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# Effect of the Bio and Organic Fertilizer on Rapeseed Yield in Central Cropping Region of Mongolia

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## ABSTRACT

The research work was carried out in 2022-2023 at the field of experience of Institute of Plant Agricultural and Science located in Hongor sum of Darkhan-Uul province.

The purpose of the study is to improve the quality and yield of rape seeds by applying fertilizers in accordance with the biochemical characteristics of rapeseed in the conditions of the central agricultural region. The innovative aspect of the research work is to test the quality and yield of rapeseed new types of fertilizers (Darkhan humate, Darkhan Rizo, mixed) and determine the appropriate rate and time.

Since 2001, the soil microbiology laboratory of Institute of Plant Agricultural and Science has produced rhizobacterial fertilizers in dry form in laboratory conditions, containing local active strains (Azospirilum brasilense, Azoarcus sp, Azotobacter chroococum) that absorb air nitrogen into the soil and break down indigestible phosphorus into the soil. The conditions and opportunities for high yield have been created.

According to the results of the analysis conducted in the Soil &Agrochemical laboratory of Institute of Plant Agricultural and Science , the composition of "Darkhan Humate" organic fertilizer contains an average of 22.6% humic acid, 20.4% fulvic acid, and 4 types of macro elements that play an important role in plant nutrition: NPK (13-21-13%), sulfur S - 7.5%, 10 types of macro &micro elements: calcium Ca – 1.12%, magnesium Mg – 0.69%, sodium Na – 2.7%, silicon Si – 2.1%, iron Fe – 0.7%, manganese Mn – 0.2%, cobalt So – 0.015%, zinc Zn – It contains not less than 0.72%, boron B – 0.35%, copper Cu – 0.35%, 2.5% of 18 types of plant-derived amino acids, and 0.05-0.1% of auxin or 3 types of hormones that increase the national development and green mass of plants [4]. In the current situation of deteriorating soil fertility in Mongolia, the yield of rapeseed is still low and the oil content is still low due to the lack of nutrients. Therefore, a study was conducted to investigate the effect of using a mixture of bio and organic fertilizers on crop yield and quality.

**KEYWORDS:** *Humate, rizo bacterial fertilizer, rapeseed, seed oil content.*

## INTRODUCTION

Rapeseed uses 1.2-2.0 times more nutrients from the soil than annual grasses to form a unit of crop during the (relatively short) growing season. Rapeseed consumes 60 kg of nitrogen, 2.4 kg of phosphorus, and 4.2 kg of potassium to produce one centner of yield. The potassium requirement of rape is 1.5-2.0 times higher than that of cereal crops for the formation of a unit seed yield. According to D. Shpaar's research, when potassium fertilizers are used, the oil content in seeds increases by 3.6%. The period of the most intensive use of potassium in rapeseed is the period of peak leaf growth [1, 2].

The effect of nitrogen (N) and sulfur (S) on canola yield was studied in two consecutive Rabi seasons 2014–2015 and 2015–2016 at the farm of Shere-Bangla Agricultural University, Dhaka, Bangladesh. The experiment was

carried out in a split scheme with three replications and four nitrogen options, i.e. 0 (control), 60, 120 and 180 kg ha-1; and four versions of sulfur, i.e., 0 (control), 15, 30, and 45 kg ha-1. Variation of N and S had a significant effect on yield structure.

The results show that the application of 120 kg of N and 45 kg of S per 1 ha gives the highest yield. Also, according to the results, parameters such as the height of the tallest plant, the number of branches, the number of pods, the number of seeds in 1 pod, the weight of 1000 seeds, seed yield, biological yield, and yield index were obtained. As a result of the experiment, it was concluded that the combination of 120 kg N and 45 kg S per 1 ha had the best results compared to other alternatives [7].

A scientist from the former Soviet Union predicted that the rapeseed oil content could reach 65%. However, currently the oil content of the main canola varieties is only 45-48% in Canada and 41-42% in China and Australia. In 2009, a Chinese breeder reported the highest oil content of rapeseed at 60% [8]. In our country, the oil content is less than 40% when unfertilized, which is still a problem due to the fact that the requirements of production technology are not reach [5].

## Materials And Methods

The experimental site is located in the drier sub-region of the Central Cropping Region, which is the central non-irrigated agricultural region of the country.

Data from the agro-meteorological station of Darkhan-Uul province in 2022 and 2023, where the experience research was conducted, was taken and used.

In 2022, when the research was carried out, the average monthly temperature during the growing season was 0.4 degrees lower than many years average, the sum of active heat was 108.3 degrees, and the amount of precipitation was 39.2 mm less, which indicates that there was a lot of drought. During the plant growth period of 2023, the sum of active heat above 10°C is 54.6°C higher than many years average, 147.9 mm more than many years average, and the distribution is 6.7 mm less than many years average in May, 19.4 mm in June, and 54.3 mm in July, with 24.1 mm in August and 56.8 mm in September, respectively.

The humus layer of the field is 35-40 cm, with 1.52% humus and a neutral. According to the level of nutrient supply for rapeseed cultivation determined by the agrochemical laboratory of the Institute, the nitrogen (NO3-N) in plant digestible form is 1.79 mg/100 g or very little, and it is a sufficient soil with phosphorus and potassium.

Planting was calculated at the rate of 2 million seed per hectare and was sown at a depth of 2-3 cm with the Omichka-SKP-2.1 seeder. The total experimental area was 0.25 ha, the size of 1 plot size was 105 $m^2$ (2.1 width, 50 m length) in 4 repetitions sowed on May 25.

## Experiment Variant:

- with seeds (s)

- with seeds (s) + period of true leaf formation (t.l.f)

- with seeds (s) + period of true leaf formation (t.l.f) + budding (b)

- Without fertilizer (Control)
- Humat- 0.5 l/t

  - Humate 0.5 l/t (s)

  - Humate 0.5 l/t (s) + 1 l/ha (t.l.f)

  - Humate 0.5 l/t (s) + 1 l/ha (t.l.f) + 1 l/ha (b)
- Humat- 1.0 l/t

  - Humate 1.0 l/t (s)

  - Humate 1.0 l/t (s) + 1 l/ha (t.l.f)

  - Humate 1.0 l/t (s) +1 l/ha (t.l.f) +1 l/ha (b)
- 1 l/t (1:10) Humate: Rizo

  - 1 l/t (1:10) Humate: Rizo (s)

  - 1 l/t (1:10) Humate:Rizo (s) + 1 l/ha (1:10) (t.l.f)

  - 1 l/t (1:10) Humate:Rizo (s) +1 l/ha (1:10) (t.l.f ) +1 l/ha (1:10) (b)
- Darkhan Rizo $10^9$ (10 l/t)

  - Darkhan Rizo $10^9$ (10 l/t) (s)

  - Darkhan Rizo $10^9$ (10 l/t) (s) + 109 (10 l/ha) (t.l.f)

  - Darkhan Rizo $10^9$ (10 l/t) (s) + 109 (10 l/ha) (t.l.f) +109 (10 l/ha) (b)
- Humate-7B (1 l/t)

  - Humate 7B (1 l/t) (s)

  - Humate 7B (1 l/t) (s) + (1 l/ha) (t.l.f)

  - Humate 7B (1 l/t) (s) + (1 l/ha) (t.l.f) +(1 l/ha) (b)

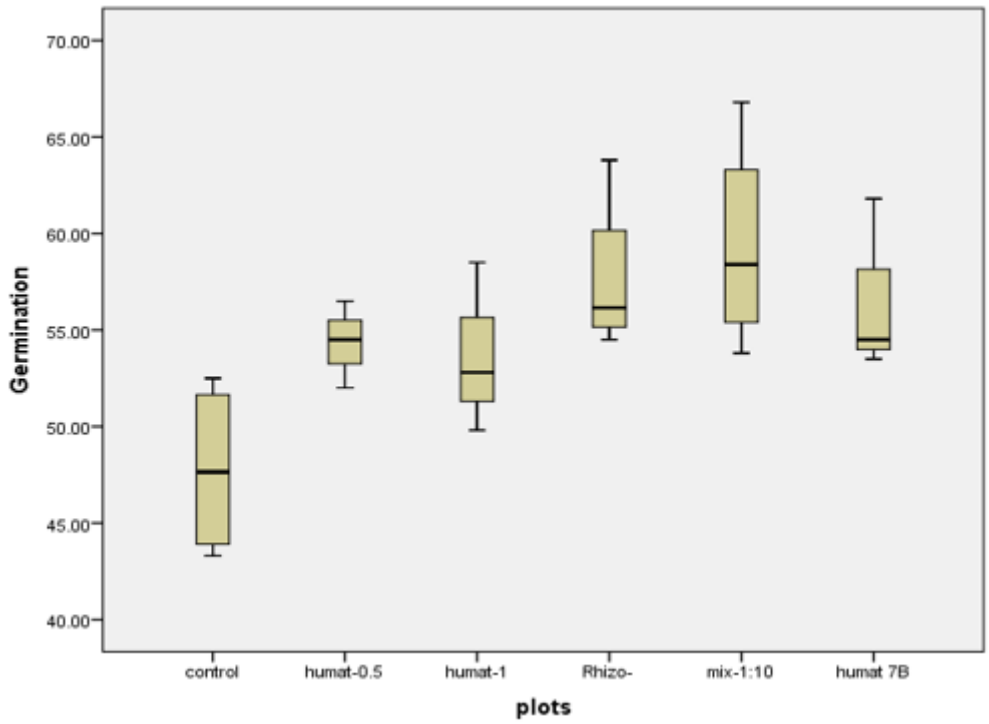
## Research Result

Depending on the number of plants in the field, the amount and quality of the crop can be affected. The quality of field cuttings directly depends on the moisture and temperature of the soil at the time of plant growth

*Table 1. Effects of fertilization on rapeseed field emergence, 2022-2023.*

| № | Version | 2022 | 2023 | Average, % | Out of control, % |
|---|---|---|---|---|---|
| **1** | Without fertilizer (Control) | 47.0 | 48.5 | 47.8 b | - |
| **2** | Darkhan Humate - 0.5 l/t | 56.8 | 52.0 | 54.4 ab | 6.6 |
| **3** | Darkhan Humate – 1.0 l/t | 54.3 | 52.6 | 53.4 ab | 5.7 |
| **4** | Darkhan Rizo – 10 l/t | 61.5 | 53.8 | 57.7 ab | 9.9 |
| **5** | Darkhan Humate : Rizo - 1:10 | 64.5 | 54.1 | 59.3 a | 11.6 |
| **6** | Humate 7в-1 l/t | 60.0 | 52.1 | 56.1 ab | 8.3 |

Application of pre-plant fertilizer to rapeseed resulted in 47-64.5% field emergence in 2022 and 48.5-54.1% in 2023 compared to the field-emergence control in the studied years. On an average of 2 years, the alternatives were 47.8-59.3% better than the control, and the alternatives with fertilizer were 5.7-11.6% better than the control. Darkhan Humate:Rizo fertilizers mixed at a dose of 1:10 or Humate--0.5 L and Rizo 5 L were significantly better than other alternatives (SPSS-oneway anova - Graph-1). In 2023, the percentage of field emergence is lower than the previous year, when the field emergence of rapeseed is uniform, i.e. in the first days of June, it is believed to be due to the increase in air temperature and the lack of precipitation, which is due to overheating and reduced moisture content.




*Graph-1*

*Table 2. Effects of fertilizer rate and time of application on rapeseed biometricily analyze, 2022-2023.*

| Version | plant weight, g | Plant height, cm | plant quantity | Number of product branch, unit | Number of pod, unit | Number of pod seeds, unit | 1000 seeds weight, gr | Seed yield, g/m2 |
|---|---|---|---|---|---|---|---|---|
| **Without fertilizer (Control)** | 225.3 | 111.0 | 29.0 | 66.5 | 59.5 g | 9.0 b | 3.4 f | 83.2 |
| **with seed, l/t** | | | | | | | | |
| **Darkhan Humate - 0.5 l/t** | 232.6 | 126.0 | 32.8 | 80.0 | 71.8 ef | 10.0 ab | 4 bcde | 114.1 |
| **Darkhan Humate – 1.0 l/t** | 262.7 | 124.8 | 32.6 | 79.5 | 65.2 fg | 9.8 ab | 4.08bcd | 91.4 |
| **Darkhan Rizo – 10 l/t** | 334.3 | 116.9 | 30.5 | 75.6 | 75.2 def | 9.5 ab | 3.8 cde | 104.2 |
| **Darkhan Humate : Rizo - 1:10** | 312.4 | 138.5 | 34.3 | 77.4 | 84.3 abcd | **10.8 a** | 4.14 bc | 128.3 |
| **Humate 7в-1 l/t** | 413.6 | 123.5 | 32.5 | 67.4 | 73.6 ef | 9.6 ab | 3.9 cde | 94.6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **with seed + period of true leaf formation, l/hec** | | | | | | | | |
| **Darkhan Humate - 0.5 l/t** | 347.2 | 129.8 | 30.3 | 78.8 | 75.3 def | 9.0 b | 4.0 bcde | 121.8 |
| **Darkhan Humate – 1.0 l/t** | 320.1 | 128.5 | 32.9 | 73.5 | 86.5 abc | 9.3 ab | 3.8 cde | 111.2 |
| **Darkhan Rizo – 10 l/t** | 280.1 | 123.8 | 29.9 | 79.4 | 78.9 bcde | 10.0 ab | **4.6 a** | 124.8 |
| **Darkhan Humate: Rizo - 1:10** | 264.2 | 145.3 | 35.1 | 84.1 | **94.4 a** | 10.8 ab | 4.3 ab | 155.8 |
| **Humate 7в-1 l/t** | 260.4 | 121.5 | 31.9 | 65.1 | 72.6 ef | 9.6 ab | 3.9 cde | 106.9 |
| **with seeds + period of true leaf formation + budding, l/hec** | | | | | | | | |
| **Darkhan Humate - 0.5 l/t** | 236.5 | 137.8 | 30.1 | 96.8 | 88.5 ab | 9.2 ab | 3.8 cde | 117.4 |
| **Darkhan Humate – 1.0 l/t** | 248.6 | 126.6 | 33.4 | 78.0 | 77.6 cde | 9.6 ab | 3.7 ef | 115.5 |
| **Darkhan Rizo – 10 l/t** | 252.7 | 141.4 | 30.3 | 76.1 | 78.2 bcde | 10.5 ab | 4.1 bcd | 113.5 |
| **Darkhan Humate: Rizo - 1:10** | 267.3 | 123.0 | 31.6 | 77.5 | 81.3 bcde | **10.8 a** | 3.9 bcde | 128.4 |
| **Humate 7в-1 l/t** | 256.6 | 128.5 | 31.6 | 68.4 | 77.8 cde | 9.6 ab | 3.9 bcde | 113.8 |

According to the results of biometric measurement of rapeseed yield, the plant weight was 156.4-435.5 g, and the average of 2 years was higher in the version using Humate 7b fertilizer with seeds than other versions. Darkhan Humate:Rizo 1:10 mixed fertilizer with seeds + when true leaves are formed, the number of plants is 24-38.8 pcs , out of which Humate 1 L with seeds + at the time of true leaf formation + at the time of tillering were higher than the other variants respectively. The number of pods in 1 plant was 56.7-108, of which Humate: Rizo-1:10 mixed fertilizer with seeds + true leaf formation was significantly superior to other alternatives.

The number of seeds in a pod was 7.1-12.0, of which the Humate:Rizo mixed fertilizer with seeds + at the time of true leaf formation and with seed + at the time of true leaf formation fertilization were significantly superior.

The weight of 1000 seeds is 3.21-4.9 g, of which, with seeds + at the time of true leaf formation, the version using Darkhan Rizo fertilizer at a dose of 10 L was significantly superior to other versions. Due to the effect of nitrogen-fixing bacteria of Darkhan Rizo fertilizer, the supply of nitrogen to the soil increased, and thus the weight of the seeds increased.

***Table 3.*** *Effects of fertilizer rate and time on rapeseed yield, 2022-2023.*

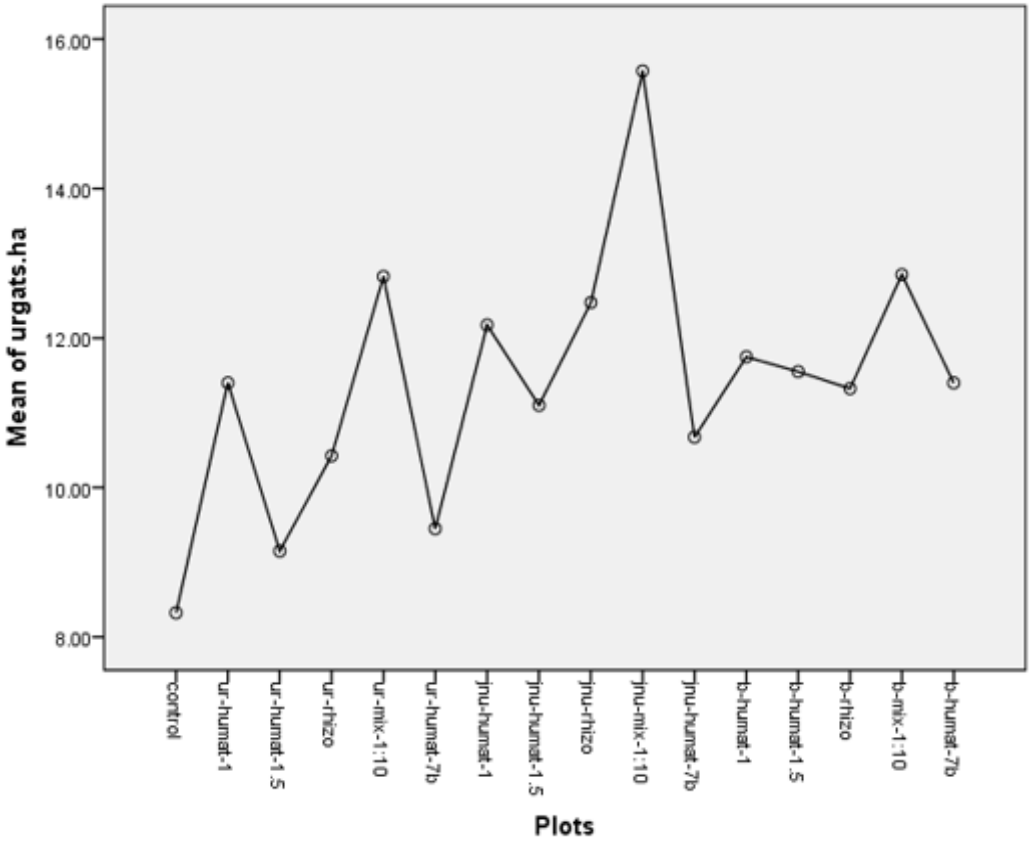
| № | Version | 2022 он | 2023 он | Average, cen/hec | Out of control, % |
|---|---|---|---|---|---|
| **1** | Without fertilizer (Control) | 7.5 | 9.1 | 8.3 g | - |
| | **with seeds, l/t** | | | | |
| **2** | Darkhan Humate - 0.5 l/t | 10.3 | 12.5 | 11.4 bcde | 3.1 |
| **3** | Darkhan Humate – 1.0 l/t | 10.6 | 7.7 | 9.1 fg | 0.8 |
| **4** | Darkhan Rizo – 10 l/t | 9.8 | 11.0 | 10.4 def | 2.1 |
| **5** | Darkhan Humate : Rizo - 1:10 | 12.9 | 12.8 | 12.8 b | 4.5 |
| **6** | Humate 7в-1 l/t | 9.9 | 9.0 | 9.5 efg | 1.2 |
| | **with seed + period of true leaf formation, l/hec** | | | | |
| **1** | Darkhan Humate - 0.5 l/t | 12.0 | 12.3 | 12.2 bcd | 3.9 |
| **2** | Darkhan Humate – 1.0 l/t | 13.7 | 8.5 | 11.1 cdef | 2.8 |
| **3** | Darkhan Rizo – 10 l/t | 13.5 | 11.5 | 12.5 bc | 4.2 |
| **4** | Darkhan Humate:Rizo - 1:10 | 17.6 | 13.5 | **15.6 a** | **7.3** |
| **5** | Humate 7в-1 l/t | 11.9 | 9.5 | 10.7 cdef | 2.4 |
| | **with seed + period of true leaf formation + budding, l/hec** | | | | |
| **1** | Darkhan Humate - 0.5 l/t | 11.2 | 12.3 | 11.7 bcd | 3.4 |
| **2** | Darkhan Humate – 1.0 l/t | 13.4 | 9.7 | 11.5 bcd | 3.2 |
| **3** | Darkhan Rizo – 10 l/t | 10.0 | 12.7 | 11.4 bcde | 3.1 |
| **4** | Darkhan Humate:Rizo - 1:10 | 11.7 | 14.0 | 12.8 b | 4.5 |
| **5** | Humate 7в-1 l/t | 12.8 | 10.0 | 11.4 bcde | 3.1 |

According to the yield of 2022, the unfertilized control version yield 7.5 t/ha, and the versions with fertilizer applied with seeds and during the growing season yielded 2.4-9.9 t/ha more than the control. Darkhan Humate: Rizo-1:10 mixed fertilizer with seed + 0.5:5 L at the time of emergence of true leaves was selected as having a higher yield than other alternatives, i.e. 17.6 t/ha.

In 2023, the yield was 9.1-14.0 t/ha. At the time of emergence of true leaves with 1.0 L of Darkhan Humate fertilizer with seed and with seed + true leaves, the versions using 1 L of Humat 7B fertilizer with seeds did not exceed the control, but the versions with other fertilizers produced 0.4-4.9 h/ha more yield. Of these, Darkhan Humate:Rizo-1:10 mixed fertilizer along with seeds +true leaves at the time of emergence and at the time of fertilization, the version that used 0.5:5 l was selected as having a higher yield than the other versions, i.e. 13.5-14.0 t/ha.

According to the 2-year average yield, the fertilized variants produced 0.8-7.3 t/ha better than the control.

Comparing the versions, the version that used Darkhan Humate:Rizo-1:10 mixed fertilizer with seed + 0.5:5 L at the time of true leaf formation was significantly better than the other versions or 15.6 h/ha yield (IBM SPSS statistics 23-Graph 2).




*Graph-2*

***Table 4.*** *Quality indicators of rapeseed, 2022-2023.*

| № | Version | Analyze | |
|---|---|---|---|
| | | protein, % | Oil content, % |
| **1** | Without fertilizer (Control) | 16.4 | 37.5 |
| **With seed, l/t** | | | |
| **2** | Darkhan Humate - 0.5 l/t | 17.4 | 38.2 |
| **3** | Darkhan Humate – 1.0 l/t | 16.6 | 37.8 |
| **4** | Darkhan Humate:Rizo - 1:10 | 13.6 | 40.2 |
| **5** | Darkhan Rizo – 10 l/t | 13.5 | 38.3 |
| **6** | Humate 7в-1 l/t | 12.8 | 37.9 |
| **with seed + period of true leaf formation, l/hec** | | | |
| **1** | Darkhan Humate - 0.5 l/t | 13.8 | 41.5 |
| **2** | Darkhan Humate – 1.0 l/t | 16.1 | 40.8 |
| **3** | Darkhan Humate : Rizo - 1:10 | 14.8 | 41.6 |
| **4** | Darkhan Rizo – 10 l/t | 15.6 | 40.6 |
| **5** | Humate 7в-1 l/t | 14.7 | 40.7 |
| **with seed + period of true leaf formation + budding, l/hec** | | | |
| **1** | Darkhan Humate - 0.5 l/t | 17.4 | 39.6 |
| **2** | Darkhan Humate – 1.0 l/t | 18.0 | 41.7 |
| **3** | Darkhan Humate : Rizo - 1:10 | 17.0 | 41.5 |
| **4** | Darkhan Rizo – 10 l/t | 16.4 | 40.4 |
| **5** | Humate 7в-1 l/t | 16.0 | 40.2 |

Unfertilized control version protein 16.4%, variants that applied Darkhan Humate fertilizer with seed at 0.5 and 1.0 l/ha, Darkhan Humate 0.5 l/ha, 1.0 l/ha and Humate: Rizo 1:10 versions with 3 repeated applications are higher than the control. The oil content of the unfertilized control version was 37.5%, while the versions applied with seeds and 2 and 3 times at the development stage all exceeded the control.

## Conclusion

By applying fertilizer to rape seeds before planting, the versions field emergence with fertilizer versions were 5.7-11.6% better than the control, and the version using a mixture of Darkhan Humate:Rizo fertilizer 1:10 or Humate-0.5 L and Rizo 5 L was significantly better than other versions.

According to the 2-year average of the yield, the fertilized versions produced a superior yield of 0.8-7.3 t/ha compared to the control. Darhan Gumat:Rhizo -1:10 mixed fertilizer with seeds + 0.5:5 L rate at the time of true leaf formation was significantly better than other versions, yield was 15.6 t/ha.

The oil content, which is the main character of the quality of oilseeds, is higher than the control in all versions where fertilizers were applied.

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None.

## Conflict of Interest

The authors declare that there is no conflict of interest.

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## Ethical Consideration and Informed Consent

Not applicable.

## References

[1] Amarsanaa.B “Recommendations for rapeseed fertilization”. Mongol agronomist №12, 2022.

[2] Amarsanaa.B “Use of agrochemical based fertilizers”, 2022.

[3] Batsukh.B, Myagmarsuren.Ya “Experiment methods”, Darkhan, 2008.

[4] Bayarsaikhan.B, Bat-Otgon.K "Effect of Darkhan Humat fertilizer rate and application time on wheat yield and seed quality under irrigated conditions" 2021 report.

[5] Munkhjargal.O. “Cultivation technology of rapeseed” 2013.

[6] Munkhjargal.O. “Scientific basis of cultivation of oilseeds in the eastern agricultural region of Mongolia" 2019.

[7] https://acsess.onlinelibrary.wiley.com/doi/abs/10.2136/sssaj1984.03615995004800010020x

[8] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0062099.