EFFECT OF TIME OF SEEDLING EMERGENCE ON SEED PRODUCTION AND TIME TO FLOWERING OF EIGHT WEEDS

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Summary. Seed production from wild oats (*Avena fatua* and *A. sterilis*), paradoxa grass (*Phalaris paradoxa*) turnip weed (*Rapistrum rugosum*), New Zealand spinach (*Tetragonia tetragonoides*) urochloa or liverseed grass (*Urochloa panicoides*), mintweed (*Salvia reflexa*) and common thornapple (*Datura stramonium*) was measured from plants which emerged at two monthly intervals from June 1978 to April 1979, and which were spaced 1 m apart in a row. Seed production per plant ranged from 1600 to 189 400 and was highest from plants emerging early in the growing season (April and June for winter growing species and August to December for spring and summer growing species). Time from seedling emergence to flowering for winter growing species emerging in June and April was 113 to 133 days; this time was approximately halved for plants emerging in summer. Days to flowering ranged from 32 to 56 days for the spring and summer growing species.

INTRODUCTION

Seed production is one of the critical phases in the life cycle of annual weeds and is thus one of the factors which affects weed populations. The aim of this experiment was to measure the effect of time of emergence on seed production per plant for eight weed species common in grain crops. This experiment is part of a research project on the dynamics of weed seed populations in wheat growing soils.

MATERIALS AND METHODS

Seed collected from farmers' paddocks was germinated in the laboratory and placed in peat pots in the glasshouse. At the 2 to 3 leaf stage, the seedlings were planted in krasnozem soil in the field at the Queensland Wheat Research Institute, Toowoomba. A split plot design with three replicates was used, with time of planting as the main plots and weed species as the sub-plots. Each sub-plot was 1 m wide and consisted of four plants spaced 1 m apart in a row. Seedlings emerging within the first two weeks of each planting month were planted at two monthly intervals from June 1978 to April 1979. A basal application of nitrogen and phosphorous fertilizer was applied to the site in June 1978 and the experiment was irrigated during dry periods.

Florets or fruit remaining on the plants at maturity or the scars from where they had fallen were counted for all species except New Zealand spinach; the fruit of New Zealand spinach were gathered from the soil surface and counted.

Summed growing degree days were calculated by summing daily average temperatures in ^{o}C for Toowoomba (Weather Bureau data) for the period from seedling emergence to first flowering.

RESULTS

Seed production for the two wild oat species was highest from plants emerging in June, with progressively lower production from plants emerging in April, August and the spring and summer months (Table 1). There was a tendency towards the same result for paradoxa grass but the differences between emergence times were not significant (the F test was significant at $P = 0.10$). Seed production for turnip weed was highest from plants which emerged in June and August. For urochloa grass, common thornapple and New Zealand spinach, seed production was highest from plants emerging in late winter, spring or early summer. There was a similar tendency for mintweed but the differences between emergence times were not significant. Missing values for seed production (Table 1) occurred because in those cases many of the plants died before maturity and reliable seed production values cannot be presented, although some seed was produced.

The number of days to first flowering for wild oats, paradoxa grass and turnip weed was approximately halved for plants emerging in summer compared with those emerging in April or June (Table 1); total summed growing degree days tended to follow the same pattern. For the other four species the effect of emergence date on the number of days to first flowering was not as great. Summed growing degree days tended to be constant especially for urochloa grass, mintweed and common thornapple.

The viability of seeds produced in the experiment was not measured but seed from some species was used later in germination experiments. Maximum germination values were 100% for wild oats (both species), paradoxa grass and mintweed, 92% for urochloa grass and 73% for turnip weed.

DISCUSSION

The number of viable seeds produced may have varied somewhat from the values shown in Table 1, since aborted florets or fruit would have been included in the values for all species except New Zealand spinach because of the method of counting. Although the values from germination tests showed that seed viability was high for at least five species, viability may have varied between plants from different emergence dates. The four New Zealand spinach plants within each plot spread to form a complete ground cover. Thus it is likely that plants growing further apart would have produced more seed per plant than the values reported in Table 1. Wild oats emerging late in winter or in summer were affected by stem rust so that values recorded are probably underestimates of the production from healthy plants.

The values reported here support the generalization that weeds produce large numbers of seeds (Roberts 1970; Swarbrick 1979). Seed production was generally highest from plants emerging early in the growing season - April and June for winter growing species and August to December for spring and summer growing species. The lowest seed production values for each plant were generally very much less than the highest values, but even the lowest values could be considered a large number of seeds from a single plant. A major factor in the maintenance of weed populations may be the number of seeds produced by plants emerging late in the growing season after weed control measures have been carried out or emerging outside the usual growing season. The lowest values for wild oats were 1600 to 1800 seeds per plant. If only 1% of these produced seedlings there would be 16 to 18 plants in place of one parent plant.

Table 1. Effect of seedling emergence date on seed production per plant, days to first flowering and summed growing degree days for eight weeds.

Weed species and attributes	Seedling emergence date					
	June 1978	August 1978	Oct. 1978	Dec. 1978	Feb. 1979	April 1979
Wild oats (*A. fatua*)						
Panicles/plant	66	49	-	57	47	110
Florets/plant	11 200[2]a	4500[3]c	-	1600[3]d	1700[3]d	8800b
Days to flowering	121b	78c	52e	60d	60d	133a
Summed GDD[1]	1427	1032	896	1295	1321	1853
Wild oats (*A. sterilis*)						
Panicles/plant	60	37	45	41	37	74
Florets/plant	9400a	3400[3]c	1800[3]d	1800[3]d	1800[3]d	5600b
Days to flowering	-	89b	66c	66c	89b	133a
Summed GDD	-	1217	1209	1417	1854	1853
Paradoxa grass						
Spikelets/plant[6]	21 600a	11 400a	3500a	-	-	19 100a
Days to flowering	113a	79b	49c	-	-	-
Summed GDD	1346	1049	871	-	-	-
Turnip weed						
Seeds/plant	77 900a	46 600a	7700b	4500b	-	-
Days to flowering	119a	76b	50c	42d	53c	-
Summed GDD	1362	1008	874	863	1127	-
New Zealand spinach						
Seeds/plant	-	189 400a	96 200ab	44 700b	-	40 400b
Days to flowering	-	53a	43bc	36c	47ab	54a
Summed GDD	-	758	792	759	1017	818
Urochloa grass						
Seeds/plant	-[5]	-	101 000a	56 300b	10 000b	-[4]
Days to flowering	-	-	49a	40b	38b	-
Summed GDD	-	-	833	842	814	-
Mintweed						
Seeds/plant	-[4]	179 100a	145 900a	73 200z	-	-
Days to flowering	-	56a	43b	40b	32c	-
Summed GDD	-	687	720	822	695	-
Common thornapple						
Fruit/plant	-[5]	-[5]	159	98	19	-[4]
Seeds/plant	-	-	99 600a	65 100a	6 100b	-
Days to flowering	-	-	38b	-	36b	55a
Summed GDD	-	-	661	-	765	875

[1] GDD = growing degree day.
[2] Values within a species and with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).
[3] Damaged by stem rust.
[4] Killed by frost.
[5] Seed unavailable for planting.
[6] One seed per spikelet.

It is the number of weeds per unit area which emerge and survive to compete with the crop, which is of economic importance, and thus seed production per unit area is more important than seed production per plant. Although the seed production per plant from weeds in crops may be small, the seed production per unit area may still be large. Wilson (1979) found that wild oats in wheat and barley crops produced only 11 to 64 florets per plant but 3200 to 10 300 florets m^{-2}. These values per plant were much less than the values reported here from weeds growing without competition. However, plants comparable to those grown in this experiment have frequently been observed on uncultivated contour banks, near fence lines and in unplanted portions of paddocks.

Time from seedling emergence to first flowering for wild oats, paradoxa grass and turnip weed cannot be predicated using summed growing degree days because of the variation in the values. This indicates that flowering in these species is probably influenced by photoperiod. This has been shown for *Avena fatua*, although the response does vary with genotype (Chancellor 1976; Paterson *et al.* 1976). Summed growing degree days for the other four species were less variable indicating that their response to photoperiod, if any, was much less than for the winter growing species.

The number of days from seedling emergence to first flowering has a practical implication. This is the period during which weeds should be controlled because viable seeds are produced relatively soon after flowering. The time to flowering for wild oats, paradoxa grass and turnip weed emerging in autumn or early winter was approximately four months. In contrast, New Zealand spinach, urochloa grass, mintweed and common thornapple flowered in summer in 1 to 2 months. For these weeds, the time available to apply control measures before flowering could be only a few days because newly emerged seedlings may not be readily observed and paddocks infrequently inspected.

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