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INFLUENCE OF TIMING AND SOWING METHODS ON THE ENERGY EFFICIENCY OF GROWING GRAIN SORGHUM

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We have revealed energy efficiency of timing and sowing methods of grain sorghum. It was found that the best option was to sow this cropin the medium terms with the soil temperature is +12-14° C and a distance of 45cm between the rows.

Key words: *grain sorghum, energy assessment, energy ratio, energy consumption*

To grow crops using intensive resource and energy-saving technologies, the effectiveness of which is usually higher than the existing ones, remains an important reserve of further growth of gross crop production. A prerequisite for the introduction of new technology in production is its energy assessment, one benefit of which is to determine the main parameters common for different countries in terms of economic efficiency [3, 6]. When calculating energy costs we usually take into account direct energy costs (fuel, electricity) and materialized energy costs of the production of fertilizers, pesticides and agricultural chemicals, as well as the cost of human labor and energy consumption of mechanization [1, 5].

Besides the energy cost of growing crops, when assessing energy effectiveness of a technology we take into account the energy content of the resulting yields, which is calculated on the basis of the value of the energy assessment of a production unit.

Energy ratio and energy consumption per unit of production are the most important parameters that characterize the energy efficiency of crops.

The aim of our study was to analyze the influence of timing and sowing methods on the energy efficiency of growing grain sorghum.

Materials and methods of work. In the years 2008-2010, we conducted research to study the influence of timing and sowing methods on the yield of the grain sorghum *Genicheskoye 209* at the Podillia State Agricultural and Technical University's experimental field with thick-layered leached chernozem and low humus percentage.

The research involved a study of timing (factor A): the temperature of the soil (temperature level, TL) at a depth of 10cm, plus 10-12° C; 12-14° C (benchmark value); and plus 14-16° C. Each sowing was carried out in a different way (factor B) for row spacing of 15, 30, 45, and 70 cm (benchmark value).

The experiment was repeated four times, using the method of sowing on split plots of land. The area of each plot was 100 m^2.

The study was conducted according to generally accepted methods [2, 4]. Statistical data processing was performed using a computer software program.

Results of the studies. It was found that energy efficiency indices of growing grain sorghum differ significantly depending on the timing and sowing methods (see: Table 1).

Table 1 **Energy efficiency of growing grain sorghum**

Timing (factor A) at the depth of 10cm, temperature (TL)	Sowing method (factor B), distance between the rows, cm	Energy costs, GJ/ha	Gross energy output, GJ/ha	Energy ratio	Energy consumption, GJ/ton
+10-12°C	15	8.89	93.0	10.46	1.73
	30	8.92	100.0	11.21	1.61
	45	9.49	109.3	11.52	1.57
	70 (benchmark)	9.42	105.1	11.16	1.62
+12-14°C (benchmark)	15	8.92	99.2	11.12	1.63
	30	8.98	111.0	12.36	1.46
	45	9.53	121.2	12.72	1.42
	70 (benchmark)	9.46	117.4	12.41	1.46
+14-16°C	15	8.90	95.3	10.70	1.69
	30	8.95	105.0	11.73	1.54
	45	9.51	115.2	12.11	1.49

	70 (benchmark)	9.43	108.3	11.48	1.58
Fr	Factor A	38.65	42.78	47.31	64.24
	Factor B	6408.47	80.90	41.32	65.08
F_{05}	Factor A	5.14			
	Factor B	4.76			

Energy costs for growing grain sorghum depended on timing and methods of sowing and were 89-9.53 GJ/ha. Depending on the distance between the rows sowing sorghum at the depth of 10cm and the soil temperature of _+12-14° C turned out to be the most energy-consuming (8.92-9.53 GJ/ha), whereas sowing sorghum at the temperature of +10-12° C proved to be the least costly (8.89-9.49 GJ/ha).

Moreover, sowing methods for grain sorghum and soriz were characterized by different energy costs. The highest energy costs were registered in the case of sowing with a distance of 45cm between the rows (9.49-9.53 GJ/ha) and the lowest in the case of sowing with a distance of 15cm between the rows depending on the timing (8.89-8.92 GJ/ha).

Gross energy output of grain sorghum yield was considerably different depending on the variations of the experiment. It depended mainly on the yield and was 93.0-121.2 GJ/ha.

It was ascertained that among the above sowing methods the largest gross energy output of the yield (99.2-121.2 GJ/ha) was obtained in the case of sowing seeds at a depth of 10 cm and the soil temperature of +12-14° C, and the lowest gross energy output (93.0-109.3 GJ/ha) was registered when sowing seeds in the early period.

Sowing sorghum with the distance of 45cm between the rows turned out to be the best method to get the highest gross energy output of 109.3-121.2 GJ/ha.

Of all the variants of the experiment the highest gross energy output (121.2 GJ/ha) was registered in the case when the seeds were sown at a depth of 10cm, soil temperature of +12-14° C, and the distance of 45cm between the rows.

One of the most important parameters to determine the energy efficiency of crop production is an energy ratio – the ratio of gross energy output to the costs of the crop cultivation.

The results of out research show that in terms of timing the highest energy ratio (11.12-12.72) turned out to be in the case of sowing the seeds at a depth of 10cm and the soil temperature of +12-14° C. In terms of row spacing, the highest energy ratio (11.52-12.72) proved to be in the case when the distance between the rows was 45cm. Of all the variants of the experiment the highest energy ratio (12.72) was registered when sorghum was sown in the medium term, soil temperature of +12-14° C, and a distance of 45cm between the rows.

Alongside with the index of the energy ratio, such indicator as energy consumption per unit of production is usually taken into consideration as well when assessing the energy costs of agricultural crop cultivation. This indicator shows the energy costs required to grow 1 ton of a crop. Among the timing options for sowing grain sorghum the lowest level of energy consumption per unit of production (1.42-1.57 GJ/t) proved to be in the case of sowing the seeds at a depth of 10cm and the soil temperature of +12-14° C. speaking about the sowing methods, the lowest level of energy consumption per unit of production (1.42-1.63 GJ/t) turned out to be in the case of row spacing of 45cm.

Of all the variants of the experiment, cultivation of grain sorghum with sowing the seeds at a depth of 10cm, soil temperature of +12-14° C and row spacing of 45cm proved to be the least expensive in terms of the energy costs (1.42 GJ / t).

Conclusion. The best performance of energy efficiency of growing grain sorghum turned out to be the variant when sowing was carried out in medium terms at a depth of 10cm, soil temperature of +12-14 °C and row spacing of 45cm. In this case the energy ratio was 12.72, and the energy of 1 ton of grain was 1.42 GJ/t.

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ВЛИЯНИЕ СРОКОВ И СПОСОБОВ СЕВА НА ЭНЕРГЕТИЧЕСКУЮ ЭФФЕКТИВНОСТЬ ВЫРАЩИВАНИЯ СОРГО ЗЕРНОВОГО.

В.Н. БУРДЫГА

На основе проведенных исследований установлены показатели энергетической эффективности способов и сроков сева сорго зернового и лучшие варианты опыта. Наилучшей энергетической эффективностью характеризовался вариант где сев сорго проводился в средние сроки при температуре почвы на глубине 10 см, плюс 12-14° С с шириной междурядий 45 см.

Ключевые слова: *сорго зерновое, энергетическая оценка, энергетический коэффициент, энергоемкость.*

ВПЛИВ СТРОКІВ ТА СПОСОБІВ СІВБИ НА ЕНЕРГЕТИЧНУ ЕФЕКТИВНІСТЬ ВИРОЩУВАННЯ СОРГО ЗЕРНОВОГО

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Визначено енергетичну ефективність способів та строків сівби сорго зернового. Встановлено, що кращим був варіант де цю культуру висівали в середні строки за температури ґрунту +12-14° С з шириною міжрядь 45 см.

Ключові слова: *сорго зернове, енергетична оцінка, енергетичний коефіцієнт, енергоємність*