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G. Zh. Medeuova

Kazakh state women's pedagogical university, Almaty, Kazakhstan.
E-mail: medeuova.galiya96gmail.com

OPTIMIZATION OF PHOTOSYNTHETIC ACTIVITY AND YIELDING CAPACITY OF RICE CULTIVARS DEPENDING ON METHODS OF APPLICATION OF NITROGENOUS FERTILIZERS AND SEED APPLICATION RATES

Structural abstract. In case of application of increasing rates of mineral amendments, in particular of nitrogen fertilizers in medium-grown cultivars, ***the first effect*** of increasing of grain yield enhancement has been observed at a rate of N120P90-120 kg/ha of rate of application. In the circumstances, in agrocoenosis of medium-grown rice-cultivars cenotic mutual influence has not been conductive to reduction of net photosynthesis of photosynthesis (Ph.n.pr., g/m^2 per day). At high-yielding seedings, in case of application of optimal rate (N160-180R 120 kg/ha) of fertilizers, large CA, FP, Ubiol are formed in medium-grown cultivars. However, the level of average net productivity of photosynthesis (Ph.n.pr., g/m^{2}per day), in particular after heading phase it has not decreased. This effected the formation of high crop yield of grain (72-78 c/ha) that is ***the second effect*** of increasing of grain yield enhancement of rice cultivars. At high-yielding seedings of narrow-leaved cultivars with vertical phylotaxy of Kuban 3, Krasnodar 424, Aru, the highest yielding capacity has been obtained in case of application of 25-33% of annual rate of nitrogenous fertilizers before seeding, and 67-75% in the form of two fertilizations at crop stages 6-7 and 8-9. At seedings of large-leaved cultivar of Marzhan, Aral 202, Togusken 1, the largest grain yield has been formed upon application of 60-70% of annual rate of nitrogenous fertilizers before seeding, and application of other 30-40% in the form of fertilization at crop stage 6-7.

Key words: rice, cultivars, methods of application of mineral fertilizers, optimization of photosynthetic activity, formation of optimal leaf area and the largest grain yield.

Nitrogenous fertilizers promotes a significant increase in crop area (CA) of rice croppers [Hill Jt et al.,2001, 491-500; Tuong T.P., et al., 2000, 3-18; Zhailybay K.N., 2018, 63-70; Zhailybay K.N., 2018, 103-109; Olzhabayeva A.O., 2018, 9-20]. Provided that, leading role in grain formation belongs to upper, in particular upper leaves 2-5 of main stem, and stem shoots, length and width of leaf blades [Lizandr A.A., 391-397]. In connection therewith, the effect of methods of application of optimal rate of nitrogenous fertilizer - N180 kg / ha (compared to P120 kg / ha) and seed application rates on assimilative apparatus formation and rice grain yield have been researched. Cultivars of rice varieties varying in architectonics: Kuban 3, medium-grown, with narrow vertical phylotaxy; Marzhan is medium-grown, large-leaved. Plot area in dummy experiments is 5 m^2, at large-plot experiments - 100-120 m^2, replication of experiment - four times, agrotechnics is universal for Kyzylordin region (Kazakhstan) [Sistem of agroculral., 380-410]. Research of effect of optimal rate of nitrogenous fertilizer (N160-180 kg/ha of rate of application) against phosphate fertilizer (P 120 kg/ha of rate of application) has been carried out according to the following pattern:

Block 1. ***N180P120 kg/ha of rate of application,*** the annual rate of fertilizers has been applied before seeding.

Block 2 -*N180P120 kg/ha,* 70% of the annual rate of nitrogenous fertilizer (N120 kg/ha) have been applied before seeding, the remaining 30%, or N60 in the form of fertilizations at crop stage 6-7;

Block 3 -*N180P120 kg/ha,* 50% of the annual rate of nitrogenous fertilizer (N90) and two fertilizations, 25% each, have been applied before seeding: N45 at crop stage 4-5 and N45 - at crop stage 6-8 - method developed by the laboratory of mineral nutrition of Institute of Botanics of the Academy of Sciences of the Republic of Kazakhstan [Gostenko G.P.,12-36; Starkova A.V.,9-12];

Block 4 -*N180R120 kg/ha,* 1/3 (33% or N90) of the annual rate of nitrogenous fertilizer and two fertilizations have been applied before seeding: N90 at crop stage 6-7 (at the beginning of 3[d] phase of organogenesis), and N30 - at stem elongation phase (8-9 leaves) - method developed by Laboratory of Plant Physiology of Kazakh Research and Development Institute of rice [Ramazanova S.B.,18-20];

Block 5 -*N180R120 kg/ha,* 25% (N45) of the annual rate of nitrogenous fertilizer and two fertilizations have been applied before seeding: 50% (N90) at crop stage 3-6, and 25% (N45) - at crop stage 8-9 - method developed by Russian Research and Development Institute of rice [Aliyezhin Ye.P.,25-27].

Background - phosphate fertilizer (P120 kg/ha of rate of application) have been applied before seeding. At large-plot and farm scale trials, blocks 4 and 5 are combined, as effect of these variations turned out to be the same.

At dummy experiments, rice seeds have been sown manually using narrow-rowed method in the steps of markers in quantities of 100, 300, 500, 700, 900 pcs/m^2 and covered with soil. At large-plot experiments, seeds have been sown by drill-machine SZ-3.6 in the following norms: Marzhan cultivar - 130 kg/ha (3 million of viable grains), 230 (6 million), 280 (7.5 million), 320 kg/ha (9.5 million of seeds); Kuban 3 cultivar - 100 kg/ha (3 million), 200 (6 million), 250 (7.5 million), 300 kg/ha (9.5 million of viable grains). Crop area has been determined using method of V.V.Anikiev, F.F. Kutuzov, usability of

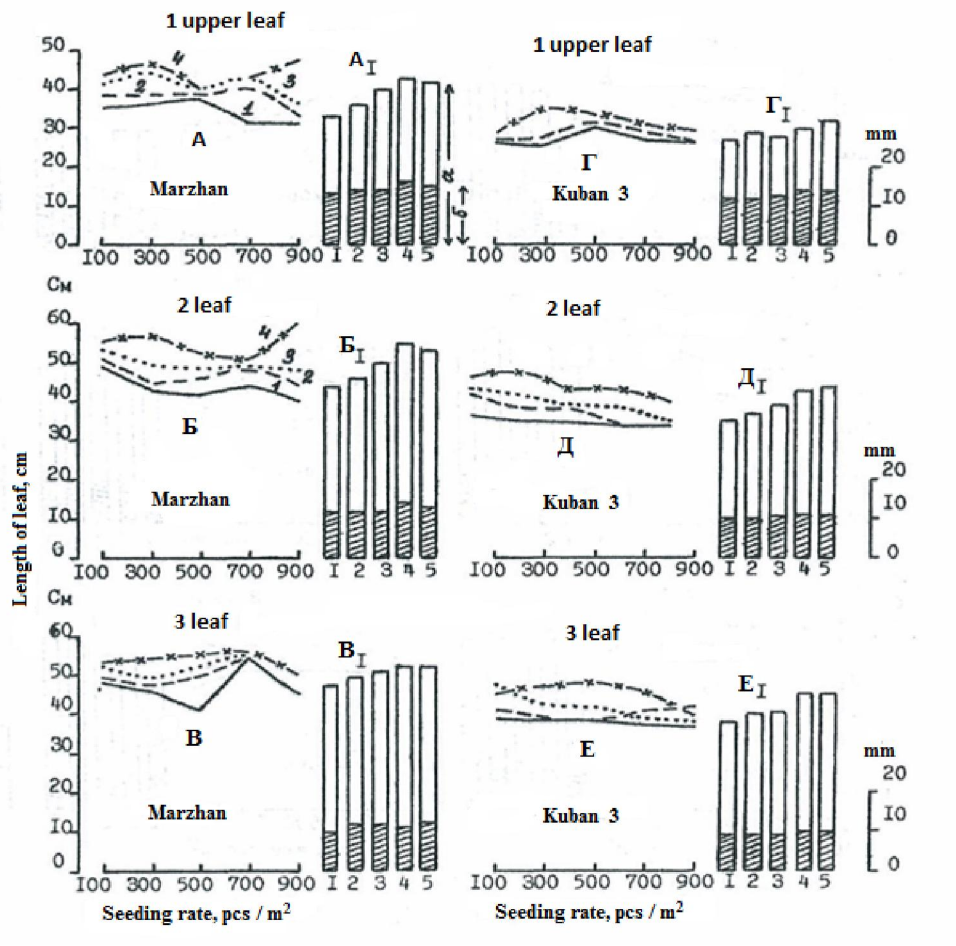

Figure 1 – Change of length and width of main stem leaves of Marzhan and Kuban 3 cultivars depending on seeding rate of seeds (А, Б, В, Г, Д, Е) and methods of nitrogenous fertilizer application ($А_1$, $Б_1$, $В_1$, $Г_1$, $Д_1$, $Е_1$).
_Block 1; _ _ _ _Block 2; . . . . . .Block 3; _ x_x_x_Block 4.
1, 2, 3, 4, 5 - Blocks with relative numbers; a - length, and b - width of leaf
(averaged values by block - methods of nitrogenous fertilizer application)

which has been checked by experience [Anikiev V.V.,375-377]. Agrotechnics is universal for PreAral zone. Change of degree of density of rice croppers in agrocoenosis and methods of nitrogenous fertilizer application has a significant impact on formation and size of assimilative apparatus (figures 1-7).

Marzhan cultivar in Block 1 (application of full rate of nitrogenous fertilizer before seeding) have length of the first leaf (from top) of main stem that increases in case of seeding of 500 pcs/m^2 of seeds, and it reduces with seeding overcrowding. In Block 1, the length of main stem flag of Marzhan cultivar is 30.5-36.9 cm, the width is 1.25-1.43 cm depending on population (of the 2nd, in consequence, the length of 2nd and 3rd leaves of main stem is more than the flag but the width is smaller. In case of split application of nitrogenous fertilizer (Blocks 2, 3, 4, 5), the length and width of leaves increase, the largest of their values is noted in Block 4 (*figure 1,* $А_1$, $Б_1$, $В_1$). Thus, in the Block 4, the length of flag is 41.0-45.8 cm, the width is 1.50 -1.70 cm, the 2nd leaf, respectively, - 52.0-63.2, and 1.2-1.6 cm, the 3rd - 51.0-55.2 and 1.0-1.4 cm (figure 1).

Sizes (length and width) of leaves of the average stem shoot is less than those of leaves of main stem. Provided that, dependency of length and width change of stem shoot leaves depending on grain seeding rate and methods of nitrogenous fertilization are similar to the leaves of main stem (figure 2; $А_2$, $А_3$, $Б_2$, $Б_3$, $В_2$, $В_3$).

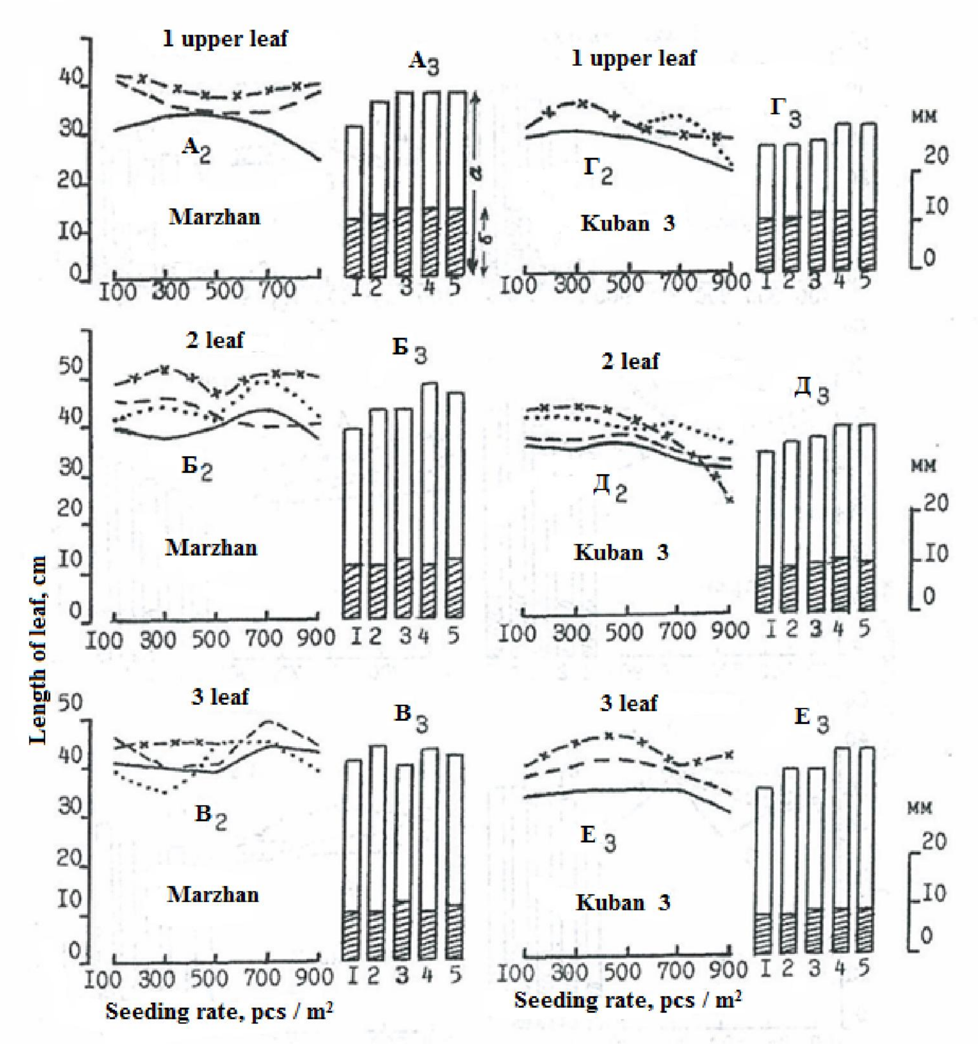

Figure 2 – Change of length and width of stem shoot leaves of Marzhan and Kuban 3 cultivars depending on seed application rate ($А_2$, $Б_2$, $В_2$, $Г_2$, $Д_2$, $Е_2$) and methods of nitrogenous fertilizer application ($А_3$, $Б_3$, $В_3$, $Г_3$, $Д_3$, $Е_3$).
_Block 1; _ _ _ _Block 2; . . . . . .Block 3; _ x_x_x_ Block 4.
1, 2, 3, 4, 5 - Blocks with relative numbers; a - length, and b - width of leaf
(averaged values by block - methods of nitrogenous fertilizer application)

In case of application of full rate of nitrogenous fertilizer before seeding (Block 1), the area (cm^2) of main stem flag of Marzhan cultivar increases gradually depending on seeding rate reaching a maximum at high-yielding seedings (seeding of 500 pcs/m^2 of seeds), and then decreases with overcrowding. Area of the 2nd and the 3rd leaves also increases, maximum is reached with seeding of 700 pcs/m^2 of seeds, and at heavy seedings (seeding of 900 pcs/m^2 of seeds) decreases (figure 3; $А_4$, $Б_4$, $В_4$).

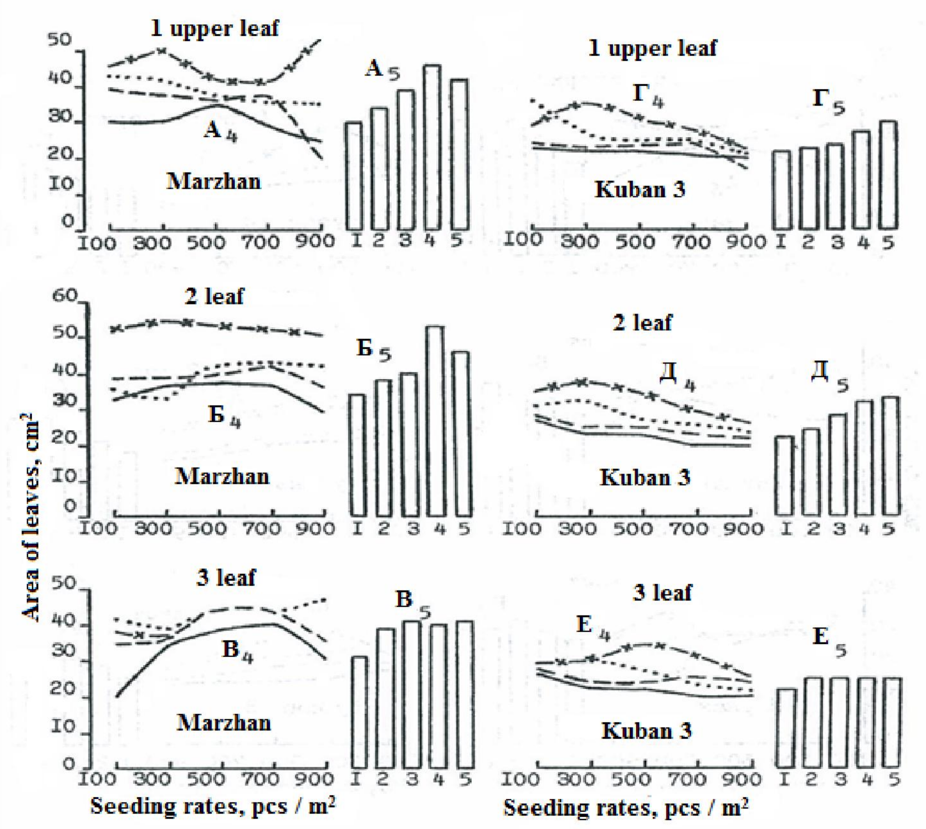

Figure 3 – Change of cropper (cm^2) area of main stem of Marzhan and Kuban 3 cultivars depending on seed application rates ($А_4$, $Б_4$, $В_4$, $Г_4$, $Д_4$, $Е_4$), methods of nitrogenous fertilizer application ($А_5$, $Б_5$, $В_5$, $Г_5$, $Д_5$, $Е_5$).
______Block 1; _ _ _ _Block 2; . . . . . .Block 3; _ x_x_x_ Block 4.
1, 2, 3, 4, 5 - Blocks with relative numbers; a - length, and b - width of leaf
(averaged values by block - methods of nitrogenous fertilizer application)

In case of split application of nitrogenous fertilizer (Blocks 2, 3, 4, 5), increasing in crop area is principally observed at thinned out (seeding of 100 pcs/m^2 of seeds) and moderate (300 pcs/m^2 of seeds) seedings (figure 3; $А_4$). Averaged according to seeding rates, the area of flag and bracing leaves of the main stem were the largest in Block 4, and the 3rd leaf - in Blocks 3, 4, 5 (figure 3; $А_5$, $Б_5$, $В_5$). Similar dependency of crop area change has been observed related to stem shoots (figure 4; $А_6$, $А_7$, $Б_6$, $Б_7$, $В_6$, $В_7$).

Formation of assimilative apparatus of leaves of **Kuban 3 rice cultivar** differs from Marzhan cultivar. Thus, in Block 1 the length of main stem leaves on a practical level has been unchanged depending on seed application rate. Provided that, the length of the 2nd leaf is more than the 1st, the 3rd is more than the 2nd but the width. In case of split application of nitrogenousfertilizer (Blocks 2-5), the length of the flag and the 2nd leaf of main stem increases with seeding of 300 pcs/m^2, the 3rd - with seeding of 500 pcs/m^2, and then it gradually decreases. Overall length and width of leaves are noted in Blocks 4.5 (figure 1; Г, Д, Е).

Leaf sizes of mid stem shoot of Kuban 3 cultivar are less than those of main stem leaves. Provided that, dependency of change of length and width of stem shoot leaves depending on seeding rate are similar to those of leaves of main stem (figure 2; $Г_2$, $Д_2$, $Е_2$). Kuban 3 cultivar crop area of main stem and stem shoots in Block 1 is larger with seeding of 100 pcs/m^2 of seeds, then it gradually decreases with overcrowding of seedings. In case of split application of nitrogenous fertilizer (Blocks 2-5), in particular, in

Block 4, area of flag and the 2nd leaves of main stem is more with seeding of 300 pcs/m^2 of seeds, and the 3rd leave - with seeding of 500 pcs/m^2 of seeds, then it gradually decreased (figure 3; $Г_4$, $Д_4$, $Е_4$). Areas of stem shoot flag is more in Blocks 4.5; the 2nd and the 3rd leaves - in Blocks 3, 4, 5 (figure 4; $Г_6$, $Г_7$, $Д_6$, $Д_7$, $Е_6$, $Е_7$).

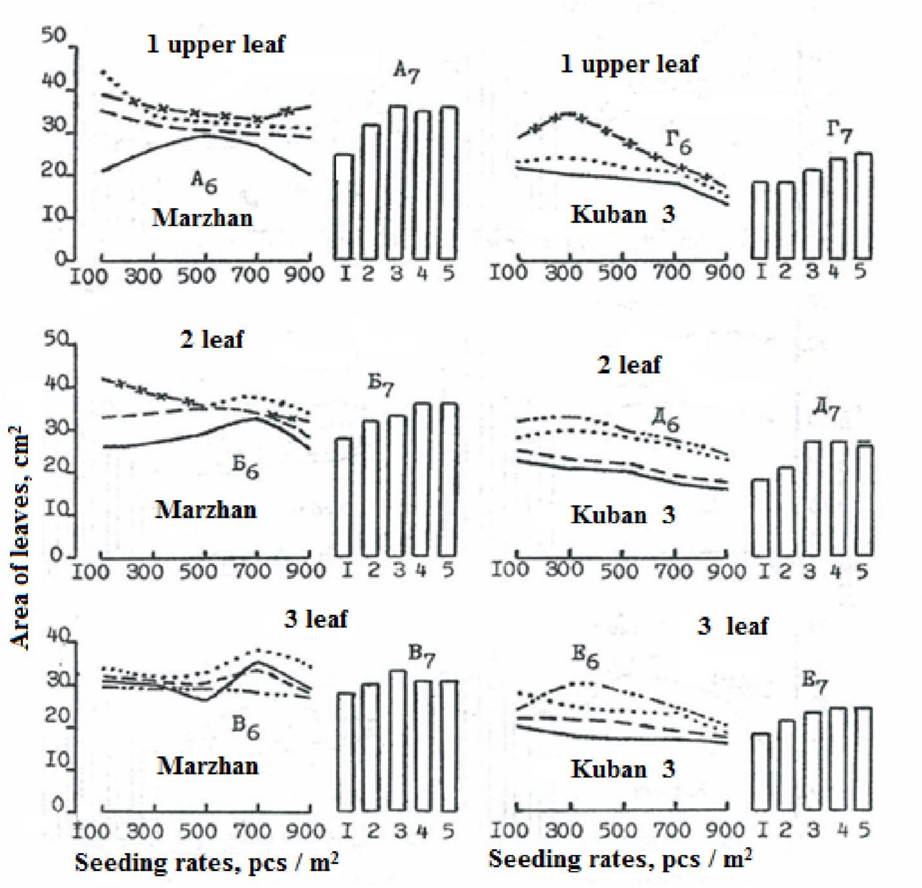

Figure 4 – Change of length and width of stem shoot leaves of Marzhan and Kuban 3 cultivars depending on seed application rate ($А_6$, $Б_6$, $В_6$, $Г_6$, $Д_6$, $Е_6$) and methods of nitrogenous fertilizer application ($А_7$, $Б_7$, $В_7$, $Г_7$, $Д_7$, $Е_7$)

Particulars of assimilative apparatus formation of Kuban 3 and Marzhan cultivars have had definitive impact on formation of grain yield structure elements. Thus, number of spikelets in main stem head and stem shoots significantly decreases with overcrowding of seedings (figure 5; Ж, З, И, К). The biggest number of spikelets in main stem head and stem shoots of Kuban 3 cultivar are noted in Blocks 4.5 (figure 5; $И_1$, $К_1$). Other dependency is observed in Marzhan cultivar. Thus, larger number of spikelets on main head is noted in Blocks 2, 4, 5. With increasing of rate and number of fertilizations (Blocks 4.5), the number of stem shoots, length, width and size of crop area increase, but this does not lead to increase in number of spikelets on main head compared with Block 2, and it decreases on stem shoot head. The biggest number of spikelets on stem shoot head of Marzhan cultivar is noted in Block 2 (figure 5; $З_1$).

As a consequence of this, grain yield of Kuban 3 cultivar in Block 1 increases with overcrowding of seedings. In case of split application of nitrogenous fertilizer (Blocks 2-5), the yield is increased, however, the highest level has been noted at high-yielding seedings (seeding of 500, 700 pcs/m^2 of seeds) and in Blocks 3, 4, 5 (figure 6; $И_2$, $И_3$). Marzhan cultivar has turned out to be the most yielding at high-yielding seedings (seeding of 500, 700 pcs/m^2 of seeds), and upon application of 60-70% of annual rate of nitrogenous fertilizer before seeding, and 30-40% - in the form of fertilization at crop stage 6-7 (figure 6; $Ж_2$, $Ж_3$). This is confirmed by results of large-spot experiments. Thus, the largest grain output yield of Kuban 3 cultivar was being formed when seeding of 7.5 million of viable seeds, and application of 25-33% of annual rate of nitrogenous fertilizer before seeding, and 67-75% in the form of fertilization at crop stages 6-7 and 8-9 (Block 4, figure 6; $К_2$, $К_3$), and Marzhan cultivar - in Block 2 (figure 6; $З_2$, $З_3$).

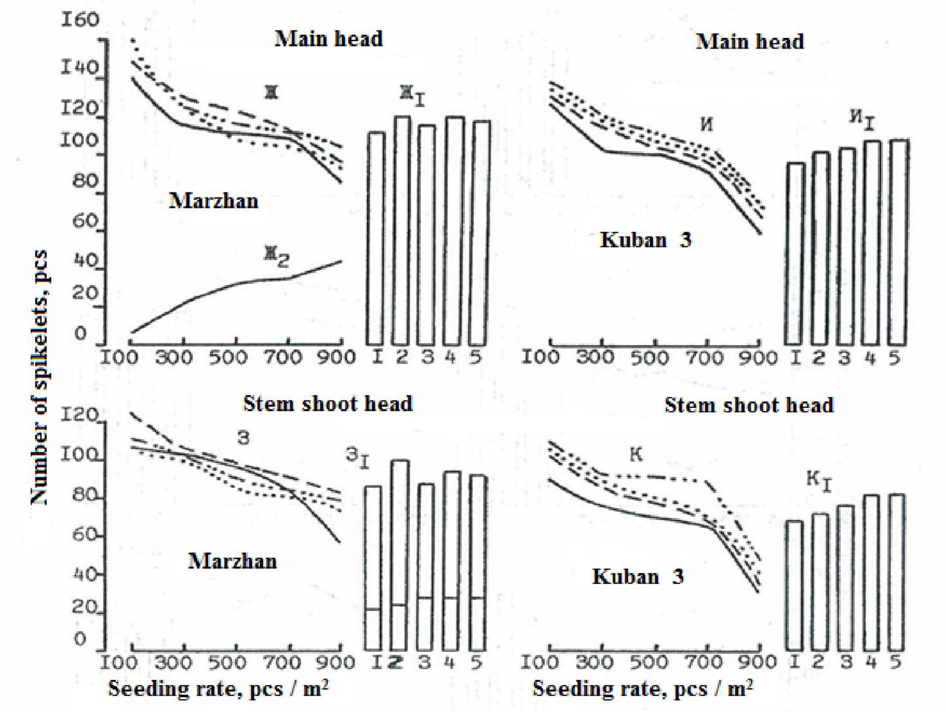

Figure 5 – Change of number of spikelets on main stem heads and stem shoots of Marzhan and Kuban 3 cultivars depending on seed application rate (Ж, З, И, К) and methods of nitrogenous fertilizer application.
Designations: ______Block 1; - - - - -Block 2; . . . . .Block 3; - . . .- . . .- Block 4;
Figures specify numbers of Blocks 1, 2, 3, 4, 5 (each block has averaged number of spikelets)

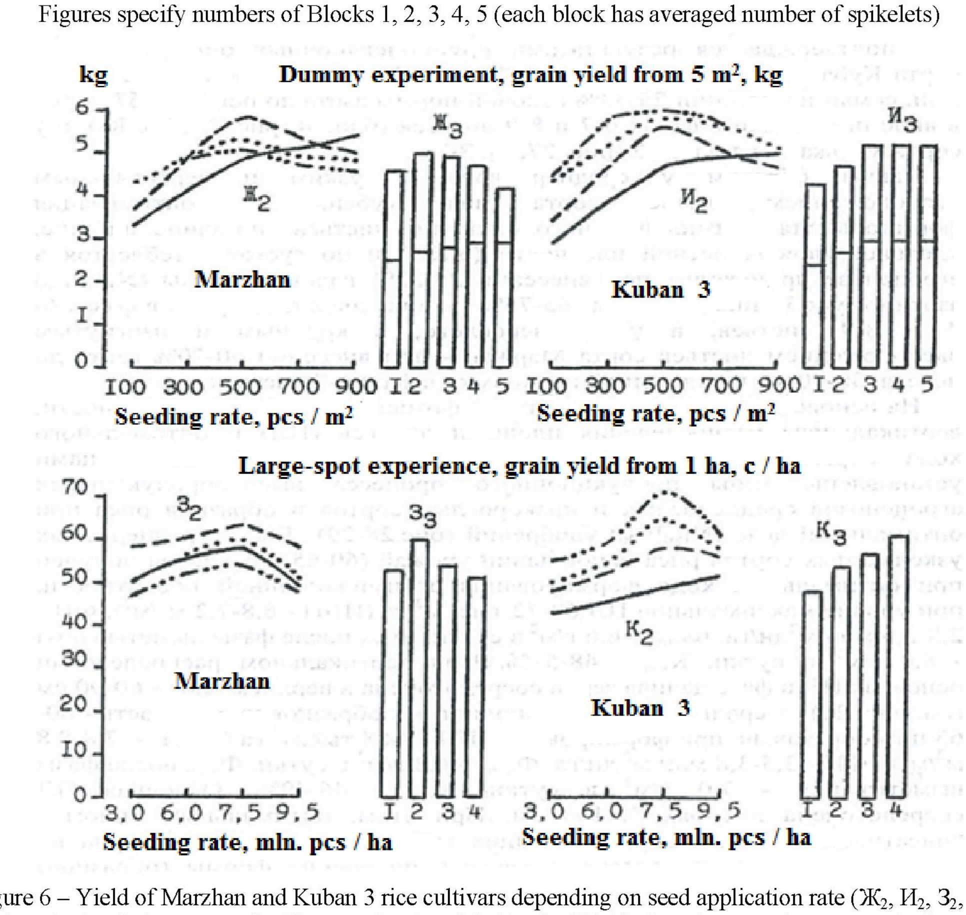

Figure 6 – Yield of Marzhan and Kuban 3 rice cultivars depending on seed application rate ($Ж_2$, $И_2$, $З_2$, $К_2$), and methods of nitrogenous fertilizer application ($Ж_3$, $И_3$, $З_3$, $К_3$) (designations are the same as in figure 5)

Thus, in medium-grown Kuban 3 rice cultivar with narrow and vertical phylotaxy, the optimization of formation of assimilative apparatus – leaves in length, width and area, as well as degree of density of yielding stem in agrocoenosis occurs upon application of 25-33% of annual rate (N180P120 kg/ha) of nitrogenous fertilizer before seeding, 65-75% - in the form of two fertilizations at crop stages 6-7 and 8-9, and in medium-grown, large-leaved Marzhan cultivar - upon application of 60-70% of nitrogen before seeding, 30-40% - in the form of single fertilization at crop stage 6-8, and when performing all technological processes in due time and qualitatively. On the basis of interconnection of photosynthetic activity indicators, vertical allocation of crop area (CA) and optimal progress of formation of assimilative apparatus - leaves, we have established types of productive process of high-producing agrocoenosis of medium-grown and low-grown cultivars, and rice exponents at optimal rate (N180P120 kg/ha) of fertilizers. Thus, the largest grain yield of medium-grown, narrow-leaved rice cultivars (65-75 c/ha) has been received at optimal progress of formation of assimilative surface at maximum level of CA - 68-72 thous. m^2/ha (LAI, - 6.8-7.2 m^2/m^2), FP - 2.8-3.5 million of m^2 days/ha, Ph.n.pr. - 6.6 g/m^2/day (average for the vegetation period), Ph.n.pr. - average after heading phase - 8.0 g/m^2/day, EEP - 48-51% (figure 7).

In case of vertical allocation, the main CA at grain filling phase is concentrated in upper layer - 60-90 cm. Yield of medium-grown large-leaved cultivars and rice exponents equal to 62-73 kg/ha has been established in the course of formation of CA 78-88 thousand of m^2/ha (LAI, 7.8 - 8.8 m^2/m^2), FP 3.5-3.8 million m^2days/ha upon average for the vegetation period of Ph.n.pr. - 6.3 g/m^2/day, Ph.n.pr. after heading phase - 7.0 g/m^2/day, EEP - 46-49%. The main CA is concentrated in layers 50-100 cm (figure 7).

In case of application of heavy rate (N240R 180 kg/ha) of fertilizers for rice seedings of Kuban 3 cultivator, vast crop area is formed (CA) - 82.0-86.8 thousand of m^2/ha, and for seedings of Krasnodar-skiy 424, Marzhan, Aral 202 cultivars - level of CA reaches 90.8 thousand of m^2/ha, photosynthetic potential (PP) - 3.85-4.02 million of m^2 days/ha, however, net productivity of photosynthesis (Ph.n.pr. g/m^2/day) decreases. In such agrocoenosis, leaves of rice cultivars shade each other reciprocally, adverse, negative coenotic interactions increase that leads to reduction in grain yields (figure 7).

Therefore, the main cause of reduction in yields upon application of heavy rate (N240R 180 kg/ha) of fertilizers is forming of adverse agrocoenosis architectonics and decrease in net productivity of photosynthesis (Ph.n.pr, g/m^2/day). In such agrocoenosis, leaf area index (LAI, 8-10 m^2/m^2), powerful photosynthetic potential (PP, 4.02 million of m^2days/ha) and heavy yield of biomass (Ubiol, c/ha) are formed. In the above seedings, the main part of crop area (CA) in vertical direction is located in relatively low layers - 30-60 cm. In such cases, the leaves of joining rice croppers shade each other reciprocally resulting in significant reduction in intensity value and net productivity of photosynthesis that leads to a decrease in synthesis of organic substances (assimilates) by these leaves. In addition, upon application of heavy rate (N240P180 kg/ha) of fertilizers, at seedings rice grow high (135-145 cm) and lodge earlier at grain filling phase resulting in increasing of number of feeble and fistular grains. In such cases, huge total biomass is formed but grain yield and its quality decrease.

High productiveness of agrocoenosis of rice cultivars is connected to a certain extent with vertically location of leaves, and in spacing. *Inconditions of the Kazakh PreAral, location of main crop area in 60-90 cm layers of medium-grown cultivars is positive, as it improves agrocoenosis architectonics. Such seedings absorb more photosynthetic active radiation (PAR), grain yield and its quality increase shortly. Interconnections of photosynthetic activity indicators of rice cultivars improve varying in height, architectonics and early ripening (figure 7).*

Study results show (figure 7) that net productivity of photosynthesis (Ph.n.pr., g/m^2/day) of rice croppers is a complex integrated physiological process. Therefore, Ph.n.pr. has complex functional interdependence with leaf area index (LAI, m^2/m^2), photosynthetic potential (PP, million of m^2 days/ha), growth and development of rice croppers during vegetation period, huge total biomass formation (Ubiol). These indicators and processes are subject to significant impact of environmental (temperature, soil conditions, its salinity, salinity of agricultural and underground water) and technological and agri-environmental (land-clearing, rates, methods, time of fertilizer application, spacing and degree of density of croppers in seedings, etc.) factors. With a favorable agricultural background (application of N160-180P120 kg/ha of fertilizers), optimum level of crop area (CA, thousand of m^2/ha), photosynthetic potential (PP, mln. of m^2 days/ha) and total biomass (Ubiol) are formed. In such circumstances, high level of net productivity of photosynthesis (Ph.n.pr., g/m^2 day) contributes to a shortly increase in grain yield and its quality improvement (figure 7).

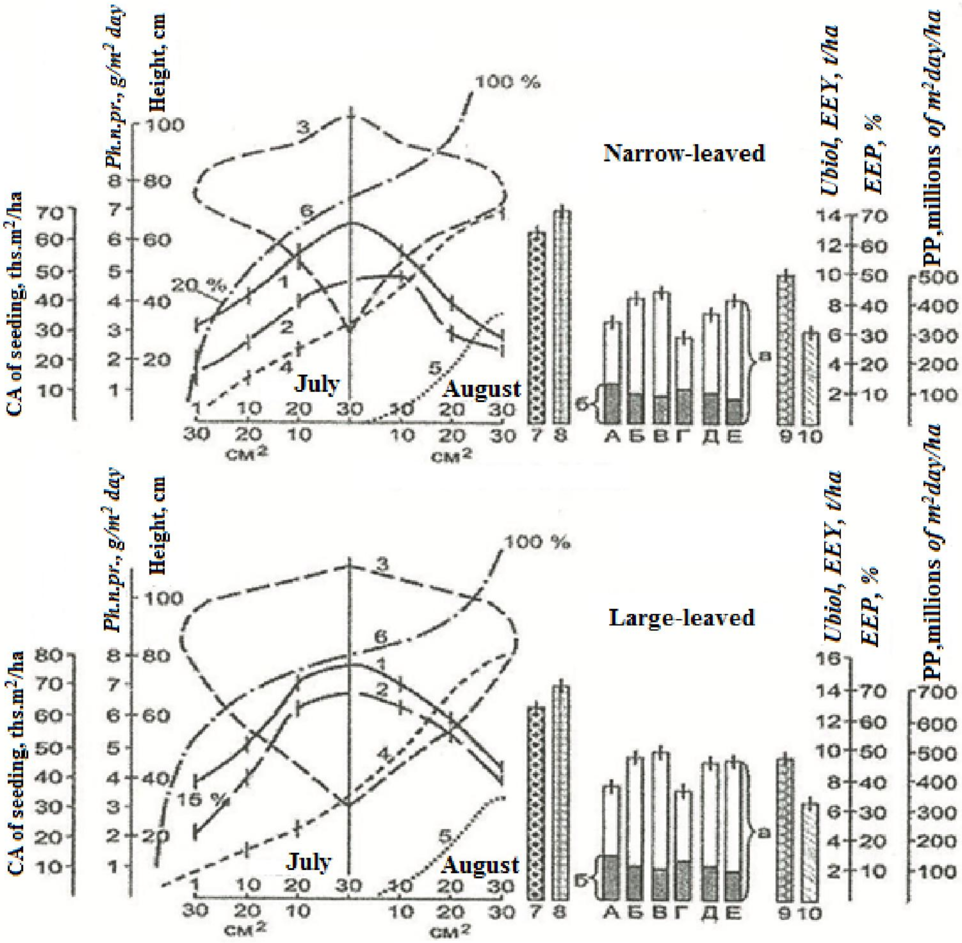

Figure 7 – Typesofphotosyntheticactivityofmedium-grown narrow-leaved and large-leaved rice cultivars at high-producing agrocoenosis and optimal rate of mineral fertilizers.

Designations: 1 - intensity value of crop area formation (CA, thousands of m^2/ha); 2 - intensity value of photosynthetic potential formation (PP, thousand of m^2days/ha); 3 - location of crop area in height at grain filling stage (CA, cm^2); 4 - formation of biomass (Ubiol, t/ha); 5 - grain yield formation (EEY, t/ha); 6 - change of lighting intensity inside the seeding; 7 - average net productivity of photosynthesis for the vegetation period (Ph.n.pr., g/m^2/day); 8 - average Ph.n.pr. after heading phase (Ph.n.pr., g/m^2/day); 9 - economical effectiveness of photosynthesis (EEP,%): 10 - grain yield, t/ha.;

А, Б, В – length (cm), width (mm) of the flag, length (a, cm), width (b, mm) of the 2nd and 3rd main stem leaves;

Г, Д, Е – length (a, cm), width (b, mm) of the flag, length (a, cm), width (b, mm) of the 2nd and 3rd stem shoot leaves

To improve grain yield of rice cultivars, it is necessary to increase net productivity of photosynthesis (Ph.n.pr., g/m^2 day). Study results show [2, 3] that at high-producing agrocoenosis, and in case of application of N120R120 kg / ha fertilizer rate at seedings of Kuban 3, Aru, Marzhan, Aral 202, Togusken 1 rice cultivars, level of average Ph.n.pr. (g/m^2 day) for the vegetation period does not decrease that contributed to formation of a sufficiently heavy grain yield (e.g., at seedings of Kuban 3 cultivar, 58.1 c/ha of grain has been obtained, Marzhan - 53.4-61.5 c/ha, Aral 202-50.1 c/ha,- Togusken 1-52.6 c/ha). Therefore, **the first effect** of grain yield increasing has been noted in case of N120P120 kg/ha rate of fertilizer application, as no adverse coenotic interinfluences in agrocoenosis have been observed, level of Ph.n.pr. indicator is high, and they do not come into conflict with CA, PP, total biomass (Ubiol) indicators.

At high-producing agrocoenosis and in case of N180P120 kg / ha rate of fertilizer application at seedings of Kuban 3, Aru cultivars, and in case of application of N160-180P120 kg/ha at seedings of Marzan, Aral 202, Togusken 1, negative coenotic interinfluences are increased. Nevertheless, level of net productivity of photosynthesis (Ph.n.pr., g/m^2/day) has been turned out to be sufficiently high (not lower than 6.5 g/m^2/day), as great amount of photosynthetically active radiation had impact on agrocoenosis (PAR) - 2.5-3.2 billion of kcal/ha. Due to better architectonics of high-producing agrocoenosis of mentioned cultivars, 80-90% of PAR are absorbed by seedings resulting in heavy yield formation (Kuban 3 cultivar - 78.0 c/ha, Marzhan cultivar - 70.1-72.8 c/ha). This is the **second effect** of heavy yield formation in case of application of optimal (N150-180R 120 kg/ha) rate of fertilizers (figure 7).

At densedagrocoenosis (seeding of 900 pcs/m^2 of seeds), and when application of heavy rate (N240P180 kg/ha) of fertilizer, high CA, PP and total biomass (Ubiol) are formed in cultivars above mentioned, but this has led to a decrease in net productivity of photosynthesis (Ph.n.pr., g/m^2 day), coefficient of economical efficiency of photosynthesis (EEP, %). At such seedings, rice croppers grew high (135-145 cm), however, the main part of crop area (CA) was located in vertical direction relatively lower than 30-50 cm layers, and leaves were shaded reciprocally, and adverse coenotic interinfluences increased. As a consequence of this, although huge total biomass was formed but grain yield decreased.

Under production conditions, formation of high-producing agrocoenosis and CA, PP, total biomass (Ubiol), Ph.n.pr. and EEP relative to these seedings of medium-grown narrow-leaved Kuban 3, Krasnodarskiy 424, Aru cultivars with vertical phylotaxy has been obtained in case of seeding of 7.5 million of viable grains (250 kg/ha), and in case of N180R 120 kg/ha rate of fertilizer application.

Under production conditions, formation of high-producing agrocoenosis and photosynthetic activity indicators relative to these seedings of medium-grown large-leaved Marzhan, Togusken 1, Aral 202 cultivars has been obtained in case of seeding of 7.5 million of viable grains (280 kg/ha), and in case of N160-180P120 kg / ha rate of fertilizer application.

So, *optimum morphotype of croppers forming maximum grain yield at high-yielding seedings has turned out to be obtaining of type (exponents) of rice with relatively large flag, with longer 2nd, 3rd and 4th leaves, relatively short the 5th leaves. Orientation of leaves in spacing: flag - horizontal after heading phase, the 2nd and 3rd leaves - vertical, the 4th and the 5th leaves - with increasing angle of deflection (figure 7). This is the optimal type of production process of agrocoenosis of medium-grown narrow-leaved and large-leaved cultivars and exponents of rice in Kazakhstan PreAral conditions conducive to formation of the heaviest grain yield.*

According to the results of experimental studies, the following conclusions have been formed:

1. In case of application of optimum (N180P120 kg/ha) rate of fertilizers at high-yielding seedings, low-grown, short and narrow-leaved cultivators, and medium-grown but early ripening rice exponents formed relatively smaller crop area (CA, thousand of m^2/ha), photosynthetic potential (PP, million of m^2 days/ha), total biomass (Ubiol, c/ha). Therefore, when application of heavy (N240P120-180 kg/ha) rate of fertilizers, CA, PP, Ubiol indicators of above mentioned cultivars and rice exponents increased resulting in formation of the heaviest grain yield.

2. When application of optimal (N160-180P120 kg/ha) rate at high-producing agrocoenosis, medium-grown cultivars (Kuban 3, Krasnodarskiy 424, Marzhan, Aral 202, Togusken 1) formed the heaviest grain yield, and when application of heavy (N240P120-180 kg/ha) rate, grain yields decreased.

3. At high-yielding seedings, and when application of optimal (N160-180P120 kg/ha) rate of fertilizers, medium-grown cultivars formed large CA, PP and Ubiol, and net productivity value of photosynthesis (Ph.n.pr., g/m^2/day) did not decrease but was at relatively high level. This had an impact on formation of heavier grain yield of medium-grown cultivars (Kuban 3, Krasnodarskiy 424, Marzhan, Aral 202, Togusken 1) compared to tiny, low-grown and medium-grown but early-ripening cultivars and rice exponents. In making an assessment of rice cultivars in breeding nursery, relatively high level of Ph.n.pr. in process of formation of larger CA, PP and Ubiol is positive event, i.e. refers to good indicators.

4. In case of application of increasing rates of mineral amendments, in particular of nitrogen fertilizers in medium-grown cultivars, ***the first effect*** of increasing of grain yield enhancement has been observed at a rate of N120P90-120 kg/ha of rate of application. In the circumstances, in agrocoenosis of medium-grown ricecultivars cenotic mutual influence has not been conductive to reduction of net photosynthesis of photosynthesis (Ph.n.pr., g/m^2 per day).

5. At high-yielding seedings, in case of optimal (N160-180P120 kg/ha) rate application, large CA, PP, Ubiol are formed in medium-grown cultivators, however, level of net productivity of photosynthesis (Pn.n.pr., g/m^2day), in particular after heading phase, did not decrease. This effected the formation of high crop yield of grain (72-78 c/ha) that is ***the second effect*** of increasing of grain yield enhancement of rice cultivars.

Ғ. Ж. Медеуова

Қазақ мемлекеттік қыздар педагогикалық университеті, Алматы, Қазақстан

АЗОТ ТЫҢАЙТҚЫШЫН ЕНГІЗУ ТӘСІЛДЕРІНЕ ЖӘНЕ ТҰҚЫМ СЕБУ НОРМАСЫНА БАЙЛАНЫСТЫ КҮРІШ СОРТТАРЫНЫҢ ФОТОСИНТЕТИКАЛЫҚ ҚЫЗМЕТІНІҢ ОПТИМИЗАЦИЯЛАНУЫ ЖӘНЕ ДӘН ӨНІМІНІҢ ҚАЛЫПТАСУЫ

Аннотация. Әртүрлі дозадағы минеральды, әсіресе азот тыңайтқыштарын енгізу тәсілдеріне байланысты дән өнімі артуының **бірінші эффекті** азот тыңайтқышын N120P90-120 кг/га мөлшерінде берілгенде байқалады. Мұндай жағдайда орта бойлы күріш сорттары агроценозында ценотикалық өзара әсерлесу Фотосинтездің таза өнімділігін (Фт.ө., г/м^{2}тәулік) төмендетпейді. Жоғары өнімді егістерде минеральды тыңайтқыштардың оптимальды дозасын (N160-180P120 кг/га) енгізгенде орта бойлы сорттар жоғары деңгейде жапырақ алаңы (ЖА, мың м^2/га), фотосинтетикалық потенциал (ФП, млн. м^{2}тәулік/га), биомасса (Өбиол) қалыптастырады. Бірақ, фотосинтездің таза өнімділігінің (Фт.ө., г/м^{2}тәулік) орташа деңгейі және масақтану фазасынан кейінгі орташа мөлшері төмендемейді. Бұл өте жоғары дән өнімінің (72-78 ц/га) құралуына әсер етті, және бұл жоғары дән өнімі қалыптасуының **екінші эффекті.** Орта бойлы, тік жапырақты Кубань 3, Краснодарский 424, Ару сорттарының жоғары өнімді егістігіне азот тыңайтқышының жылдық нормасының 25-33%-ын себу алдында, 67-75%-ын екі рет: 6-7 және 8-9 жапырақты кезеңде үстеме қоректендіру ретінде берілгенде ең жоғары дән өнімі алынды. Ірі жапырақты Маржан, Арал 202, Түгіскен сорттарының жоғары өнімді егісіне азот тыңайтқышының жылдық нормасының 60-70%-ын себу алдында, 30-40%-ын үстеме қоректендіру ретінде 6-7 жапырақты кезеңде берілгенде ең жоғары өнім алынды.

Түйін сөздер: күріш, сорттар, минеральды тыңайтқыштарды енгізу тәсілдері, фотосинтетикалық қызметін оңтайландыру, жапырақтардың оптимальды мөлшерінің және ең жоғары дін өнімінің қалыптасуы.

Г. Ж. Медеуова

Казахский государственный женский педагогический университет, Алматы, Казахстан

ОПТИМИЗАЦИЯ ФОТОСИНТЕТИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ И ФОРМИРОВАНИЕ ВЫСОКОЙ УРОЖАЙНОСТИ СОРТОВ РИСА В ЗАВИСИМОСТИ ОТ СПОСОБОВ ВНЕСЕНИЯ АЗОТНЫХ УДОБРЕНИЙ И НОРМЫ ВЫСЕВА СЕМЯН

Аннотация. При внесений возрастающих доз минеральных, особенно азотных удобрений у среднерослых сортов ***первый эффект*** повышения урожайности зерна наблюдалось при дозе N120P90-120 кг/га д.в. В этих условиях в агроценозах среднерослых сортов риса ценотическое взаимовлияние не способствовало снижению чистой продуктивности фотосинтез (Фч.пр., г/м^{2}сутки). На высокопродуктивных посевах при внесении оптимальной дозы (N160-180P120 кг/га) удобрений у среднерослых сортов формируются большая ПЛ,ФП, Убиол. Однако уровень средней чистой продуктивности фотосинтеза (Фч.пр., г/м^{2}сут.), особенно после фазы выметывания не снижалось. Это оказало влияние на формирование высокой урожайности зерна (72-78 ц/га), что является ***вторым эффектом*** повышения урожайности зерна у сортов риса. На высокопродуктивных посевах узколистных, с вертикальным расположением листьев сортов Кубань 3, Краснодарский 424, Ару наибольшая урожайность получено при внесений 25-33% годовой нормы азотных удобрений до посева и 67-75% в виде двух подкормок в фазах 6-7 и 8-9 листьев. На посевах крупнолистного сорта Маржан, Арал 202, Тогускен 1 наибольший урожай зерна сформировано при внесении 60-70% годовой нормы азотного удобрения до посева и внесении остальных – 30-40% в виде подкормки в фазе 6-7 листьев.

Ключевые слова: рис, сорта, способы внесения минеральных удобрений, оптимизация фотосинтетической деятельности, формирование оптимальной площади листьев и наибольщей урожайности зерна.

Information about author:

Medeuova Galiya Jumakanovna, Candidate of Agricultural Sciences, Acting Professor; Kazakh state women's pedagogical university, Almaty, Kazakhstan; medeuova.galiya96gmail.com

REFERENCES

[1] Hill J.E., Mortimer A.M., Namuco O.S., Janiya J.D. 2001. Water and weed management in direct-seeded rice: Are we headed in the right direction? // In: Peng S., Hardy B., editors. Rice research for food security and poverty alleviation. Proceedings of the International Rice Research Conference, 31 March-3 April, 2000, Los Baños, Philippines. Los Baños (Philippines): International Rice Research Institute. P. 491-510.

[2] Tuong T.P., Pablico P.P., Yamauchi M., Confesor R., Moody K. Increasing water productivity and weed suppression of wet seeded rice: effect of water management and rice genotypes // J. Experimental Agriculture. 2000. 36: 1-19.

[3] Zhaylybay K.N., Medeuova G.Zh., Nurmash N.K. Rice Culnure in Kazakhstan // News of the National Acalemy of sciences of Kazakhstan. Series of Biological and Medical. 2018. Vol. 3, N 327. P. 63-71. ISSN 2224-5308 (Print). ISSN 2518-1629 (Online).

[4] Zhaylybay K.N., Medeuova G.Zh., Nurmash N.K. Rice Grain Quality Formation Depending on the Mineral Fertilizers Dosages // News of the National Acalemy of sciences of Kazakhstan. Series of Biological and Medical. 2018. Vol. 4, N 328. P. 103-111. ISSN 2224-5308 (Print). ISSN 2518-1629 (Online).

[5] Olzhabayeva A.O., Baimanov Zh.N., Daldabayeva G.T., Aldambergenova G.N., Sharmenova A.A. Improwing the efficiency of using resoureces on rice systems // News of the National academy of sciences of the Republic of Kazakhstan. Series of agricultural sciences. 2018. N 1(43). P. 9-21.

[6] Lizandr A.A., Brovtsyna V.L. Physiological role of rice stem leaves in formation and ripening of grain // Plant physiology. 1964. Vol. 11, N 3. P. 391-397.

[7] Sistem of agricultural production in Kyzylordinskaya region (Recommendations). Almaty: Bastau, 2002. 412 p.

[8] Gostenko G.P., at al. Ontogenetic changes in rice response to fertilizers // Mineral nutrition of rice. Almaty: Science, 1972. P. 12-29.

[9] Starkova A.V. at al. Physiological characteristics of the critical period in mineral nutrition of rice // Mineral nutrition in rice ontogenesis. Almaty: Science, 1982. P. 9.

[10] Ramazanova S.B. Special aspects of formation of rice productivity elements upon different times of application of nitrogenous fertilizers // Reports of All-Union Academy of Agricultural Sciences named after Lenin. 1982. N 8. P. 18-20.

[11] Aliyoshin Ye.P., Konokhova V.P., Aprod A.I. at al. Practical guide on intensive technology of rice cultivation. M., 1986. P. 25-27.

[12] Anikiev V.V., Kutuzov F.F. New method of determining of leaf area spacing of gramineous plants // Plant physiology. 1961. Vol. 8. Abs. 3. P. 375-377.

[13] Imanbayeva A.A., Belozerov I.F., Ishmuratova M.Yu. Using of computer programm «BD-PLANT-KZ» for cadastral registration of plants of the natural flora of Kazakhstan // News of the National academy of sciences of the Republic of Kazakhstan. Series of biological and medical. ISSN 2224-5308. 2019. Vol. 1, N 331. P. 32-41. https://doi.org/10.32014/2019.2518-1629.5.