Ant theft of Sirosa phalaris pasture seeds in northern New South Wales

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Predation of pasture seeds sown onto the soil surface has long been recognised as a potential source of seed loss (Campbell 1966; Johns and Greenup 1976), particularly for phalaris. A further study (Kelman *et al.* 2002) showed that ant theft of phalaris seeds was highest for caryopses and that seeds retained in the floret remained relatively untouched by predating ants.

In a study of seed production and soil seedbank numbers in grazed Sirosa phalaris pastures, Lodge (2002) indicated that soil seedbanks were at best only two-thirds of the total numbers of seeds produced in the preceding year. Clearly, low numbers of seeds in the seedbank, lowers the ability of a species to successfully regenerate by seedling recruitment and so maintain its presence in a pasture in the long term.

These studies were conducted as part of the Temperate Pasture Sustainability Key Program (TPSKP) to confirm the role of seed predation by ants and the extent of seed loss. Studies were established in 1995 at the 3 TPSKP sites previously reported by Lodge (2001) and Lodge and Orchard (2000).

Methods

Ant theft studies were located in each of 3 field sites (Lodge and Orchard 2000) on commercially sown stands of Sirosa phalaris-subterranean clover, 50 km south east of Tamworth (31°23'S, 150°52'E, 525 m elevation, average annual rainfall 700 mm). These field sites were part of the TPSKP studies, with 2 grazed by sheep and 1 by cattle. At each field site, an ant theft study site was located in the central area of 4 plots in which grazing was excluded seasonally. At each ant theft study site plant litter was removed to expose a bare soil surface for a strip about 5 cm wide and 25 cm long at each of 3 locations (about 2 m apart). At each location the strips were either covered by an open quadrat (40 by 40 cm), surrounded by a quadrat with 5 cm sides covered with 70% Sarlon shade cloth (to prevent loss of seeds by water movement, 1 mm mesh, quadrat sides to the soil surface), or completely covered by a quadrat with Sarlon sides and covering over the top (to prevent rainfall infiltration and losses by germination, losses by runoff and predation by birds and mice).

At each ant theft study site, 20 Sirosa phalaris caryopses (seeds) were placed in each strip at 1 cm intervals. After their placement in the field, seeds that remained were counted 24 hours later and again after 7 and 28 days. After 28 days, new locations were selected and 20 new caryopses were placed onto freshly cleared strips. Ant theft sites were setup from January to December 1995. If rainfall was likely, then seed placement was delayed by 1-2 days so that initial placement of seeds always occurred on fine days. If rainfall occurred within 24 hours of initial placement of seeds, then new ant theft sites were selected and the process repeated. No germination of caryopses placed on the soil surface was observed.

Data (remaining seed numbers) were initially analysed at each time to determine differences among the 4 plots, 3 field sites and 3 cover types at each location. No significant differences were evident for these factors. Mean seed numbers were expressed as a proportion (%) of the initial number of caryopses (20) placed each month. Data for monthly rainfall (mm) and mean maximum and minimum temperatures (°C) were collected on-site from an automated weather station. Estimates of Sirosa phalaris herbage mass were made in treatments, 8 times throughout 1995, using the procedures described by Lodge and Orchard (2000).

Results

All of the seeds placed at the ant theft study sites were removed by day 7 (Table 1). Rates of seed predation (Table 1) were highest in January, February, November and December (65.3 to 92.9% of seed taken within 24 hours of placement in the field) and lowest in June to August (26.8 to 35.3% of seed removed within 24 hours). Rates of predation

appeared to be related to temperature, being highest when maximum (r=0.71) and minimum (r=0.82) temperatures were high or lowest in the cooler months (Table 1), rather than rainfall or herbage mass (r=0.35 and r=0.19, respectively).

Discussion

These data confirmed the previously reported high rates of ant theft of phalaris seed reported by Campbell (1966), Johns and Greenup (1976), and Kelman *et al.* (2002) and the relationship between temperature and ant activity reported by Johns and Greenup (1976). However, all seeds were predated within 7 days, indicating a loss of phalaris seeds of 1600 seeds/m^2/week at any time of the year. Given that maximum Sirosa phalaris seed production was 4800 seeds/m^2 and highest soil seedbanks were 2080 seeds/m^2 (Lodge 2001), then it is highly likely that ant theft is a major factor contributing to poor regeneration of this species from seed. Subsequent studies by Kelman *et al.* (2002) showed that in the Tamworth environment heavy summer stocking of phalaris pastures for short periods to cover seeds with soil and litter to prevent ant theft, resulted in increased seedling emergence. Hence, this may be a useful strategy for increasing seedling regeneration in grazed Sirosa phalaris pastures in northern NSW.

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Table 1. Cumulative percentage of Sirosa phalaris seeds predated 24 hours and 7 days after placement in the field from January to December 1995, together with monthly rainfall (mm), mean maximum and minimum temperatures (°C), and estimated phalaris herbage mass (kg DM/ha)

	Cumulative percent (%) seed predated after			Temperature		
	24 hours	7 days	Rainfall (mm)	Mean maximum (°C)	Mean minimum (°C)	Herbage mass (kg DM/ha)
Jan.	65.3	100	98	28	16.2	1203
Feb.	92.9	100	17	27	16	1525
Mar.	42.4	100	0	27.8	14.2	-
Apr.	43.8	100	0	22.6	9.9	873
May	46.4	100	97	18.1	9.6	681
June	33.9	100	36	14.3	5.8	1475
July	35.3	100	18	12.7	3.5	-
Aug.	26.8	100	0	19.1	6.6	1212
Sep.	41.9	100	69	18.8	8.2	-
Oct.	53.6	100	37	24	10.6	2636
Nov.	69.4	100	85	27.1	14.7	1419
Dec.	67.2	100	93	26.5	14.1	-

- = Not assessed.