COOL SEASON WEED INVASION OF IMPROVED SUBTROPICAL PASTURES

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Summary. The cool season weeds, spear thistle *(Cirsium vulgare)*, flaxleaf fleabane *(Conyza bonariensis)* and Argentine peppercress *(Lepidium bonariense)* are opportunisitc invaders of subhumid, subtropical pastures of improved fertility status resulting from legume establishment. The incidence of these weeds appears cyclical in relation to climatic sequences, but their presence appears not to affect animal production. This study follows the behaviour of Argentine peppercress in a year in which it predominates. The species exploits the open space within the pasture mostly, though not exclusively, during the period of pasture inactivity, providing soil moisture is available. The effects of different pasture treatments such as species composition, biomass and grazing pressure appear to have little effect at this time. Once the pastures recommence growth they exert increasing effects on Argentine peppercress behaviour, especially in the case of sown grass/legume pastures.

INTRODUCTION

In the subhumid subtropics the build-up of soil fertility following the improvement of pastures by introduced legumes has led to invasion by the cool season weeds, spear thistle, flaxleaf fleabane and Argentine peppercress (Tothill and Jones 1977). These invaders can appear as sequential waves of infestation with usually only one species being dominant at any one time. The infestation of one species may often be abruptly succeeded by another species in spite of substantial seed-set in the demising population. Figure 1 outlines the course of these infestations at the C.S.I.R.O. Narayen Research Station, Mundubbera since 1975, which was the first year of an observed invasion of any of these weeds. Two of the subsequent years, 1977 and 1979, were without weeds, when insufficient rain fell to support weed populations. These breaks more or less accompanied a change from one species to another. However attempts to understand the reasons for these invasions must rest on long term recording of environmental and vegetation response characteristics and also on the population dynamics of the species involved. No real effects have yet been apparent on animal productivity.

This contribution looks at the population dynamics of the latest of these waves, *viz* Argentine peppercress, through the cool season of 1980 and into the 1981 growing season.

MATERIALS AND METHODS

Three of the treatments of a large grazing experiment, commenced in 1972 at Narayen Research Station, were selected for this study. They were: SGL-native pasture of black speargrass *(Heteropogon contortus)* oversown with siratro *(Macroptilium atropurpureum)* and grazed at 1 steer to 1.3 ha; SGH- same as SGL, but grazed at 1 steer to 0.9 ha and; BGH- sown pasture of buffel grass *(Cenchrus ciliaris)* with siratro grazed at 1 steer to 0.9 ha.

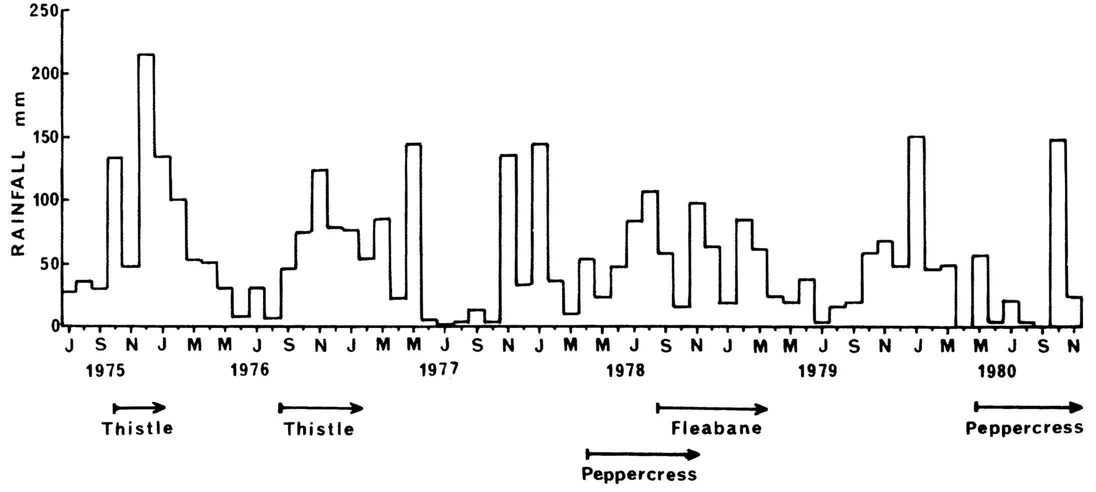

Figure 1. Monthly rainfall 1975 to 1980 with the activity periods of cool season weeds.

Weed Counts. One hundred permanent quadrats each 25 by 25 cm were laid out at random, though slightly repositioned into the intertussock space, in five strata in each of the three treatments. The quadrats were not protected from grazing but located 3 m to one side of a numbered marker peg. The numbers of each weed species occuring within the quadrat were counted according to the germination cohort to which they belonged. The species were also scored for their developmental stage of growth on the basis of 1=vegetative, 2=flowering, 3=pod set, 4=pod ripening and 5=seed shedding. An estimate of the percentage of green herbage cover for each quadrat was also made.

General vegetation description. A general description of the vegetation in the three paddocks in terms of species composition by mass was made on three occasions during the period of the study using the BOTANAL procedure of Tothill *et al.* (1978). The sampling was carried out on a square grid at 28 m intervals using a quadrat of 50 by 50 cm.

Soil moisture. Rainfall was recorded at 3 raingauge sites around the periphery of the study area. Soil moisture was monitored with gypsum blocks placed at 5, 10, 20 and 30 cm at three locations in the treatment areas.

Seed Reserves. The soil seed reserves were estimated using the method of Jones and Bunch (1977). A total of 50 soil cores, each 7.5 by 10 cm, were taken per paddock, 10 samples being bulked per stratum. Potential viability was determined by the tetrazolium test on imbibed seeds.

RESULTS

Three rainfall events governed the dynamics of the Argentine peppercress population during 1980-81 (Figure 2). There was a massive germination of seed in May 1980. These seedlings persisted as a dense juvenile population throughout the unusually dry winter of 1980, growing to a stage of no more than about 4 to 5 leaves. In October another rainfall event stimulated a second cohort of seedlings as well as stimulating the May cohort to rapid growth and development. A final rainfall occurred in the last week of December, by which time Cohort I had largely passed the stage of flowering and was at pod ripening, Cohort II was at full flowering and pod initiation while a small additional

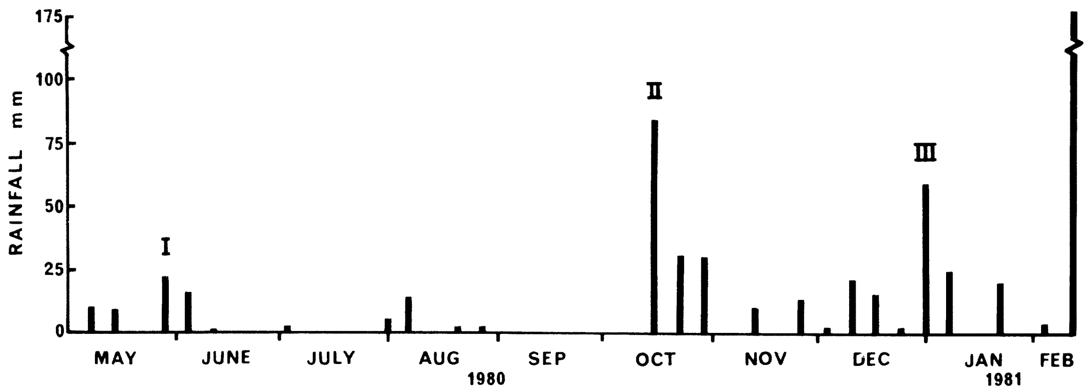

Figure 2. Weekly rainfall May 1980 to Feb. 1981 covering the period of Argentine peppercress activity. Successive germination events are denoted I, II, III.

recruitment of seedlings was observed. Plant counts for these cohorts are shown in Tables 1 and 2 and the pattern of rainfall distribution for the growing season of Argentine peppercress is shown in Figure 2. Following the October rain the soil moisture below 10 cm did not fall below wilting point for the remainder of the season though the surface and 5 cm levels did so for two short periods.

There was a considerable difference in total herbage yield and total ground cover % between the three treatments (Table 1), where levels of infestation can be gauged from presence (frequency %) and dry matter yield.

The reserves of seed in the soil were determined at December 1 1980, which is likely to be the time when minimum numbers of seeds are left in the soil and before any new season's seeds have been contributed. Only 63, 25 and 25 seeds m^{-2} were recorded for the treatments SGL, SGH and BGH respectively indicating that the seed reserves available for Cohort III were very low indeed. Seed viabilities were between 50 and 100%.

DISCUSSION

The 1980 cool season was an "Argentine peppercress year" with flaxleaf fleabane and spear thistle being insignificant. The massive germination of

Table 1. Pasture attributes measured in the general vegetation surveys.

Sampling Date	Pasture attributes: Total dry matter (kg ha^{-1})			Pasture attributes: Total cover (%)			Argentine peppercress: Dry weight (kg ha^{-1})			Argentine peppercress: Frequency (%)		
	SGL[1]	SGH	BGH	SGL	SGH	BGH	SGL	SGH	BGH	SGL	SGH	BGH
May 20 1980	22472	11519	22580	64	42	79	6	8	0	-	-	-
Nov.25 1980	11509	946	22485	63	46	77	332	432	208	90	96	91
Jan 9 1981	11544	716	22554	83	73	83	127	95	125	75	83	51

[1]Grazing experiment treatments: SGL = spear grass, low stocking rate; SGH = spear grass, high stocking rate; BGH = buffel grass, high stocking rate.

Table 2. Argentine peppercress populations and cover of all green herbage measured in the fixed intertussock quadrats.

Sampling Date	Argentine peppercress population (no. m^{-2}): Cohort I			Argentine peppercress population (no. m^{-2}): Cohort II + III			% cover all green herbage		
	SGL[1]	SGH	BGH	SGL	SGH	BGH	SGL	SGH	BGH
Nov. 25 1980	95.0	97.5	95.0	5.3	7.3	15.5	59	43	17
Jan. 8 1981	55.0	47.5	17.5	15.0	10.5	10.0	46	42	14

[1]Grazing experiment treatments: SGL = spear grass, low stocking rate; SGH= spear grass, high stocking rate; BGH = buffel grass, high stocking rate.

Argentine peppercress (Cohort I) resulted from a moderate rainfall in May 1980. Dry conditions with very little rainfall prevailed until October and Cohort I, which was apparently little reduced in numbers, survived in an advanced stage of wilting until this time when it grew rapidly to maturity. Some previous measurements using the pressure bomb apparatus on Argentine peppercress during a soil moisture drying cycle have indicated it to be a species tolerating very high levels of moisture stress (J.C. Tothill unpublished).

The relationship of Argentine peppercress populations to the three treatments is interesting. Since the quadrats were slightly repositioned from randomness into the spaces between the perennial plants, they were biasedly sampling the intertussock space, whereas the frequency and biomass data from the grid sample represent a non-biased estimate of the whole treatment area. In the November sampling of Cohort I, Argentine peppercress numbers (Table 2) and frequency (Table 1) were the same in all treatments though there were differences in biomass. This result may indicate that the environment of the intertussock space is not affected by the surrounding vegetation during the nonactive phase of pasture growth. Following the recommencement of pasture growth, Cohort I was increasingly affected by the pasture, as shown by the change in relative responses of dry weight, frequency % and population numbers between the November and January samplings, particularly in the BGH treatment with buffel grass. This treatment also had a strong effect on the behaviour of Cohorts II and III. No recruitment from Cohort III occurred in BGH while in the speargrass pastures (SGL and SGH) there were recruitments. This hints at the strongly competitive effects some perennial sown grasses can have as evidenced by Michael (1970) in temperate Australian pastures.

Thus Argentine peppercress can be considered one of several fertility - exploiting weeds with cool season activity which can invade improved subtropical pastures when there is sufficient moisture for growth or survival. Since the resident or sown perennial pasture grasses are inactive at that time, there is little interference with the weeds until late in their phase of growth and development when the pastures reactivate in early summer. In this respect buffel grass appears to be more competitive than the native grasses.

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