IMPACT OF NUTGRASS ON SUGARCANE YIELD

Emilie Fillols, BSES Ltd

Keywords: nutgrass, *Cyperus rotundus*, sugarcane, competition

ABSTRACT

Nutgrass management is an important issue affecting productivity and profitability in sugarcane production in Australia. Recent experiments carried out by BSES Limited in Mackay have confirmed and highlighted the impact of nutgrass competition on the local sugarcane industry, in order to keep growers focused on the importance of controlling nutgrass in due time.

This paper relates the outcome of two experiments conducted in 2009-2010 in plant cane. Significant yield losses were caused by nutgrass left uncontrolled in two trials on dry land and irrigated land. Cane and sugar yield losses were proportional to the duration of nutgrass competition. Cane emergence and growth were also significantly inhibited by nutgrass competition in the experiment on dry land but not on irrigated land. Competition between nutgrass and cane for moisture more likely influenced the trial on dry land, whereas competition for nutrients and allelopathy could have interacted in the irrigated trial.

INTRODUCTION

Nutgrass (*Cyperus rotundus*) is a perennial sedge which is widespread throughout the temperate, sub-tropical and tropical countries of the world and affects most cane growing regions of Australia. Dotted with creeping rhizomes descending to considerable depth in friable soils and forming tubers used as spreading organs, nutgrass is a significant weed problem.

Many research studies have shown the capacity of nutgrass to compete with crops if left uncontrolled. Turner (1984) noted severe reduction in yields of plant cane caused by nutgrass competition on sandy soil in South Africa under rain-fed conditions. Recent experiments in New South Wales (Aitken, 2010) showed cane yield losses of around 30% in both plant and ratoon cane where nutgrass was allowed to grow without any control. These losses were explained by competition between cane and nutgrass for soil moisture and nutrients. Delaying the control of nutgrass by 8 weeks significantly reduced the sugar yield by 22% in another experiment in Maryborough (plant cane in dry land conditions). Competition for moisture was again the proposed explanation (Callow, 2010).
In other farming systems, allelopathy was suggested as another cause of crop yield loss. Rice germination, growth and yield were significantly reduced by leachates from nutgrass, and inhibition may have been due to the presence of allelopathins (Valliappan, 1989).

MATERIAL AND METHODS

Two trials were implemented near Mackay in 2009 on dry and irrigated land to better understand the competition phenomenon (Table 1). Trial 1, the dry-land trial, was planted in late July and received hardly any rainfall for almost 2 months after planting (0.5 mm in July, 0.3 mm in August, 9.8 mm in September), dramatically delaying cane emergence. Nutgrass infestation was medium–high in trial 1 (779 nutgrass/m^2 2 months before planting) and quite light in trial 2 (242 nutgrass/m^2 1 month after planting).

Table 1. Information on trial sites

Trial	Location	Soil type	Variety	Irrigation	Planted	Harvested
1	Racecourse	Solodic	Q183	No	27 Jul 09	2 Aug 10
2	Pleystowe	Podzolic	Q200	Yes (Winch)	20 Sept 09	7 Sept 10

The trial design was a Latin square design with four treatments (Table 2) and four replications.

Table 2. Treatments applied in trials.

Treatment	Description
T0	no nutgrass competition
T4	nutgrass controlled after 4 weeks competition
T8	nutgrass controlled after 8 weeks competition
T12	nutgrass controlled after 12 weeks competition

For the T0 treatment, nutgrass in trial 1 was controlled in the previous fallow using Roundup®CT @ 3 L/ha + ammonium sulphate 425g/L @ 1.8% 3 weeks before planting the cane, whereas trial 2 wasn't sprayed in fallow. Both trials were treated with pre-emergent herbicides just after planting (Stomp®Xtra @ 2.2L/ha + Atradex®WG @ 2 kg/ha) to control grasses and broadleaves without affecting the nutgrass. Hand weeding ensured the trials were free of other weed species during the duration of the experiment. Once the crop was planted, nutgrass was controlled according to the treatments using Sempra® @ 125g/ha + Activator® @ 0.2% (150 L/ha of water) with a back pack equipped with a constant flow valve and a three-nozzle boom. More than one application was necessary to ensure nutgrass-free plots.
The number of emerged cane shoots was counted at the 3-leaf stage, tillering stage, at stooling-out (of the T0 treatment) and one month later.
Cane height was assessed about five months after planting by measuring the height of the Top Visible Dewlap (HTVD).
Yield was calculated by weighing the three middle rows of each plot using a commercial harvester and BSES weigh truck, and six stalks per plot were processed through the BSES small mill to determine the sugar content. The income calculation was based on the Mackay Sugar Cane Payment system.
Data on numbers of shoots were analysed by SAS using a mixed model repeated-measures analysis. Cane height, yield and income data were analysed by Statistix using an ANOVA for Latin square. Means were compared using the LSD test.

RESULTS

Trial 1

One month after planting (1 Sept 09), twice as many cane shoots had emerged in the T0 treatment (nutgrass controlled in fallow) compared to the other treatments (Table 3).
Five months after planting, twice as many shoots had emerged in T0 and T4 compared to T12. The statistical test was significant (interaction treatment*date p = 0.0001).

Table 3. Cane shoot count (shoots ha^{-1}) in trial 1 (dry land).

Treatment	1 Sept 09	14 Sept 09	9 Dec 09	5 Jan 10
T0	19306 a	30000 a	99500 a	97389 a
T4	10667 b	19444 a	68861 a	97472 a
T8	9861 b	18306 a	36939 ab	63667 b
T12	8472 b	18028 a	37861 b	50167 b

Means within columns followed by the same letter are not significantly different

Five months after planting, the cane in T0 was significantly taller than in the other treatments (data not shown). The cane in plots where nutgrass was controlled after 4 weeks (T4) was also taller than the cane where nutgrass was controlled later. Cane in T4 was 31% shorter than in T0 (T12 cane was 44% shorter).
Plots always free of nutgrass (T0) obtained the best cane and sugar yields (Table 4). By comparison, 12% cane loss and 11% sugar loss occurred where nutgrass was left uncontrolled for 4 weeks. When nutgrass competed with cane for 8 to 12 weeks, cane and sugar losses reached 25 to 27%. Uncontrolled nutgrass also generated significant income losses (-$650 after 4 weeks competition to -$1535 after 12 weeks competition).

Table 4. Cane yield, sugar yield and income in trial 1

Treatment	Cane yield (t/ha)	Sugar yield (t/ha)	Income ($/ha)
T0	127.6 a	20.1 a	5797 a
T4	112.3 b	17.9 b	5146 b
T8	94.7 c	14.8 c	4354 c
T12	93.6 c	15.1 c	4262 c
Statistical test	p = 0.0001	p = 0.0021	p = 0.0017

Means within columns followed by the same letter are not significantly different

Trial 2

Three months after planting, a difference in nutgrass competition between treatments was visible in terms of number of cane shoots but was not statistically significant: shoot numbers were reduced by 10 to 25% in plots where nutgrass was left uncontrolled for 4 to 12 weeks (interaction treatment*date, p = 0.38; treatment, p = 0.29).
Four months after planting, cane stalks were 20 to 30% shorter in T4, T8 and T12 compared to T0 due to nutgrass competition but the differences were not statistically significant.
Cane yield was significantly higher when nutgrass was controlled from planting onwards (T0) (Table 5). Eight and 12 weeks competition with nutgrass resulted in 15 and 18% cane yield reduction. Sugar yield was significantly decreased by 12 to 20% when nutgrass was not controlled from planting and income losses of $500 in T4 and $868 in T12 were recorded.

Table 5. Cane yield, sugar yield and income in trial 2

Treatment	Cane yield (t/ha)	Sugar yield (t/ha)	Income ($/ha)
T0	89.0 a	15.0 a	4338 a
T4	81.5 ab	13.2 b	3837 b
T8	76.0 b	12.5 b	3631 b
T12	72.8 b	12.0 b	3470 b
Statistical test	p = 0.0191	p = 0.0183	p = 0.0207

DISCUSSION

On dry land (trial 1), early nutgrass competition with cane significantly reduced cane emergence and development. Moisture stress, competition for nutrients and/or the allelopathic effect created in the plots where nutgrass wasn't controlled rapidly were the possible explanations. This trial was planted in the dry season of a dry year: it is likely that cane emergence and development were probably impeded mainly by additional moisture stress due to uncontrolled nutgrass.
Nutgrass impeded cane shoot emergence and development to a lesser extent on irrigated land (trial 2). In this trial, supplementary irrigation provided cane with easy access to moisture, nutgrass infestation was quite light, no fallow treatment was applied on T0

treatments and a herbicide mix used to control emerging vines had a negative impact on nutgrass development (Starane®Advanced @ 0.78 L/ha + Amicide®625 @ 0. 8L/ha + Uptake® oil @ 2% was applied 20 Oct 2009). All these factors could explain why the impact of nutgrass competition on cane emergence wasn't significant. As this trial wasn't sprayed in the fallow, it is not possible to judge the relevance of nutgrass control in fallow under irrigated conditions.

Yield and income losses due to nutgrass competition were significant in trial 1 and reached 25 to 27%. The competition for moisture observed in the early stages of cane development impacted the yield. Aitken (2011) also found that uncontrolled nutgrass resulted in a reduction in yield up to 27% that could be even worse in drier conditions. In his study, even nutgrass uncontrolled for four weeks resulted in a trend for reduced yield. He estimated 11.5 mm rain from the plough layer could be removed by nutgrass within 4 to 8 days after rainfall. The best option for growers to avoid nutgrass competition for moisture in the early cane stages seems to control nutgrass in the fallow before planting.

Although delayed control of nutgrass did not significantly affect cane emergence and development in trial 2, significant losses in cane yield (up to 18%), sugar yield (up to 20%) and income (up to 20%) were recorded. As competition for moisture could not explain yield loss in this trial, the other possible impacting factors are:

- competition for nutrients: nutgrass can take up around 23 to 47 kg N/ha and 46 to 49 kg K/ha that would otherwise be available to the cane crop (Aitken*,* 2011)
- allelopathy as inhibitor of germination, growth and yield reduction as reported by Valliappan (1989) and Quayyum (2000).

In both trials, significant yield losses were recorded when nutgrass competed with cane for 4 weeks, which proves how relevant it is to control nutgrass as early as possible. Control in the fallow is the most convenient and cheapest option. An efficient herbicide treatment costs about $70 in the fallow and $200 in the crop. In all cases, it is worth applying one or more nutgrass herbicide treatments to limit nutgrass competition and maintain yield.

Acknowledgment

We thank Jo Stringer and Emily Deomano (BSES Limited) for their support in data analysis, Allen Eaton and Tim Staier (BSES Limited) for their technical assistance, and the cooperating sugarcane growers.

References

Aitken, R.L., Munro, A.J. and McGuire, P.J. (2011). An integrated approach to nutgrass control. *Final report* – SRDC project NFS002.

Callow, B. (2010). Effect of nutgrass/purple nut sedge (*Cyperus rotundus*) on sugarcane yield. *BSES Bulletin* 24: 11-12.

Quayyum, H.A., Mallik, A.U., Leach, D.M. *et al*. (2000). Growth inhibitory effects of nutgrass (*Cyperus rotundus*) on rice (*Oryza sativa*) seedlings*. Journal of Chemical Ecology* 26(9): 2221-2231.

Turner, P.E.T. (1984). Preliminary investigations into the competitive effects and control of *Cyperus rotundus* L. in sugarcane fields. Proc. S. Afr. Sug. Technol. Ass. 58: 143-148.

Valliappan, K. (1989). Allelopathic effects of nutgrass, *Cyperus rotundus,* in direct seeded rice. *Proceedings 12th Asian-Pacific Weed Science Society Conference.* (2): 441-445**.**