatments 7 and 8 where it was exceeded by fathen (which gave 34 and 39%). The other main contributions, ranging from 23–28%, were twin cress (treatment 1), spurrey (treatments 1 and 9) and fathen (treatments 4, 5, 6, 9).

In 1976 fewer species accounted for the bulk of the population. Willow weed was numerically greatest throughout.

Similar numbers of twin cress and spurrey occurred in each treatment and their sum approximately equalled the willow weed totals. Toad rush numbers were at a maximum in treatment 2, declining to nothing after treatment 6.

Crop Weeds

TABLE 3: Composition of weed population, major species

% of total number and % of total dry weight, in parenthesis.

Treat- ment No.	Willow weed	Twin cress	Spurrey	Black night- shade	Fathen	Toad rush	Others
<i>1975 experiment</i>							
1	16 (25)	14 (23)	19 (26)	13 (3)	12 (13)	16 (—)	10 (10)
2	30 (60)	12 (12)	13 (7)	12 (3)	8 (11)	16 (—)	9 (7)
3	29 (57)	11 (10)	8 (4)	11 (3)	9 (13)	22 (—)	10 (13)
4	18 (44)	12 (13)	12 (6)	36 (9)	13 (24)	— (—)	9 (4)
5	18 (38)	8 (14)	8 (6)	33 (7)	21 (23)	— (—)	12 (12)
6	16 (35)	9 (13)	11 (7)	32 (11)	18 (23)	— (—)	14 (11)
7	20 (29)	6 (5)	26 (16)	18 (3)	15 (34)	— (—)	15 (13)
8	8 (19)	2 (2)	23 (16)	35 (9)	16 (39)	— (—)	16 (15)
9	17 (32)	5 (4)	30 (28)	19 (4)	16 (24)	— (—)	13 (8)
<i>1976 experiment</i>							
1	35 (20)	16 (18)	22 (58)	1 (—)	1 (1)	11 (—)	14 (3)
2	36 (34)	16 (17)	21 (46)	1 (—)	1 (1)	13 (—)	12 (2)
3	32 (39)	16 (26)	20 (31)	2 (—)	2 (1)	16 (—)	12 (3)
4	37 (51)	17 (15)	15 (30)	2 (—)	1 (1)	8 (—)	20 (3)
5	27 (53)	17 (26)	14 (17)	4 (—)	2 (3)	19 (—)	17 (1)
6	29 (68)	12 (16)	12 (7)	8 (—)	2 (4)	11 (—)	26 (5)
7	30 (79)	9 (7)	17 (5)	11 (—)	7 (4)	— (—)	26 (5)
8	21 (83)	8 (6)	13 (2)	13 (1)	4 (2)	— (—)	41 (6)
9	36 (95)	6 (2)	11 (1)	12 (—)	6 (1)	— (—)	29 (1)

By weight, willow weed was the dominant weed except in treatments 1 and 2 when it was exceeded by spurrey. With the gradual increase in weight of willow weed during the course of the experiment to a final 95% of all species there was a corresponding decline of twin cress and spurrey weights from start to finish.

Minor species

A few species were quite common but seldom contributed more than 3 or 4% of the total population either numerically or by weight. The densities of these species is shown in Table 4. In 1975 scrambling fumitory, broad-leaved dock and catchfly occurred throughout, reaching their peak in treatment 3. *Poa annua* in both years and also, in 1976, catchfly, narrow-leaved plantain, white clover, creeping buttercup and chickweed were at their maximum in treatments 1 and 2, declining thereafter.

Other species

Several species occurred sparsely but regularly enough for some emergence patterns to be seen, as shown in Table 5. In the early part of the season parsley piert, annual mouse-ear chickweed and Scotch

Crop Weeds

thistle occurred, in the second half scarlet pimpernel and summer grass were present. Both oxalis corniculata and wireweed tended towards the middle period and dandelion occurred in the early and middle treatments.

TABLE 4: Numbers of minor species, per m²

Treatment No.	1975 experiment				1976 experiment					
	scrambling fumitory	broad-leaved dock	catchfly	poa annua	catchfly	poa annua	narrow-leaved plantain	white clover	creeping buttercup	chickweed
1	17	30	20	30	15	57	24	69	42	17
2	20	55	21	24	11	49	24	67	38	18
3	38	69	23	15	10	39	15	18	23	15
4	13	15	7	18	7	51	11	35	21	16
5	9	29	10	9	—	16	6	10	7	9
6	9	15	5	4	—	10	6	12	6	—
7	10	22	11	2	—	3	5	14	3	—
8	8	9	9	2	—	9	11	20	6	—
9	9	10	10	2	—	3	6	20	5	—

TABLE 5: Regular occurrence of 'other' species in both experiments

Treatment No.	scarlet pimpernel	parsley piert	annual mouse-ear chickweed	scotch thistle	summer grass	oxalis corniculata	wireweed	dandelion
1			*	*				*
2		*	*	*			*	*
3		*	*			*	*	*
4		*	*			*	*	*
5	*		*		*	*	*	*
6	*				*	*	*	*
7	*				*	*	*	
8	*				*			
9								

DISCUSSION

In both spring periods considered in these experiments a major weed flush followed the preparation of seedbeds during the first half of September — a time generally considered rather early for sowing

Crop Weeds

most of the district's crops. Weeds from these seedbeds did not produce as much bulk however in their nine to ten weeks growth as did those from seedbeds made late in September and even the second week in October in 1975. The greatest numbers of main species in 1975 resulted in a higher total density and also a larger biomass from all but the earliest and latest treatments. In this middle period, the principal contributor numerically was black nightshade, but by weight this weed was of little significance in comparison with willow weed and fathen. A discussion of inter-specific competition is beyond the scope of this paper, but the apparently poor competitive ability of black nightshade illustrates the common experience in crops such as peas, beans and tomatoes that this species often becomes much more significant when others have been controlled.

Sequential emergence in these two trials cannot be linked with any certainty to particular climatic factors. It is unlikely that either soil moisture or temperature imposed germination limits on any of the common species although it is noted that the end of toad rush germination coincided with a definite rise in soil temperature (above 10°C at 10 cm depth) in each trial.

The numerical importance of willow weed, twin cress and spurrey early in the season is in accordance with general observation. However the results showed clearly that numerical proportions can give a poor indication of the growth of a weed species in a stand and emphasise the difficulties of predicting the development of a dynamic weed complex. For example, in 1976, willow weed accounted for 95% of a high total weed weight at the end of the experimental period when, in fact, its frequency was quite low.

As local information of this type is collected it should become easier for more accurate prognoses of weed occurrence to be made which, in turn, will be of considerable value when formulating herbicide programmes for different crops.

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