PESTS AND DISEASES.

ERADICATION OF NUT GRASS.

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Nut Grass (*Cyperus rotundus*), Nat. Order Cyperaceae: One of a family of plants popularly known as Sedges.

Bailey, in his "Queensland Flora" describes some sixty-five species of Cyperus, several of which present a somewhat similar appearance, when growing, to nut grass, but fortunately are not pests like that species.

In the early stages of growth the appearance of several species is much alike, but later, when the flowering stems and flowers appear, the resemblance to a large extent ceases. Nut grass stems are rather slender, rising to a foot or a little higher, the upper portion of which is three-sided, the flowers being of a rich brown colour, the spikelets of which are borne in clusters on the stems. The species can always be distinguished by the nuts, which are bitter flavoured and borne on slender under-ground stems like widely separated beads on a string. Another species, *Cyperus esculentus*, or "Chufas" produces nuts somewhat similar to nut grass, but these are borne on single stems massed round the base of the plant and are sweet to taste, while the species is not a pest like nut grass but possesses economic value.

Nut grass is popularly supposed to reproduce from seed, but no authentic instance is recorded of plants being raised from seeds, which in many trials have been found infertile. Reproduction is effected from nuts and probably portions of the underground stem, which are distributed by the cultivating implements, the cloven hoofs of animals, or other mechanical agencies. It occurs widely in most tropical and sub-tropical climates over the globe and is more particularly plentiful on alluvial soils. Usually on virgin soils the nuts occur to within a few inches of the surface, but on cultivated lands will be found to the depth of the cultivated soil or as deep as the hole from which a stump has been taken and then filled in with soil. Nuts planted at a depth of some feet can be calculated to grow to reach the surface, so that no ploughing under can be considered as a means of extermination.

Nut grass is a decided menace to successful cultivation, since its growth is so rapid from the food supplies stored in the nuts as to smother out most crops, especially those of a low growth. Many strong-growing crops of more or less tall growth, such as sugar-cane, maize, sorghums, &c., are successfully grown in infested land, more especially in the cooler parts of the year, but their success is largely dependent on extra cultivation, which, in a wet season, cannot be effected as often as would be desirable.

The eradication of nut grass, economically, over an extended area is a problem which has not yet been solved and which does not appear possible of solution.

There are several means of eradication, but so far all are costly, or insist on a portion of the land whilst under treatment remaining unproductive or largely so over a term of years. Nut grass will thrive in dense shade and may be eventually smothered out by a dense-growing crop over two or more years. It may also be killed out by poisoning, fermentation, or burning processes which are only applicable to small patches on account of cost, but which, from the fact that from these patches a whole field would become infected, must be treated or fenced off to allow of the larger area being worked profitably. The following systems have been tried with success on small areas :—

SALT.

Apply the cheapest salt obtainable at the rate of 1 lb. to the square foot as a top dressing and allow it to remain undisturbed until all has been dissolved by rain and carried into the soil—repeat if any fresh shoot occurs. The effect of this treatment is that the land will be poisoned for other crops by the salt and the land will be of no value for some years until the major portion of the salt has been leached out.

ARSENIC.

The same remarks apply as to the effect of salt on the soil except that arsenic will be much more difficult to get rid of. Continued sprayings of the nut grass with a solution of arsenic or other weed killer would be prohibitive on account of the time necessarily taken up while the eradication of the arsenic from the soil would still have to be taken into consideration.

MOLASSES.

At the Agricultural Conference, at Gatton College in 1899, Mr. W. Gibson, of Bundaberg, is credited with the statement that he eradicated a patch of nut grass by pouring a few casks of molasses over it. Where the molasses is obtainable very cheaply, as in the case near a sugar-mill, its use in the eradication of nut grass is well worthy of trial. It is suggested, in applying molasses with this object in view, that the ground containing the nut grass be broken up for 6 in. or so in depth and molasses mixed with water in equal quantities, or two of water to one of molasses poured on until the soil is saturated. The fermentation of the water and molasses will be great and the destruction of the nuts might be expected.

STABLE MANURE.

A patch of nut grass was eradicated at the Acclimatisation Society's Gardens, Brisbane, years ago by placing a thick heap of fresh manure over it. The fermentation and heat engendered together with the total exclusion of light could be calculated to eradicate the pest, but some long time would necessarily be taken and the incident is merely related as one of passing interest.

PIGS AND POULTRY.

Any means whereby the foliage of nut grass can be entirely prevented must in time cause the death of all nuts and roots. Thus, if poultry are kept enclosed in sufficient numbers to eat off every green shoot as it appears, or if pigs are styed or the soil is so trampled that no green growth is possible, the same result would be achieved as if a floor or other light-obscuring structure was built over it.

PAPER MULCH.

It is possible much assistance towards eradication may be possible by the use of paper mulch in growing certain crops, which system has been much extolled in the recent few years. This paper is bought in rolls, which are laid on the ground and pegged or weighed down, the plants to be grown being planted by making a small hole in the paper. The success of the system with pine-apples has been demonstrated, but it remains to be seen if the same measure of success will be achieved with other plants, since the pine-apple plant is partly epiphytical. The exclusion of light and the prevention of growth of the nut grass by means of the paper mulch should have some effect, and might be tried by farmers on infested patches with tomatos or crops grown similarly.

FIRE.

At the State Farm, Home Hill, during clearing operations some time ago, a patch of nut grass some 20 ft. across was discovered, which was eradicated in the following manner :—The land had been ploughed before the nut grass had been observed. The soil of the infested part was dug up and turned over with shovels, and logs, branches, etc., from the clearing near by hauled on to the patch, making a good pile. This was then fired and resulted in the destruction of all nut grass on the burnt portion. It will be necessary where this is attempted to see that there is a certain amount of moisture in the soil, as it is considered the generation of steam assists in killing the nuts and roots.

INSECTS.

Some species of a Coccid insect are parasitical on nut grass. One, *Antonina australis*, has been spoken of as successful in New South Wales, and it has been observed in operation at Home Hill. The *Antonina* is closely allied to the Cochineal insect, but performs its work below the ground on the nuts, on which it appears as a white dusty part, exuding a blood-coloured liquid on being pricked with a pin. The effect of the insect is to destroy the nuts and subsequently the plant, which, when attacked, shows a yellowing and unhealthy appearance of the leaves, which afterwards die off. To eradicate nut grass by infestation with this parasite, it must be left two or three, if not more, years undisturbed, and the patch must be thickly infested with nut grass in order that the insects can easily travel from nut to nut. The foregoing treatments are only applicable to small areas, since the cost would be prohibitive over any large area, wholly or partly infested. On such an area the only feasible method is to endeavour to smother the nut grass out by dense, quick-growing crops, occupying the ground for long periods or planted in quick succession.

SMOTHER CROPS.

Kikuyu Grass.—Pennisetum clandestinum is considered to be the best grass to give success in this direction, but it must not be grazed or cut, and it must be allowed to occupy the ground at least three years.

Buffalo Grass.—Stenotaphrum americanum should also be successful. This grass, frequently used for lawns, must not be confused with Buffalo Couch, a name frequently given to Carpet grass, *Paspalum platycaule*, which latter is not recommended.

Beans.—The Lima Bean and also the Lab Lab, when grown without support, will cover the ground with a dense mass of vine and will last practically two years, smothering out any growth that does not grow higher than nut grass. A certain amount of profit might be derived from this crop by hand-picking the pods for use green, or in the case of the Lima or Haricot beans when ripe.

Velvet Beans.—Beans of this family form a dense growth and are valuable for hay or green forage. According to the variety they could be expected to cover the ground from five to eight months, when they should be ploughed under or harvested and another smother crop planted immediately.

Sorghum.—Sacchaline or other tall-growing varieties of sorghums sown broadcast rather thickly, using 30 to 40 lb. of seed to the acre, would form a dense growth and prevent any other growth while occupying the ground. In the North this crop could be expected to last uncut for two years.

Field Peas or Vetches.—These would be grown only in the winter months, when the nut grass does not make very much growth and would, with cereals such as wheat, barley, &c., be crops to grow between the crops previously mentioned, which succeed better in the warmer months.

When smothering out nut grass by growing crops, it is important that the crops be continuous, so that the nut grass has as little breathing space as possible.

ENTOMOLOGICAL CONTROL.

Mr. Edmund Jarvis, Entomologist, Bureau of Sugar Experiment Stations, Meringa, North Queensland, supplies the following additional information on the subject:—Whilst Acting State Entomologist for Queensland during 1913, I was asked to investigate certain methods of using a parasite (*Antonina australis* Green) for destroying nut grass at Bundaberg, where it was said to be doing excellent control work.

The following notes are from my report, published in December, 1913:—

The introduction of this insect has evidently been attended with highly beneficial results, affording valuable evidence of its usefulness.

Mr. F. L. Nott states that, about three years ago, he obtained a small bag full of infested grass roots from Mr. E. Lane, who had told him of the insect's habits.

He planted pieces of these roots among his nut grass in a row, alongside a fence, at intervals of about 20 ft. apart, and finding upon examination a few months later that the parasites were spreading rapidly, was encouraged to infect other patches.

He started these experiments on 1½ acres, and at the present time has no continuous areas under this weed, and had practically destroyed all the nut grass on 20 acres of land. His soil is red volcanic, of a heavy nature.

Mr. Nott volunteered the following information, the truth of which was confirmed by my own observation:—

(1) That he has never found these coccids on roots of sugar-cane or fodder grasses, although often using the former as a smother crop.

(2) That the parasites thrive best on land that is fairly open and allowed to remain undisturbed; but in consolidated soils or roadways, &c., spread with difficulty.

The plan of procedure adopted and found successful is as follows:—

Pieces of infested nut grass are planted in rows across the area to be treated from 40 to 50 ft. apart, and 20 ft. from plant to plant each piece being placed about 3 in. below the surface against a flourishing clump of the weed. Operations are then suspended for a few months to allow the coccids to become established and extend a few feet from the infected centres, after which the ground is ploughed, harrowed, and planted with a cover crop of lucerne, sugar-cane, or pasture.

No cultivation is permitted until at least twelve months after the death of the green tops, as the parasites are still at work destroying the lower roots, and should be allowed time to reach and kill every nut.

Cultivating amongst the newly-established colonies is, I think, a drawback to the above method, but while doubtless killing a larger percentage of the insects, would, at the same time, ensure their even distribution to all parts of the field, thereby saving the hand labour entailed by closer planting.

(1) Why have several previous attempts to utilise this parasite for destroying nut grass proved unsatisfactory elsewhere?

(*a*) The land may have been disturbed too soon after treatment, thus causing exposure and death of the majority of coccids.

(*b*) Possibly soil conditions were unfavourable in some instances, the parasites are most likely unable to penetrate deeply in heavy, compact clays, or stiff wet soils, and in such cases the lower nuts might remain uninjured.

(*c*) Neglecting to plant a cover crop, or introducing the parasites during an unfavourable season, or when in a dying condition, brought about, perhaps, by prolonged exposure or damage during transit, would also tend to result in failure.

(2) Will these coccids, after exhausting the supply of nut grass attack other plants?

(*d*) This is a matter for further reserach, but evidence, so far seems to favour the supposition that their range of dietary is very limited. I examined the roots of sugar-cane and a few grasses, including "Buffalo Couch," growing among a mat consisting of dead nut grass leaves, which had been killed by this parasite, but found them unaffected.

(*e*) In 1904, Mr. W. W. Froggatt published the following information on this heading:—"Of course, there is always the danger that a root-infesting coccid may change its habits and attack other than its natural food-plant, and this was pointed out to our correspondents anxious to try experiments. To me this danger appears to be slight in this instance, as after two years the nut grass *Antonina* has not been found upon any other roots; and, secondly, that none of our grass or root crops are allied to or like the underground rhizomes of this obnoxious sedge. Again, among the described species of this genus, all of them seem to attack only one kind of food-plant."

(*f*) Many insects are very exclusive in matters of the diet, will sooner perish than eat unpalatable food. Some of the cochineal insects for example, which are closely related to the parasite under consideration, are confined to a single species of prickly-pear and cannot be induced to subsist on other species of genus *Opuntia*.

I see no reason why the services of this insect should not be successfully utilised for the purpose of destroying nut grass in Queensland in districts where soil conditions are favourable to its spread; and provided that Mr. Nott's method of treatment be adopted, it seems reasonable to assume that the results achieved at Bundaberg should be obtainable elsewhere. —Queensland Agricultural Journal, Vol. XXIII, Part 1.