

Nutgrass, a problem weed: a review of the literature

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Introduction

Nutgrass (*Cyperus rotundus* L.), a plant native to India, is known as the world's worst weed (11)*. It is a member of the family Cyperaceae, which contains approximately 3000 species, of which about 220 species are important weeds (2). Nutgrass is cold sensitive (2), only growing during the warmer months and will not survive in the colder parts of Australia. It is adapted to most soil types and soil moisture regimes (11).

Nutgrass species in cotton

Twenty two species of the genus *Cyperus* occur in western NSW (5), of which I have observed six species in or near cotton. However, only two species, *C. rotundus* and *C. bifax* C.B. Clarke. (Downs nutgrass) are problems in cotton. Identification of these species is described in an article in the Australian Cotton Grower (3).

Nutgrass propagation

Nutgrass reproduction is primarily by underground tubers. There are varying reports on nutgrass seed production, but it is generally agreed that although nutgrass commonly flowers, very few if any viable seeds are produced and seedlings are of little importance. For example, in the US, from 170 inflorescences (flower heads), containing 95,000 flowers, only 43 seeds were collected, none of which germinated (18). A Queensland study of nutgrass from 9 locations found on

* The numbers in brackets in the text correspond to the references listed at the end of this paper.

average 3 seeds per inflorescence, of which 7% germinated, although these values ranged up to 14 seeds and 37% germination (10).

Nutgrass spread

Nutgrass can spread very rapidly by tubers, which develop on rhizomes (underground stems), producing a chain of tubers attached to the growing plant. One study under ideal growing conditions, reported that 4 weeks after planting, a single tuber had produced 15 shoots and 27 new plants (7). By 8 weeks there were 172 plants and 75 new tubers. By the end of the season (20 weeks), a single tuber had produced 300 plants and 940 new tubers (7). By the end of 2 seasons, the population was equivalent to 2600 tubers per m² or 26 million nutgrass tubers per ha (6).

These tubers have strong apical dominance, so that only the top tuber in the chain is active at any time and the remaining tubers are dormant. There is no data on how long these dormant tubers remain viable in the soil, but their survival will be counted in years if their root system is intact.

Most nutgrass tubers occur in the top 15 cm of the soil (15), and are rarely found below 40 cm, although nutgrass roots may extend to 1.35 m (1). In a typical soil, 66% of tubers are in the 0 - 10 cm soil layer and 90% in the 0 - 20 cm layer (19).

Nutgrass competition with cotton

Nutgrass competes with cotton for light, nutrients and water, but also adversely affects cotton by reducing irrigation efficiency, reducing pesticide penetration, reducing harvesting efficiency and contaminating lint. Cotton is also damaged by some of the herbicides and cultivation practices used to manage nutgrass.

Although nutgrass is a very competitive weed, it does not tolerate shading (11). Under 73% shade, nutgrass growth was reduced by 65 to 70% (13). Nutgrass responds to competition by increasing shoot length and proportionally increasing tuber production compared to flower production (20).

In my experiment at Warren in the 90/91 season, the cotton yield fell from 7.9 bales per ha in the absence of nutgrass, to 1.6 bales in heavily infested plots. These plots had up to 1250 nutgrass tubers per m², but received no treatments for nutgrass control. In practice, by using management tools including herbicides and cultivation, growers can achieve much better than 1.6 bales per ha in spite of large nutgrass infestations. However, the cost of the necessary additional inputs for nutgrass infested fields may prohibit cotton production, particularly where uninfested land is available and water is the primary limiting resource.

Nutgrass control

Nutgrass tubers are susceptible to high temperatures and dehydration. Isolated tubers on the soil surface were killed by 4 days exposure to sunlight and 12 days exposure killed tubers at up to 5 cm soil depth. As temperature increases, tubers were killed within 48 hours by exposure to 50°C and by 1 hour exposure to 60°C (15). Clearly, some nutgrass control can be achieved by cultivation. Research has shown that a 90% reduction in nutgrass tubers is achievable when cultivation occurs every 4 weeks throughout a single season (16), although in practice I have found that cultivation every 4 weeks has not adequately controlled nutgrass in the field. In a glasshouse experiment where nutgrass shoots were removed every 2 weeks, some tubers still had sufficient reserves to produce new shoots after 15 months of treatment (17). Cultivation also has the advantage of breaking apical dominance (15), so that a much higher percentage of tubers will sprout and may be receptive to other treatments.

Many herbicides have been used for nutgrass control with varying degrees of success. The problem has generally been that although there are a number of herbicides which will kill nutgrass, most herbicides are not sufficiently well translocated to kill the dormant nutgrass tubers attached to the treated plant. As soon as 3 or 4 weeks after treatment, some dormant tubers can sprout and produce

new tubers, returning the area to a nutgrass density equal to or greater than that present at the time of spraying.

In the 1960's, amitrole, 2,4-D, EPTC (sold as EPTAM) and the arsenicals were used to control nutgrass. Researchers in the US found that two applications of amitrole (9 kg per ha) within 4 weeks of nutgrass emergence, one application of EPTC (11 kg per ha), or 9 applications of 2,4-D (2.2 kg per ha) starting within 2 weeks of emergence, all gave good nutgrass control (9). However, these results were only achieved after complete cultivation by rotary-hoeing to 15 cm two weeks after each treatment to initiate uniform sprouting. This approach is difficult to implement in our situation with summer rainfall and high water holding capacity soils, where a delay in cultivation for 3 or 4 weeks after rain could see the nutgrass population return to pre-treatment levels. In another study, amitrole reduced a nutgrass population by 70% when applied within 4 weeks of shoot emergence, but was ineffective when plants were 6 or more weeks old (8). EPTC controls nutgrass by inducing tuber dormancy, but dormancy is only maintained as long as high soil EPTC levels are maintained. In practice, nutgrass control with EPTC has been very variable, being least effective in soils with high organic matter contents and best in soils with high sand and silt contents. EPTC is volatile and may be rapidly lost from the soil, so that repeated applications are required for long-term nutgrass control (12).

In the 70's and 80's, glyphosate and MSMA have become the principle herbicides used against nutgrass. MSMA (3.4 kg per ha) has been shown to prevent nutgrass regrowth (14), and 3 applications (2 kg per ha) can reduce nutgrass plant numbers by 66% and tuber numbers by 88% (21). Three applications of glyphosate reduced a nutgrass plant population by 97% and the tuber population by 92%. However, with no further treatment, the nutgrass density increased from 3% to 35% of the pre-treatment population within 10 weeks (21).

MSMA has been ineffective in controlling nutgrass in my experiments, but repeated applications of glyphosate have given good results, although the timing of

glyphosate applications is important. Glyphosate toxicity to nutgrass is greatest with high humidity and no moisture stress (4), and warm temperatures.

Conclusions

- * Nutgrass is a severe weed problem because of its competitive nature and its ability to rapidly produce large numbers of active and dormant tubers.
- * Nutgrass control measures must be applied rigorously and frequently. Any lapse in control may result in rapid reinfestation of the treated area.

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