

Effect of herbicides on the carbohydrate and nitrogen contents of nutgrass (*Cyperus rotundus* L.)*

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ABSTRACT

The effect of four herbicides on the starch and nitrogen contents of the tubers, dry matter production, carbohydrate, amide, amino, ammonium and nitrate nitrogen contents of the foliage of nutgrass (*Cyperus rotundus* L.) under pot culture conditions was studied. The starch content of the tubers of nutgrass depleted maximum by the Embutox-plus and Tok E-25 when applied as foliar spray and soil placement, respectively. The foliar application of Embutox-plus and Tok E-25 appeared to have maximum reduction in the carbohydrate and different nitrogen contents in the foliage of nutgrass as compared with other herbicides used. Severe reduction in the amide and amino nitrogen was observed as against ammonium or nitrate nitrogen content on the application of herbicides.

INTRODUCTION

EFFECT of herbicides on various nitrogen fractions, extracted from plants have been reported by several investigators (Kamal 1960, Muzik and Lawrence 1959). There is no recorded report of the changes in the nitrogen fractions of nutgrass influenced by the herbicides. The results of the study undertaken on the nutgrass (*Cyperus rotundus* L.) on the application of herbicides and the changes in dry matter accumulation, carbohydrate and amino, ammonium, amide and nitrate nitrogen fractions are, therefore, reported herein.

MATERIALS AND METHODS

Uniform sized tubers (1-1.5 cm) of nutgrass (*Cyperus rotundus* L.) were planted in pots. These tubers were collected from the field at the depth of 0-15 cm from second to sixth positioned tubers in the chain.

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The herbicides used were: Bladex-0 (3-amino 1, 2, 4-triazole), Embutox-plus (2, 4-dichlorophenoxybutyric acid and 4-chloro-2-methylphenoxyacetic acid) and 2, 4-D (2, 4-dichlorophenoxyacetic acid) and Tok E-25 (2, 4-dichlorophenyl-4-nitrophenyl ether). In one set the herbicides were applied in the pots just after planting the nutgrass tubers and in the second set it was sprayed at 3-4 leaf stage of the nutgrass each at 1,500 ppm. Estimations of starch and total nitrogen content in tubers and carbohydrate in the foliage were done according to the method of A.O.A.C. (1960). The ammonium, amide, amino and nitrate nitrogen was determined by the method as described by Barker and Volk (1964).

RESULTS

Dry matter and total carbohydrate—The data on dry matter and carbohydrate of the nutgrass influenced by the herbicide application is presented in figure 1. Embutox-plus treated nutgrass plants showed only 0.7 per cent of dry matter in the 28th day sample. Little difference was seen on the 7th day of sampling. Tok E-25 was found to be less effective in reducing the dry matter of the nutgrass. Embutox-plus destroyed most of the carbohydrate contents in the foliage of nutgrass and practically undetectable amount was estimated on the 28th day. 2, 4-D and Bladex-0 showed similar effect while Tok E-25 was found to exert the last in this respect.

Nitrogen Contents—The total nitrogen percentage in the tubers of nutgrass was affected considerably on the application of herbicides. Maximum reduction was seen in the sample taken on 28th day after treatment. The effect of herbicides on the different fractions of nitrogen, ammonium and nitrate was expressed the least whereas amino and amide nitrogen were depleted to the maximum. In this context Embutox-plus did maximum damage followed by Tok E-25.

Starch content in the tuber—The data on the amount of starch content in the tuber of nutgrass are presented in figure 2. It is evident from the figure that Embutox-plus is more active in reducing the starch of the tuber through foliar sprays while Tok E-25 shows its superiority through soil application over the other treatments. Bladex-0 and 2, 4-D are also found influencing the starch content in the tubers through both the modes of application.

DISCUSSION

The herbicide-treated plants in all the series showed a decrease in their dry matter accumulation. Considerable reduction of dry weight in *Cyperus esculentus* shoots by amitrole is reported by Gill *et al.* (1970). The dry weight contents are in consonance with the changes in starch content

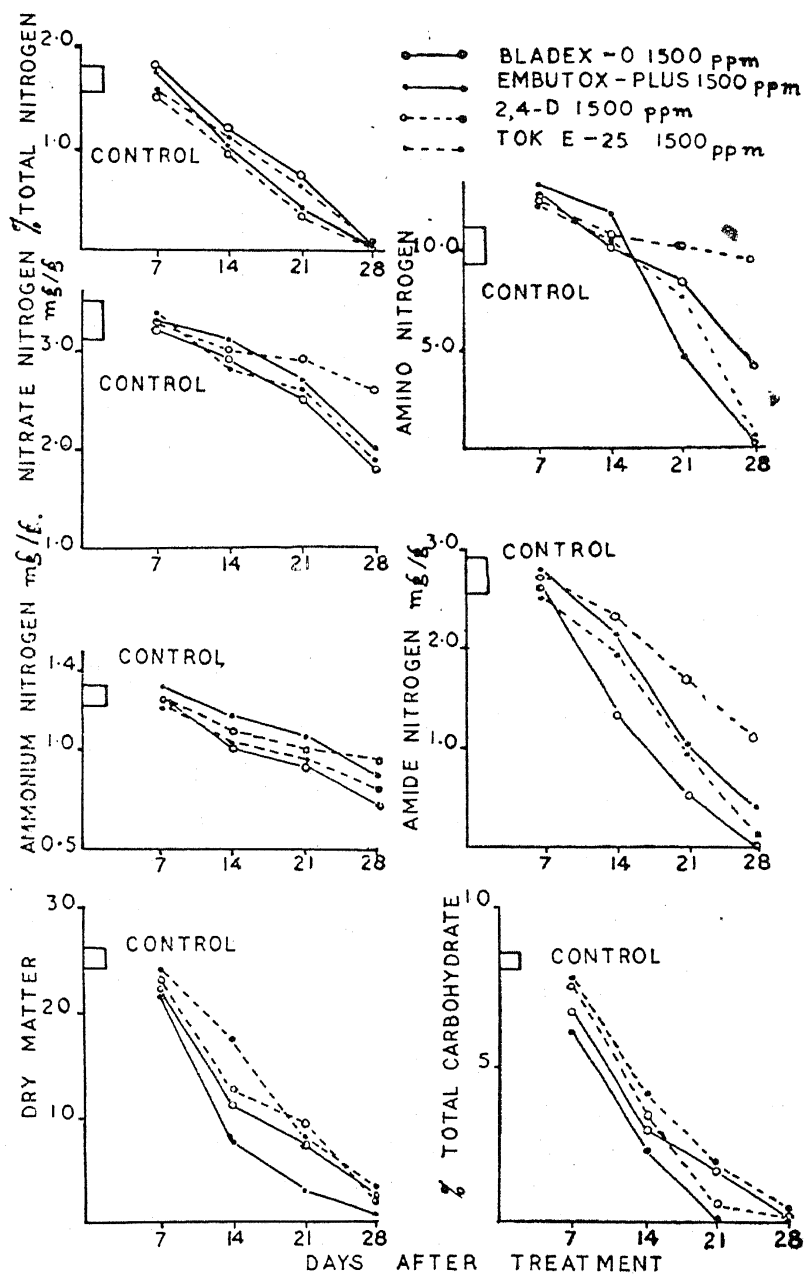


Figure 1. Herbicidal effects on the dry matter accumulation total carbohydrate and different fractions of nitrogen in the nutgrass (*Cyperus rotundus* L.) on dry weight basis.

which fall steadily following herbicide treatments. Mitchel and Brown (1946) observed that the morning glory plants having 18% starch content, were completely exhausted of starch within a period of 2 weeks after the spray of herbicides Tok E-25 when applied in the soil, showed severe depletion in starch content in the tubers while 2,4-D, Bladex-0 showed negligible decrease. However, a different picture was seen when these were applied on the foliage. By this mode of application Embutox-plus

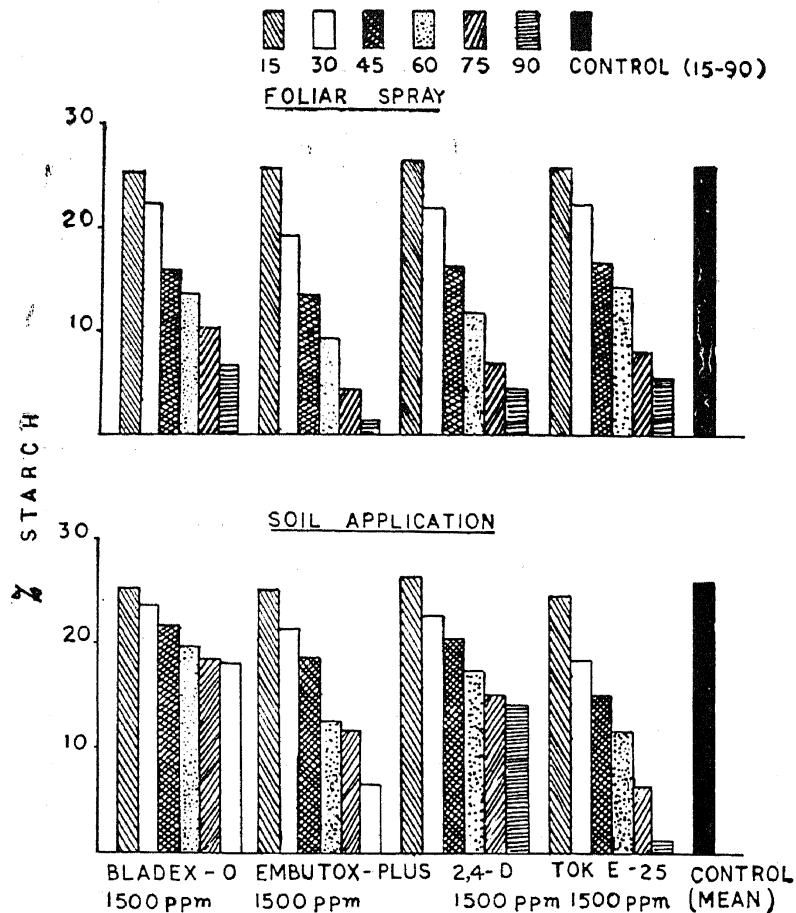


Figure 2. Effect of herbicides on the per cent starch content in the tubers of nutgrass (*Cyperus rotundus* L.).

showed maximum starch accumulation. On the other hand foliar spray of Tok E-25 showed high starch content. Differential response of the different herbicides, through foliar or soil application may be due to the fact that some are more efficient when applied in the soil showing low starch accumulation while the others are less effective and persisting not long enough in the soil to exert their influence on the reserved food of tubers. Foliar applied herbicides showing activity in the nutgrass absorbed by the leaves, moves through the system and adversely affects the food reserve of the tubers. Considerable reduction in starch content in the tubers of nutgrass by using herbicides (Ram Gopal and Mani, 1969) and by cultural methods (Arny, 1932; Timons, 1941) have also been reported.

The degradation of carbohydrate content of aerial portions of nutgrass has been correlated with the disturbances in the physiological process (Smith *et al.* 1974). The higher metabolic rates of the herbicides treated plants is attributed to higher rates of respiration (Osborne and Hallaway,

1961). The low carbohydrate content, as observed in the present experiment is presumably, due to their utilization in respiration. The effectiveness of the Embutox-plus in these studies can be correlated with its ingredients (2, 4-DB + MCPA) which suggests its synergistic influence on the nutgrass plant. The reduction in the total reserve of the nutgrass plant exhibited by the other herbicides may have a mechanism similar to this though not exactly the same but the cumulative effect brought about by 2, 4-DB + MCPA have resulted in the lowering of the essential constituents of the plant cells which are physiologically active.

The losses due to herbicide application is more towards the amino and amide contents than ammonium or nitrate fractions. Treatment of plants with 2, 4-D caused a rapid and characteristic change in the nitrogen fractions of leaf, stems and underground structures (Smith *et al.* 1947) while 2, 4-D and MH caused breakdown of protein synthesis in the tissues (Pilet 1956, Khotyanovich and Vedeneeva 1965). The findings of the present experiment on the loss of amide and amino fractions of nitrogen in nutgrass confirms the observations of Kamal (1960) and Muzik and Lawrence (1959). The effect of herbicides on the nitrate and ammonium fractions of nitrogen in nutgrass corroborates the observations made by Swanson and Shaw (1954). Schwarze (1952) correlated the decrease in protein content in the tissues where chlorophyll content is low. This decrease in the protein is ascribed to decreased photosynthesis.

The changes in the nitrogen contents is only seen in the nutgrass plants showing susceptibility to herbicides (Misra *et al.* 1974 *a*). The herbicides showing severe effect on chlorophyll contents of the nutgrass (Misra *et al.* 1974 *b*) are only found effective in changing the nitrogenous fractions. If the herbicides (3-amino-1, 2, 4-triazole) are applied to a resistant plant (*Cirsium arvense*), no change in the soluble nitrogen fractions was noticed (Burt and Muzik 1970.)

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