



Agricultural Economics

## Economic efficiency of weed control at Sudan grass

R. Bazitov<sup>1\*</sup>, A. Stoyanova<sup>2</sup>

<sup>1</sup>Agricultural Institute, Radnevo road, 6000 Stara Zagora, Bulgaria

<sup>2</sup>Department of Crop Science, Faculty of Agriculture, Trakia University, 6000 Stara Zagora, Bulgaria

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**Abstract.** The aim of the present study was to establish the economic efficiency of the use of some herbicides and combinations in the control of weeds in the Sudan grass variety „Endje“, grown in conditions without irrigation. The study was conducted in the period 2018 - 2020 in the experimental field of the Agricultural Institute - Stara Zagora. The following herbicides were tested: Arat - 0.200 kg/ha, Buktril universal - 0.8 l/ha, Stomp new 330EK- 3.5 l/ha, Wing P - 3.5 l/ha and Dicopur F-1.1 l/ha. The economic analysis was prepared on the basis of developed technological projects, according to the yield obtained from each variant. It was found that the most economically efficient was the variant with the application of the herbicide Buctril universal - 0.8 l/ha. The profitability was the highest - 34% and from one hectare you got BGN 980 more profit compared to the option without herbicides.

**Keywords:** Sudan grass, yield, herbicides, profitability, profit

### Introduction

Receiving high and sustainable yields is unthinkable without proper chemical weed control (Stoimenova et al., 2004; Mahmood and Swenton, 2005; Tonev et al., 2010). The selection of the most suitable hybrids for each region, corresponding to the conditions and technology of cultivation, leads to stable yields, which leads to high economic performance (Gramatikov et al., 1997; Epinal et al., 2001; Marinov-Serafimov and Golubanova, 2015a). The use of herbicides to control weeds is economically friendly, as weeds increase competition and lead to increased productivity, as eliminating competition from weeds leads to increased productivity as a result of which total revenue is higher or at least equal to variable costs (Koprivlenski et al., 2015; Goranovska and Yanev, 2016; Goranovska et al., 2017). The economic analysis of the results of the use of chemical pesticides for weed control makes it possible to determine the most appropriate of them in the specific agrometeorological conditions and the situation on the market of agricultural products for the year (Vasev, 1974). Marinov-Serafimov and Golubanova, 2015b in an experiment with different variants of Sudan grass found that weed control is a factor in obtaining higher yields. In sorghum (*Sorghum*

*bicolor* L.) Moench, specific varietal reactions to some of the herbicides used have been identified. (Pannaccie et al., 2010; Kershner et al., 2012), while in *Sorghum sudanense* (Piper.) Stapf, such studies are extremely limited. (Enchev and Georgieva-Andreeva, 2013; LeBaron et al., 2008; Yu et al., 2015) According to Orashki (1983), systematic and effective weed control through the use of herbicides is a cost-effective measure that helps to increase labor productivity and production efficiency and significantly reduce production costs.

The aim of the present study is to establish the cost-effectiveness of the use of certain herbicides and combinations in the control of weeds in Sudan grass variety „Endje“, grown in conditions without irrigation

### Material and methods

The study was conducted in the period 2018 - 2020 in the experimental field of the Agricultural Institute - Stara Zagora on meadow - cinnamon soil. We set the experiment by the method of long plots in four repetitions with size of the harvest plot - 14 m<sup>2</sup>, and the experimental one of 20 m<sup>2</sup>. Weeding in the experimental area was mainly of annual species - *Setaria viridis* (L.) Beauv., *Echinochloa crus-galli* L.,

\*e-mail: rumen7588@abv.bg

*Amaranthus retroflexus* L. white dog quiver, *Chenopodium album* L., *Datura stramonium* L. and from the perennials prevailed - *Cirsium arvense* (L.) Scop., *Convolvulus arvensis* L. and *Sorghum halepense* L. We conducted the study with Sudan grass, variety „Endje“ after the predecessor barley. The following variants were tested: 1. Control - untreated;

2. Arate (500 g/l Dicamba+250 g/l tritosulforone); 3. Buctril universal (2.4 D ester 80 g/l +280 g/l bromoxynil)–800 ml/ha; 4. Stomp new (330 g/l pendimethalin); 5. Wing-P (250 g/l pendimethalin+212.5 g/l dimethenamid) and Dicopur F (600 g/l 2.4 Damine salt). Doses and periods of treatment of the tested herbicides are given in Table 1.

**Table 1.** Investigated herbicides and herbicide combinations on Sudan grass

No	Variants	Doses/ha	Treatment period
1.	Control - untreated	-	-
2.	Arat	0.2 kg	3-5 leaf of Sudan grass
3.	Butril universal	0.8 l	3-5 leaf of Sudan grass
4.	Stomp new330 EK	4.0 l.	After sowing before germination of Sudan grass
5.	Wing P	3.5 l	After sowing before germination of Sudan grass
	+ Dicopur F	1.1 l	3- 5 leaf of Sudan grass

Sudan grass sowing was carried out in the optimal agro-technical terms in all three years of the experiment. The application of herbicides was done with a back sprayer at a rate of 500 l/ha. Based on the study performed, development of economic efficiency of weed control in Sudan grass was made for the three years of the study. The economic analysis was prepared on the basis of developed technological projects, according to the actual yield obtained from each option. The expense of labour was calculated according to uniform state norms for mechanized work, applied in the system of the Agricultural Academy. Remuneration, fuel and lubricants, maintenance and repair of agricultural machinery, total production and total operating costs were calculated on the basis of current

regulations. The material costs were established at current prices, and the total productivity at prices for 2018. The efficiency was calculated on the basis of the use of own land from the state land fund and own working capital.

## Results and discussion

At this stage an economic analysis was made for the first time of the use of some herbicides and combinations in weed control in the Sudan grass cultivar “Endje” grown under non-irrigated conditions.

The economic efficiency of the application of herbicides in the control of weeds in Sudan grass is shown in Table 2.

**Table 2.** Economic efficiency of weed control variants, average for 2018 - 2020

Variants No.	Average yield kg/ha	Income from sales lv/ha	Production costs lv/ha	Operating profit lv/ha	Cost lv/ha	Rate of profitability %
1	18285	2742	563	1879	31	333
2	23925	3588	907	2681	38	295
3	24675	3701	842	2859	34	340
4	24195	3629	887	2742	36	309
5	28500	4270	1041	3229	36	311

The received income from the production sold was in accordance with the obtained yield per hectare. The lowest average yield, incl. the lowest incomes were derived from the option only without the use of herbicides (control). The extent of weed control with different species of herbicides had affected yields and sales revenue of production. The herbicidal effect was the highest in the variant with the application of the combination Wing - P (250 g/l pendimethalin + 212.5 g/l dimethenamid) - 3.5 l/ha + Dicopur F (600 g/l 2.4 D amine salt) - 1.2 l/ha. This was due to the total phytotoxicity of the two herbicides against most of the predominant weeds. The sale revenues from the production in these variants reached 4270 BGN per ha. Of the variants with only one herbicide, the application of Buctril Universal (2.4 D ester 80 g/l +280 g/l bromoxynil) - 800 ml/ha led to the highest revenues of 1 ha - amounting to BGN 3.701.

Production costs for growing one hectare of Sudan grass, depending on the degree of weed control varied from 563 lv/ha to 1041 lv/ha. The lowest costs were when no chemical control was performed with weeds. In the chemical method, the costs increased with the addition of those for the purchase of herbicides and those made for their import. In the studied variants with the lowest costs for herbicides - 842 Buctril universal (2.4 D ester 80 g/l +280 g/l bromoxynil) - 800 ml/ha was variant 3 (Buctril universal), according to the option Stomp new 330 EC - with costs -887 ml/ha. The application of the combination of the two herbicides Wing P + Dicopur F led to an increase in production costs to 1041 lv/ha. The revenues received from the sale of Sudan grass production and the costs incurred for its production had direct impact on the realized operating profit of 1ha. The profit obtained for the individual variants varied from 1879 lv/ha to 3229

lv/ha, with the lowest being for the variant without herbicides. The application of herbicides for weed control, despite the increased production costs, the operating profit increased, as in the variant with two herbicides (Wing P + Dicopur F), it reached 3229 lv/ha. The cost of production expressed by the relationship between production costs and yield obtained was the lowest in the option without herbicides 31 lv/t. The application of herbicides led to an increase in the cost per tonne of production, but also to an increase in the average biomass yield. This was due, on the one hand, to the high doses used to treat one hectare and, on the other hand, to the relatively high prices of the herbicides used, which increased production costs by 1.5 to 2 times compared to the non-herbicide variant. The highest cost per 1 ton of production had the variant with the application of the herbicide Arat - 200 g/ha. To more fully determine the efficiency of production, the profitability indicator was used, expressed as the ratio of profit to production costs in percentages. In the studied variants, the production of Sudan grass was the most profitable, when the weeds were destroyed by treating the crop with the herbicide Buctril universal - 800 ml/ha, with profitability norm 340%, and production cost 34 BGN/ton. When the combination of Wing P and Dicopur F was used for weed control, the highest profit per hectare, relatively low production cost and high profitability rate were obtained.

## Conclusion

To control weeds in Sudan grass, grown in non-irrigated conditions, the most cost-effective option is the application of the herbicide Buctril Universal - 0.8 l/ha. Profitability is the highest - 34% and from one hectare you get BGN 980 more profit compared to the option without herbicides. The other options, using one herbicide, are characterized by similar economic indicators. The combination Wing - P - 3.5 l/ha + Dicopur F - 1.1 l/ha can be successfully applied for more complete destruction of weeds and obtaining higher yield and more income from production at low cost. Its average yield increased by 10215 ml/ha, and revenues increased by 1528 BGN/ha compared to the control option - without herbicides. From one hectare you get 3229 BGN in operating profit, the cost of production is 36 BGN/ton, and the profitability - 311%.

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