

Chapter

The Influence of Planting Time on the Seed Yield and Quality Millet/*Panicum miliaceum*. L

*Khishigbuyan Turbat, Gungaanyam Galkhvv
and Namjilsuren Jamiyan*

Abstract

Millet has been cultivated in Mongolia since ancient times, and some historians believe that this cultivation may be the first crop of nomadic people. Academician P.M. Zhukovsky noted that multiline varieties of millet were found in the mountainous regions of Central Asia and Mongolia. Therefore, one of the regions of millet is Mongolia. There are records that Mongolians cultivated small rice in the 8th–12th centuries and called it Mongolian grain, cron, black rice, and millet, used it for food, and sold it to traders in China and other countries. The research study was conducted in the research area of the Research Institute of Plant and Agriculture in the area of Khongor Sum, Darkhan-Uul Province, Mongolia, in 2017–2020. The millet variety of Saratovskaya-853 was planted for seeds on May 20, 30, and June 10 at the rate of 3 million seed/ha and with 3 repetitions each. According to our research, the 20th of May is the most profitable time for planting, with a yield of 23.7 tons/ha. During this period, the number of weeds in the field was not much, the amount of protein contained in the seeds is 0.9–1.6% more than other versions, the seeds were mature, they are not affected by cold shocks and frosts, and they form a good seed casting protection against the cold. Spacing between 0.5 m and 15 cm between plants/total 9 stages. According to our research, the 20th of May is the most profitable time for sowing, with a yield of 23.7 cents/ha. During this period, the number of weeds in the field is low, the amount of protein in the seeds is 0.9–1.6% higher than other options, the seed yield is good, and the conditions are not affected by cold shock. The conditions for an increase in the yield of the version of May 20 have been established.

Keywords: cultivation, field, version, repetition, protein

1. Introduction

Millet (*Panicum miliaceum*. L) are a highly varied group of small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food [1]. Most species generally referred to as millets belong to the tribe Paniceae around the world, millet has been grown for food and fodder. *Panicum miliaceum* is a tetraploid species with a base chromosome number of 18, within the genus *Panicum* [2].

The millet is an annual food and annual plant. It is one of the ancient crops cultivated in the world more than 7000 years ago [3].

It is suitable for growing in regions with low fertility, especially India, the Sahara desert, and West Africa, where the average rainfall is usually less than 500 mm, and where the soil is sandy and slightly acidic [4].

The cultivation of millet worldwide is decreasing year by year. According to the World Food and Agriculture Organization (FAO), as of 2019, a total of 718 million hectares were planted in the world and 863 million tons of crops were harvested. As of 2020, the world's total millet crop is 30.5 million tons, of which India (42%), Nigeria (20%), China (6%), Niger (12%), Mali (5%), and Ethiopia (3%) occupying [2].

The cultivation of millet/*Panicum miliaceum*. L/worldwide is decreasing year by year. For example, India is the leading country in the production of small rice, and in 1970, the total harvest in the country met 100% of domestic needs, while in the late 1970s, this consumption decreased to 50–75% [5].

However, since 2005, small rice has become less of a staple food, and it is mainly cultivated for animal feed and alcoholic beverages. The United Nations General Assembly at its 75th session in March 2021 declared 2023 the International Year of Millets [2]. Millets can grow on arid lands with minimal inputs and are resilient to changes in climate. As a result of the International Year of Small Rice, it will be possible to use the resistant qualities of the grain to increase its nutritional value, to introduce this grain to future generations for better production, better nutrition, and to produce more food and feed [2].

Mongolia is located in the central part of Asia between 41°31'–52°09' north latitude, the average height above sea level is 1580 m, the lowest point is 560 m, and the highest point is 4347 m. It has an extreme climate, arid and arid, and it has unique features indicating the characteristics of a temperate region. Due to its elevation above sea level, it has a cool climate and annual precipitation is 250–350 mm.

The first cold shock of spring occurs in the middle ten days of May, and the first cold shock of autumn occurs in the first 10 days of September. Seasonal and daily temperature fluctuations are large, reaching +40°C in July and –40°C in January. The average daily temperature during plant growth is 16.5°C, suitable temperature for plant growth is 2274.716.5°C. Crops with a short growing season and suitable for high altitude and cool regions are usually cultivated.

An average of 400,000–600,000 hectares of land will be cultivated annually, and about 70% of it will be cultivated only with grain plants, mainly wheat. Dark chestnut and chestnut soils with sandy and mechanical compositions are prevalent. The soil climate is suitable for growing wheat and other grains, potatoes, and vegetables.

2. The purpose of the study

In the conditions of the central cultivation region of Mongolia, the following objectives have been proposed in order to detect the possible period of harvesting of millet seeds

1. To study the effect of planting time on field germination
2. Choosing the right time to harvest millet seeds
3. To study the effect of planting time on the biochemical quality of millet seeds

3. Methodology

In the pilot study shall be carried out that thinned before planting such as Saratovskaya-853, an introduced variety from the Saratov Institute of Russia, was planted at a rate of 3 million sh/ha between May 20 and June 10 in a field. The size of one pad was 3 m², and each pad was planted in 9 pads with 3 repetitions. The following observational research was carried out during the study. It includes:

Field germination: Field germination was counted as percentages of sprouts in an 83.3 cm long field in 2 rows of the center of the field when the first leaves were completely uniform in the field.

Growth period: The stage of growth and development of millet was marked as beginning at 15% and as smoothed out at 75%.

Seed yield: The yield was determined by harvesting when the middle part of the millet plant entered the panicle stage.

Biochemical analysis: The quality of millet seeds was determined and expressed as a percentage by the standard of protein (MNS6548:2015) in the Biochemistry Laboratory of the Institute of Plant and Agricultural Sciences.

Quantitative processing: The analysis of variance of research mathematical processing was calculated using R statistical program, and the correlation of factors affecting yield was calculated using the Excell program.

4. Research results

4.1 The effect of the time of planting of field germination

Millet is one of the crops with poor germination shock. According to this feature, small rice can be made when the heat is sufficient. One of the important qualities of the plant's thermal regime is heat supply, which is evaluated by its ability to pass half an hour without changing the temperature. A major determinant of crop yield is field germination. In addition to seed quality and biological characteristics, the yield of the field depends on parameters such as the temperature and moisture regime of the soil of the given year.

Plant seeds grow and absorb moisture depending on their biological characteristics. For example, 45–52% of the weight of the wheat seed is moisture [6, 7] 60–65% of the millet, and 50–55% moisture of the bare oat [8] begins to grow.

According to our research study, in the years of millet field research (2017–2020), it was between 43.1–70.7% in the version of May 20, 46.2–68% in the version of May 30, and 48.9–71.1% in the version of June 10. which means that during the planting period, the climatic parameters of the years are suitable for the growth of warm plants, but the amount of precipitation varies.

In 2017, field protrusions were 43.160.4% in research versions. Out of these, 60.4% of field crops in the scenario of June 30 are 17.3–14.2% higher than other scenarios, respectively. The soil moisture at the time of planting in this period was 19.9 mm at the depth of 0–20 cm, which is 2.6 mm more than the mid-term version and 1.3 mm less than the first time version, but the soil temperature was 30.6°C, which was 15.8–5°C more than the other scenarios. Created the conditions for the increase of protrusions [9, 10].

The differences between the experimental variants were analyzed by factorial analysis of variance in R software. In order to confirm this result, when considering

the Tukey T-test in the statistical program R, the version of the time period of June 10 is $Pr > 0.000409$ from the version of the time period of May 20, and the version of the time period of May 30 is $Pr > 0.000797$ confirmed to be. The 2018 field germination ranged from 56.0 to 50.7%. As the time of sowing is delayed, the field germination tends to decrease. In May-June of this year's planting period, the average daily temperature was 14–20.1°C, which was 0.9–1.1°C higher than the long-term average, and the amount of precipitation fell by 3.7–7.8 mm, which was 16.4–12.3 mm lower than the long-term average, so it was a very dry/arid year.

In the version of May 20, 56% of field germination is 4–5.3% more than in other versions. The temperature of the soil in the first period of planting was 21.8°C, which was 7.1°C lower than the mid-term version and 3.8°C lower than the last version, but it was suitable for plant growth and the amount of soil moisture was 0.9–1.4 mm higher, which caused an increase in field protrusion. Using T-test in R to confirm that the field outliers for the May 20 scenario are better than the other scenarios, the May 20 scenario is significantly different from the May 30 scenario by $Pr > 0.022986$, and the June 10- $Pr > 0.00611$ is very different from the time of.

In 2019, the average daily temperature in May-June was 10.7–19.9°C, the sum of active heat was 225–598°C, the heat supply was high enough, and the amount of precipitation was 4.1–48.2 mm which means it was a month lacking in moisture with 17.1–6 mm less precipitation than the average for many years.

The May 20 version is 4.5 to 13.8 higher than the other possible versions, with field germination of 62.7%. The warm soil of this period was suitable for the growth of plants, the amount of soil moisture (0–20 cm depth) at the time of sowing is 19.2 mm, and in the first 10 days of June after sowing, 11.5 mm of precipitation fell, which coincided with the leveling stage of the field germination of the first period, and then created conditions for the increase of protrusions.

An analysis of variance was performed in R to detect differences between the experimental variants, and the variants were different ($P > 0.00184$). In order to confirm this result, when T-test is also considered in the program, the period of May 20 is higher than the period of May 30 ($P > 0.0174614$), than the period of June 10 ($P > 0.001635$), and the period of June 10. It is confirmed that the period is significantly different from the period of May 30 ($P > 0.011503$) and the field protrusions of the first period of inoculation are better than other versions. According to the 2020 field germination study conducted by us, it was 71.1% in of June 10, which was 0.4–3.1% higher than the scenarios of other periods, respectively. The soil moisture during the planting period is suitable for plant growth. 16.8 mm of precipitation falls in the middle ten days of May and 16.8 mm in the middle ten days of June.

The amount of moisture is sufficient for the plants. However, the average daily temperature was 12.7°C and the soil temperature (V/20–30) at the time of planting was cooler at 15.3–16.8°C, which created the conditions for a decrease in field germination during the first planting period of this year (**Table 1**).

According to our research, the field germination of the May 20 version is 58.1%, which is 2.3–0.6% higher than other versions. The amount of heat at the time of planting increased as the time was delayed, and the amount of soil moisture was more (22 mm) in the scenario of the first time of planting, which affects the field germination. Under the conditions of our country, heat is sufficient for the shoots of millet field germination of the research years, but the size of the shoots varies depending on the amount of soil moisture and the amount of precipitation in that period (**Table 1**).

Indicators	Year	Version		
		V/20	V/30	VI/10
Field germination, %	2017	43.1	46.2	60.4
	2018	56	52	50.7
	2019	62.7	58.2	48.9
	2020	70.7	68	71.1
	average	58.1	56.1	57.8
Soil heat, °C	2017	14.8	25.6	30.6
	2018	21.8	28.9	25.6
	2019	22.8	25.4	27.2
	2020	15.3	16.8	21
	average	18.7	24.2	26.1
Soil moisture, mm	2017	21.2	17.3	19.9
	2018	17.4	16.5	16
	2019	19.2	16	21.1
	2020	30	27.5	23
	average	22	19.3	20
Air temperature, °C	2017	9.1	18.2	22.5
	2018	14	22	19.4
	2019	12.4	13.8	24.4
	2020	13.5	9	13.6
	average	12.3	15.8	20.0

Table 1.
 Effect of planting time on field germination of millet (2017–2020).

4.2 Effect of planting time on the survival rate of millet

It is the main indicator of the biological properties of plants. Survival or biological resistance is calculated by comparing the number of plants counted in the field with the number of plants' endurance at harvest. In the conditions of our country, the survival rate expectancy of grain plants is about 65–80%. According to the research of J. Namjilsuren [8], it is 62.1–90.8% of the survival rate of oat and 80–90% in the life of wheat.

According to our research, the average survival rate of millet was 87.1–80.5% in years. According to the life expectancy of the research years 2017–2020, 2017 has a higher life expectancy than other years of 88.3–95.2%. According to the survival rate years, the version of May 20 had an average of 87.1%, which was a 4.2–3.4% survival rate than the other versions (**Figure 1**).

To confirm the results of the planting time variants, analysis of variance in R software showed that the field yield among years was significantly different ($P > 0.00000001870$), but the mean field yield between the variants was not different, $P > 0.64$ (**Table 2**).

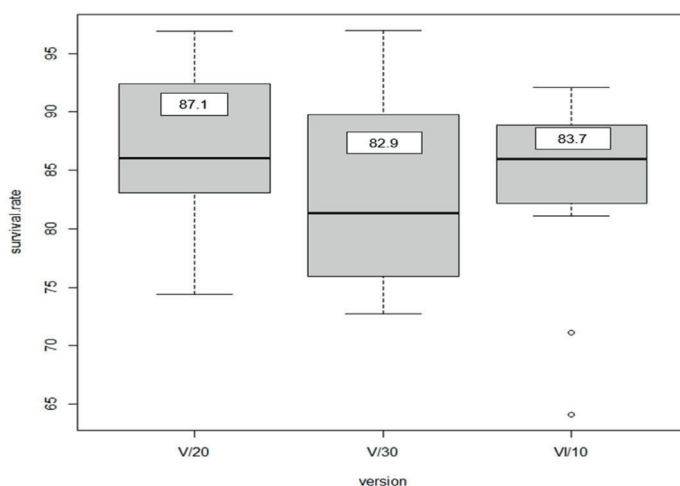


Figure 1.
Effect of millet planting time on the survival rate (2017–2020).

	Df Sum	Sq Mean	Sq F	value	Pr(>F)
Version	2	28	14	0.441	0.6474
Year	1	1827.2	1827.2	57.472	0.0000000187
Version:year	2	275.7	137.9	4.337	0.0222
Residuals	30	953.8	31.8		

Table 2.
Effect of planting time on field germination of millet (2017–2020).

4.3 Effect of planting time on growth period

Millet can grow in different soils, but the yield varies depending on the climate and soil fertility. Setting the right planting time is important not only to increase the yield but also to choose the optimal planting technology according to the soil and climate of the region.

The growing season of any crop may vary due to the biological characteristics of the crop and the soil and climatic conditions of the region. The Saratovskaya-853 variety of millet matures in 84–95 days from the growing period.

Between 1949 and 1957, M. Ölzii carried out research on millet varieties and selected 12 varieties based on the growing period. Also, the Dzungharaa Agricultural Research Institute conducted a comparative study of millet varieties and selected and studied varieties with short growth periods that could yield more under the given research conditions [3].

According to the results of the research, there was a conclusion from many years of research that it is correct to calculate the growing days by including early varieties, reaching 80 days, medium early fruiting 80–90 days, and late fruiting 90–100 days. However, according to the results of research conducted by Researcher J. Serjmaa (1964–1967), the growing days of millet varieties matured in 78–89 days [11].

In addition to factors such as the amount of rainfall and temperature during the planting period, factors such as the quality of the seeds at the time of planting and the characteristics of the variety also affect the time to harvest from the planting of millet. The Saratovskaya-853 variety of millet has 84–95 days from the time of germination to seed maturity. According to the research of J. Serjmaa (1964–1966), it took 26–35 days from cultivation to germination, and 23–28 days from tillering to sprouting of millet varieties [11].

However, according to J. Tsend, the time from germination to threshing of millet varieties was 14–21 days on average, and the development stage of the Saratovskaya–853 variety was uniform in 21 days [6].

Millet starts to be crushed 15–20 days after it starts to be crushed when it has 5–6 leaves. Crushing takes place very well in conditions with an average active heat sum of 270–300°C and an average daily temperature of not less than 17 degrees Celsius.

According to our research, the stages of development of millet from sprouting to crushing were different on May 20, 8–15 days, on May 30, 9–16 days, and on June 10, 9–18 days. Of these, the May 20 version is 12 days earlier than May 30 and 3 days earlier than June 10. In this version of the planting period, the time from the outcrop to the crushing is largely dependent on the amount and distribution of precipitation during this period, which took place in the first 10 days of the end of June and July.

It took 30 days from inoculation to emergence on May 20 and 25 days on May 30. In May, the average daily temperature was 12.8°C, total active heat was 339°C, and precipitation was 23.8 mm. However, in the version planted on June 10, the daily average temperature was 0.8°C higher than the long-term average, 6.95°C higher than the previous month, 22.0 mm higher than the previous month's average, and 8.37 mm higher than the previous month (V). 8.5 days and 5 days earlier than the 2nd-period version, affected by the protrusion.

During the research years (2017–2020), the 5-month daily average temperature of the planting period was 12.85°C, close to the long-term average, the total active heat was 339°C, 34°C more than the long-term average, and the rainfall was 23.8 mm, which was 2.6 mm more than the long-term average had a positive effect.

It takes 32–24 days from the planting of millet to germination. In the scenario of May 20, the germination was uniform for the longest time, but depending on the temperature and moisture of the soil, as the planting time is delayed, the number of days for the protrusions to be uniform is getting shorter. According to our research, the total growing period is 89.5 days for the May 20 version, 85.5 days for the May 30 version, and 80.7 days for the June 10 version. As the growing period is delayed, the growing days become shorter.

The version of the first time of planting was the version of millet that matured in 90 days. On the other hand, the growth period of the June 10 version was 80.7 days, 8.8 days shorter than the May 20 version, and 4.7 days shorter than the May 30 version. Also, during this period, the seed yield is low, the quality is poor, and the crop is formed (**Figure 2**).

4.4 The effect of planting time on yield structural parameters

The of plant yields main factor that determines a particular crop is the yield structure indicator. These vary from crop to crop. Although millet has smaller seeds

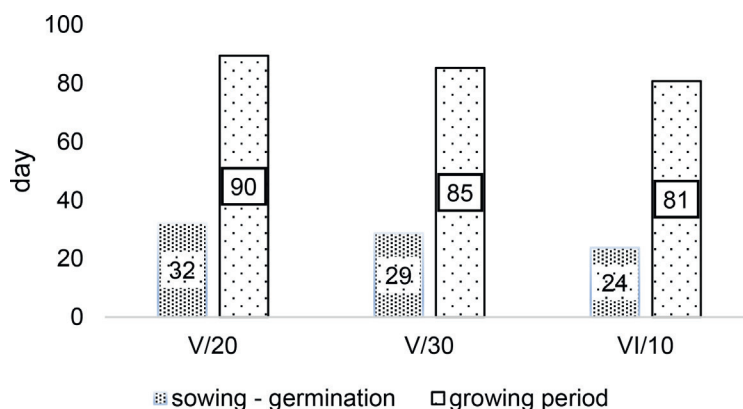


Figure 2.
Effect of millet planting time during the growing period (2017–2020).

Version	Plant height, cm	Length of panicle cm	Number of stems with panicle, sh	Number of seeds per panicle, sh	Seed weight per panicle, g	Weight of 1000 seeds, g
V/20	86.5	14	218	255	1.4	5.4
V/30	79.5	14	192	307	1.6	5.4
VI/10	80.6	12	185	256	1.4	5.3

Table 3.
The effect of planting time on millet yield structural parameters (2017–2020).

compared to other cereal crops, it has similar yield structure parameters. According to J. Namjilsuren's (2003–2004) study, the yield structure measurements made on a total of 62 variety research samples showed that the plant height was 54–104 cm, 3 short samples of 50–80 cm or 3 scores, 81–110 cm medium samples were 19 or 5 scores, and 110– There were 35 samples with a height of 140 cm or 7 points and 5 samples with a height above 140 cm or 9 scores.

The leading indicators of yield structure were plant height, number of seeds per panicle, the weight of 1000 seeds, and length of the panicle. The weight of 1000 seeds of the experimental version is 5.4–5.2 g, the plant height is 86.5–79.5 cm, the number of seeds per panicle is 255.3–306.8 sh/m², the weight of seeds per panicle is 1.4–1.6 g/m², and panicle length is 14.0–12.3 cm (Table 3).

When calculating the relationship between these parameters, the seed yield has a strong direct correlation with the weight of 1000 seeds $r = (0.94)$ and the length of the panicle $r = (0.91)$. However, the yield was moderately correlated with the number of seeds per panicle $r = (0.59)$, and the weight of seeds per panicle $r = (0.58)$. According to the parameters of the structure of the crop, which is highly related to the yield, the weight of 1000 seeds in the version of May 20 was 5.4 g, close to the mid-term version, 0.2 g more than the latest version, and the length of the panicle was 14 cm, which was 0.5 cm more than the first version and 1.7 cm more than the latest version. The plant height was 86.5 cm, which is 7–6 cm higher than in other periods (Table 2).

In the analysis of factorial variance in terms of yield structure, $P > (0.00008)$ is very different between plant height variants, (Table 4) $P > (0.02)$ difference between

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Version	2	340.7	170.36	16.89	0.0000089
Residuals	33	332.9	10.09		

Table 4.
Differences between height variants of millet plants, (R program).

time variants in terms of the number of seeds per plant. However, the weight of 1000 seeds was $P > (0.06)$ and the weight of seeds per plant was $P > (0.07)$ and there was no difference between the variants. According to the Tukey T-test, which has a high difference between the versions, there is a significant difference between the May 20 version and the May 30 version $P > (0.00001)$ and the June 10 version $P > (0.0001)$ in terms of plant height., it is confirmed that the May 30 period is better than the May 20 period by $P > (0.011)$ and the June 10 period by $P > (0.012)$.

4.5 Effect of planting time on seed yield

The yield of that crop depends on the precipitation and temperature for 5–6 months of that year. Seed yield varied depending on the growing season of millet. According to research conducted by researcher J. Serjmaa in 1965–1967, the yield of seeds was 16.2–22.2 t/ha [11].

However, according to the research conducted by J. Tsend in 2010–2012, the seed yield of Saratovskaya-853 variety of 17.5 kg/ha [6].

Because common millet is a crop that matures in succession, it is important to choose the right time to harvest the seeds. Harvesting is done when the upper part of millet ears ripens and starts to turn yellow, because millet/*Panicum miliaceum. L*/seeds ripen in series and also have a lot of spillage. Nesterov.I.M (2018–2020) According to research, the seed yield of millet was 29.6–35.5 t/ha [12].

The 4-year average yield of small rice seeds is 23.7 t/ha in the version planted on May 20, 24.1 t/ha in the version planted on May 30, and 20.9 t/ha in the version planted on June 10. Of these, the version planted on May 30 has a yield of 0.4 t/ha more than the version of May 20, and 3.2 t/ha than the version of June 10 (**Figure 3**).

There was a significant difference in seed yield $P > (0.002^{**})$ between the years of inoculation, but a small difference $P > (0.04249^{*})$ between the inoculation time variants. Considering the T-test whether the version of May 30, which has the highest seed yield, is different from other time versions, it is confirmed that the version of this time has a greater difference in yield than the version of June 10 with $P > (0.044755^{*})$. However, there is no difference between the yields in the version of May 20 $P > (0.983759)$.

We have considered the most beneficial time to sow the millet seed crop to be May 20. During this period, due to the tillage superficial of the soil before planting, the number of weeds in the field was small, and it was not affected by the late spring and early autumn shocks cold. At the germination stage of small rice, the total precipitation was 83.0 mm, which was 15 mm higher than the long-term average, the average daily temperature was 21.2°C, which was 0.3°C higher than the long-term average, and the sum of active heat was 29.4°C, which had a favorable effect on seed yield and quality.

Although the seed yield in the mid-sowing period (May 30) is better than the other options, the main parameters of the field germination, yield structure (plant

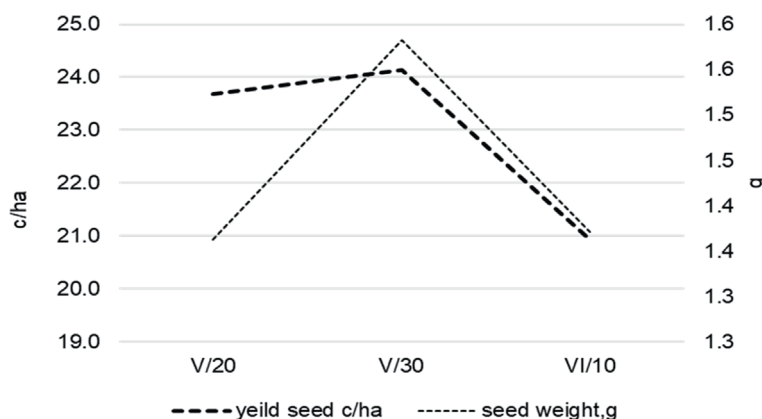


Figure 3.
Effect of planting time on seed yield of millet (2017–2020).

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Year	1	433.7	433.7	11.1	0.00209
Residuals	34	1328.6	39.1		

Table 5.
Differences between millet seed yields (R program).

height, panicle length), and seed quality are lower than in the first period. Also, due to the climatic characteristics of some years, the sowing period is not suitable due to the fact that after planting in the spring, there were negative consequences such as excessive drying of field germination, drying and death of germination, late seed development, and spot.

On the other hand, the June 10 seed harvest was delayed due to the late sowing and less than the first two periods in yield of parameters, and because it was hit by the autumn frost, it produced seeds with poor germination. Therefore, it is not suitable to plant millet for seed in the central cultivation area after June 10 (Figure 3 and Table 5).

4.6 Effect of planting time on biochemical characteristics

Cereal plants are a source of protein and starch for the world's population. Proteins are unique in that they are not added to other substances when used in human and animal feed. Cereal plants are a source of protein and starch for the world's food, and increasing plant-derived protein is an important issue in meeting the protein needs of the population, so it has become one of the problems facing the world. The protein content varies depending on the type of crop, variety, soil, and climate of the region. Phytochemical composition of grain plants (V.L. Kretovich) wheat seed contains 15% protein, barley 12%, rye 13%, and sorghum 12%. Percent, small rice contains 12%, respectively.

Researcher J. Serjmaa conducted research on small rice varieties from 1964 to 1966, and the three-year average was 751 g of green mass, 16.3% of the weight of seed coat, 6.4% of oil content, 13.3% of acid content, and 48.2% of starch content [13].

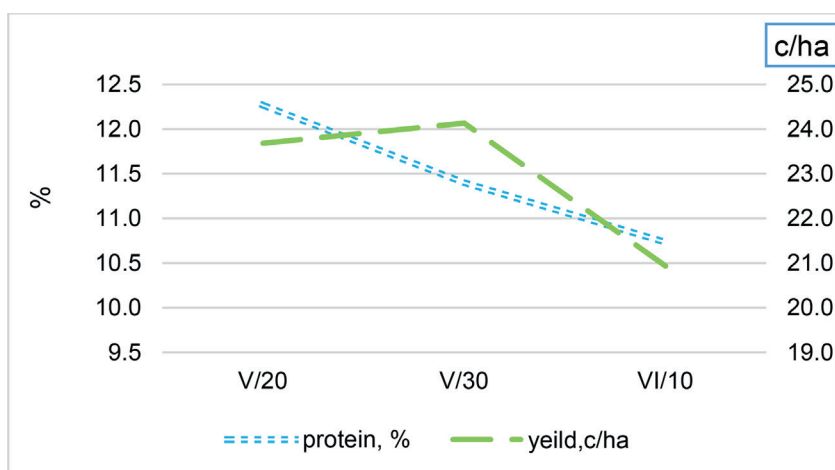


Figure 4.
 Effect of planting time on the biochemical quality of millet (2017–2020).

Looking at the chemical composition of plants of the *Panicum* genus, ordinary millet (*P. miliaceum*. L) contains 12.5 g of protein, 70.4 g of carbohydrates, 2.2 g of fiber, 1.1 g of oil, and 341 kcal of energy contains 60.9–72 g of carbohydrates and 307–341 kcal of energy [14].

According to Lorenz and Dilsaver's [15] research on the milling characteristics, composition, and nutritional quality of millet flour, millet flour had higher ash, fat, and protein content than wheat flour. According to Obilana and Manyasa [16] and Young [17], millet has many nutritional and therapeutic roles and is rich in health-promoting phytochemicals, and is considered a functional food [4].

In our study, the protein content of small rice seeds was between 12.3 and 10.4% in the inoculation variants. On the average of the research years, the protein content of the version planted on May 20 was 12.3%, which was 0.9% higher than the mid-term version and 1.6% more than the late version. When calculating the correlation between the parameters of biochemical characteristics, yield, and protein have a strong correlation of $r = 0.74$ or 74%. The protein content in the seeds of the time variants decreases as the time is delayed, and the quality changes depending on the climatic parameters of the period from germination to maturity, on the average of the years of the study, when the seed condition is mottled and has poor casting (**Figure 4**).

4.7 To compare with the materials of other researchers and to explain the advantages of own research work

Millet is one of the milk-producing crops that have high food and nutritional value, require relatively low moisture, and are resistant to drought.

Research on millet varieties and seed yield was conducted by J. Serjmaa in 1965–1967, and the seed yield was 16.2–22.2 t/ha [13]. And researcher according to J. Tsend's research in 2010–2012, the seed yield of the Saratovskaya-853 variety was 17.5 t/ha [3].

Researcher A.I. According to Baraev's (2015–2017) research in Kazakhstan, the seed yield of millet varieties was between 24.7–33.3 c/ha, which is similar to the results of our study [18, 19].

When millet was planted between V/20–30, the seed yield was 23.7–24.1 t/ha. The results of our research on seed yield are higher than those of previous researchers, which means that in today's climate change, heat supply has a favorable effect on plant growth and is the basis for increasing yield. The cultivation of millet in the conditions of the central cultivation area is an innovative and superior study suitable for the conditions of our country, which is the main cause of climate change, the reduction of crop yield, the production of healthy and safe food, and the production of healthy and safe food due to climate change.

5. Conclusion

1. In millet field germination the version planted on May 20 had 58.1% of shoots, which was 2–0.3% more than the other time versions. The amount of soil moisture in this scenario was 2–1.7 mm higher than that of the other scenarios, which created the conditions for the increase of the field germination, and the moisture field germination at the time of planting has a correlation of $r = 0.7$.
2. In the May 20 time version, the growing period was 90 days, which was the most suitable time for seed ripening, which was 5–9 days longer than the other versions.
3. It is confirmed that the version of May 20 is 12.3% of the protein content in the seeds and is better than other versions in terms of quality content. Nutrient quality indicators of millet decrease as the time is delayed, which is largely dependent on the condition of the seed.
4. According to the 24.1 t/ha in the version planted on May 30 although seed yield was 0.4–3.2 t/ha higher than the other versions, it did not reach the version of May 20 in terms of seed quality, field germination, and yield structure parameters.
5. May 20 is considered the most suitable time for sowing millet seeds. The seed yield of this version is 23.7 t/ha, which is no different from the version of May 30 ($P > (0.983759)$), and 11.8% higher quality and uniform seeds than the version of June 10.

Author details

Khishigbuyan Turbat^{1*}, Gungaanyam Galkhvv² and Namjilsuren Jamiyan²

1 Mongolian University of Life Sciences, Darkhan-uul Province, Mongolia

2 Plant Science and Agricultural Institute, Mongolia

*Address all correspondence to: bankuhish@gmail.com

IntechOpen

© 2023 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Gungaanyam G, Khishigbuyan T. Warming-tolerant Native Crops. Article. Darkhan-uul province; 2015
- [2] Available from: <https://www.fao.org/millet-2023/en>
- [3] Tsagaanshuher G. Plant Farming. Textbook. Darkhan-uul province; 2001
- [4] Habiyaemye C, Mataguinan JB. Proso millet (*Panicum miliaceum* L.) and its potential for cultivation in the Pacific Northwest, U.S.: A review. *Frontiers in Plant Science*. Jan 2017;2. Available from: <https://www.frontiersin.org/articles/10.3389/fpls.2016.01961/full>
- [5] Habiyaemye C. Proso Millet (*Panicum miliaceum* L.) and It's Potential for Cultivation in the Pacific Northwest, USA: A Review. 2017. DOI: 10.3389/fpls.2016.01961. Available from: <https://www.frontiersin.org/articles/10.3389/fpls.2016.01961/full>
- [6] Tsend J. Research on Millet Varieties and the Effect of Planting Time in the Central Agricultural Region [Master's thesis]. Darkhan-uul province; 2012
- [7] Nambar J. The result of the study of agrotechnics for growing winter wheat in the conditions of soil compaction technology [Dissertation for the Ph.D]. 2002. pp. 42-43
- [8] Namjilsuren J. Selection of bare-seeded oat varieties in the conditions of the central cultivation area, results of research on planting time and seed norms [Dissertation for the Ph.D]. 2002. pp. 95-106
- [9] Khishigbuyan T. The influence of planting time on the green mass yield and quality millet. In: Sustainable Development of Environment and Agriculture. Scientific Conference Articles. Research Articles. Mongolia: Darkhan-uul provenci; 2019. pp. 101-104. ISBN: 978-99973-935-7-9
- [10] Khishigbuyan T, Gungaanyam G, Namjilsuren J. The influence of planting time of the seed yield and quality millet. *Mongolian Journal of Agricultural Sciences*. 2018;25(03):127-131. DOI: 10.5564/mas.v25i03.1181
- [11] Serjmaa J. Millet. Mongolia: Ulaanbaatar; 1977
- [12] Nesterov IM. Influence of sowing time on the yield of millet grain in the conditions of the north-eastern part of Belarus. 2018-2020. УДК 633.17:631.559(476-18). Available from: <https://cyberleninka.ru/>
- [13] Aliscioni SS, Giussani LM, Zuloaga FO, Kellogg EA. A molecular phylogeny of (Poaceae: Paniceae): Tests of monophyly and phylogenetic placement within the Panicoideae. *American Journal of Botany*. 2003;90(5):796
- [14] Tomé D, Bos C. Lysine requirement through the human life cycle. *Journal of Nutrition*. 2007;137(6 Suppl 2):1642S-1645S. DOI: 10.3732/ajb.90.5.796
- [15] Lorenz K, Dilsaver W. Proso millets. *Mil*. 1980. Available from: <https://www.cerealsgrains.org/>
- [16] Thapliyal V, Singh K, Millet F. Potential millet for food security and power house of nutrient. *International Journal of Research in Agriculture and Forestry*. Feb 2015;2(2):22. ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

- [17] Amadou I, Gounga ME, Le G-W.
Food science and nutrition millets:
Nutritional composition, some
health benefits and processing - A
review. Emirates Journal of Food and
Agriculture. 2013;25(7):501. DOI:
10.9755/ejfa.v25i7.12045. Available from:
<http://www.ejfa.info/>
- [18] Baraeva AI. Влияние фактор среды
на прочатность зерна и зеленой массы
проса в severnom kazakhstane. Available
from: <https://kazatu.edu.kz/>
- [19] Anokhina TA. O tselesoobraznostnosti
oslojannosti prosa v khaslitte trehovoy
kultury. No. 1. – S. 6. 5. 2004