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THE EFFECT OF SOME ELEMENTS OF CULTIVATION IN STUBBLE ON THE *GLYCINE MAX* PERFORMANCE

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ВЛИЯНИЕ НЕКОТОРЫХ ЭЛЕМЕНТОВ АГРОТЕХНИКИ НА ПРОДУКТИВНОСТЬ СОИ, ВЫРАЩИВАЕМОЙ ПО СТЕРНЕ

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Abstract. In the irrigation conditions of Azerbaijan, the cultivation of *Glycine max* in stubble fields after harvesting the barley crop along with spring sowing is also economically very important. Sowing in stubble fields makes it possible to obtain additional grain yield and fodder from a single area, and to use reclamation facilities efficiently. At this time, the soil is provided with organic matter for autumn planting, and at the same time salinization is prevented, soil erosion and weed control issues are fully resolved. Cultivation of stubble field crops in large farms increases the possibilities of more efficient use of labor force, irrigation networks, agricultural machinery and equipment. During the conducted research, different results were obtained regarding the effect of different irrigation regimes and fertilizer rates on soybean grain yield. The resulting productivity depended on the plant coverage factor, leaf surface area, changes in wet and dry biomass. The smallest indicator of the yield was 10.0 centners in the variant with soil moisture of 60% before irrigation, and the highest indicator was 25.8 cwt/ha in the variant of the fertilizer rate calculated when the soil moisture was 80%, which is the same as the yield obtained from the autumn sowing of barley of the previous year (39 cwt/ha) together, it is equal to the yield of 67.9 cwt/ha from 1 hectare of land in one year.

Аннотация. В ирригационных условиях Азербайджана возделывание сои на стерневых полях после уборки урожая ячменя наряду с весенним посевом также имеет большое хозяйственное значение. Посев по стерне позволяет получить с площади дополнительный урожай зерна и кормов, эффективно использовать мелиоративные средства. В это время почва обеспечена органикой для осенних посевов, при этом предотвращается засоление, полностью решаются вопросы эрозии почвы и борьбы с сорняками. Возделывание

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сельскохозяйственных культур на стерне в крупных хозяйствах увеличивает возможности более эффективного использования рабочей силы, оросительных сетей, сельскохозяйственных машин и оборудования. В ходе проведенных исследований были получены разные результаты относительно влияния различных режимов орошения и норм удобрений на урожайность зерна сои. Полученная продуктивность зависела от коэффициента покрытия растений, площади листовой поверхности, изменения влажной и сухой биомассы. Наименьший показатель урожайности составил 10,0 ц в варианте с влажностью почвы 60% перед поливом, а наибольший показатель 25,8 ц/га в варианте нормы удобрения, рассчитанной при влажности почвы 80%, что соответствует как урожай, полученный от осеннего посева ячменя предыдущего года (39 ц/га), что в совокупности означает урожайность 67,9 ц/га с 1 га земли в год.

Keywords: diversification, moisture content, fertilizers, soil water regimes, crop performance.

Ключевые слова: диверсификация, влагоемкость, удобрения, водный режим почвы, продуктивность культур.

Recently, more attention has been paid to the cultivation of soybeans in Azerbaijan. Soybean is a valuable plant that is used in many ways. Its grain contains 35-45% protein, 17-26% fat and 17.3-27% hydrocarbons. It is rich in useful minerals.

One of the most important issues is the development of animal husbandry, which is one of the important fields of agriculture, and the elimination of protein deficiency in providing it with fodder. Its green mass and stubble are widely used in fodder. 100 kg of soybean grass contains 47-54 feed units, including 11.4-15.0 kg of digestible protein [1]. 85-90% of the beans are converted into feed and vegetable oil. The fodder is used entirely for animal feed. The specific weight of soybean in livestock nutrition is 18-20%, the value weight is 53-58%. In poultry farming, these indicators are 32-35% and 48-53%, respectively. For this purpose, in order to increase the productivity of the soybean plant, cultivation technologies should be improved, taking into account its biological characteristics [1, 8, 9].

In Azerbaijan, the temperature required for the cultivation of soybeans and obtaining a high grain and green mass products is 1700-3200°C. The optimum temperature for seed germination should be 20-22°C. Heat demand is greater during flowering and bean formation.

Along with spring sowings of soybean, it is also economically very profitable to cultivate soybeans in stubble-field after harvesting barley. In irrigated lands, the sowing carried out in stubble-field makes it possible to obtain additional grain and fodder from a single area, and to use land-reclamation objects efficiently. At this time, the soil is supplied with organic matter, its salinization is prevented, and the problems of wind erosion and weed control are completely solved.

Cultivation of crops carried out in stubble-field on large farms increases the possibility of more efficient use of labor force, irrigation water, irrigation networks, agricultural machinery and equipment. Also, it is necessary to mention the role of soybean in fodder production. Soybean fully provides the feed with protein in animal husbandry. Therefore, in order to effectively use irrigated land and strengthen the fodder base in the regions, it is considered very useful to cultivate soybeans in the field. Meteorological conditions during the growing season are more favorable for soybean that is cultivated in stubble-field than for spring planting [4].

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Material and methods

Taking into account the above, it is of great interest to study the effect of irrigation regimes and mineral fertilizers on the development and productivity of soybeans cultivated in stubble-field after harvesting barley under the irrigation conditions of Absheron. Such an experiment was carried out in the irrigation conditions of Absheron, and vegetation irrigation was carried out when the soil moisture in its calculation layer (0-60 cm, irrigation with furrow) was as much as 60%, 70% and 80% of the minimum moisture capacity [2, 5].

The soils of the experimental area belong to the gray-brown soil type and are medium and light loam according to their mechanical composition. Nutrient availability is very low. The content of total phosphorus, humus and total nitrogen is higher in the 0-20 cm layer than in the lower layers. The amount of humus in the plow layer is 1.30-1.33%, total nitrogen is 0.088-0.98%. The amount of volume mass in the 0-60 cm soil layer is 1.34 g/cm^3, the minimum moisture content in the soil is 15.1% by dry weight. The soils of the experimental area have medium permeability [1, 7].

From the agrochemical and agrophysical indicators, it is seen that the studied Absheron soils are soils of poor and medium fertility. Taking these into account, the recommended nutrient fertilizer rates were $N_{60}P_{60}K_{60}$, and $N_{90}P_{120}K_{85}$ in the nutrient background calculated for 30 cwt/ha.

Results and their discussion

Optimal water regime and optimal mineral nutrients alone do not guarantee maximum yield. In order to obtain a high yield from soybeans, it is also necessary to create optimal leaf surface and optimal radiation regimes [2, 4]. The optimal leaf surface is such a leaf surface that at which plants are fully supplied with gas exchange. According to various researchers, the optimal leaf surface of agricultural plants, including soybean, varies between 2-7 m^2 [3-6].

The leaf surface (size) and the dynamics of its formation vary widely depending on external factors (water regime, amount of mineral nutrients, FAR etc.) and cultivation conditions [7]. At the beginning of vegetation — in the branching stage, the formation of the leaf surface is getting slow, which is related to the development of the soybean root system. At this stage, the formation of the leaf surface is 15-20% of the maximum amount during the vegetation period. Later, the growth of the leaf surface intensifies, at the flowering stage it is 45-65% of its maximum amount during the vegetation period [3, 5].

Table 1

CHANGES IN THE DEVELOPMENT STAGES OF THE LEAF SURFACE OF THE SOYBEAN PLANT GROWN IN THE STUBBLE-FIELD DEPENDING ON THE IRRIGATION REGIMES AND FERTILIZER RATES, THOUSAND m^2/ha

Irrigation regimes according to fertilizer rates, %		*Development stage of plants*			
fertilizer rate	*irrigation regime*	*branching*	*flowering*	*bean formation*	*ripening of the grain*
The recommended ($N_{60}P_{60}K_{60}$)	60	10.3	28.0	32.5	27.1
	70	12	38.0	43.1	38.7
	80	15.3	49.2	52.7	48.7
The calculated ($N_{90}P_{120}K_{85}$)	60	10.5	33.9	38.1	32.9
	70	13.1	45.9	52.3	48.0
	80	16.0	61.1	67.3	63.8

The leaf surface area per hectare was less in the variant with the given fertilizer rates and minimum soil moisture content of 60% compared to the variant with the minimum soil moisture content of 80%. According to the average indicators, in the mentioned variant (the variant with the

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calculated fertilizer norm and minimum moisture content of 80% in the soil), the leaf surface area is 67.3 thousand m^2/ha (Table 1).

The formation of the assimilation apparatus ends at the stage of bean formation in the variant with the recommended fertilizer rates and the minimum moisture content of 60% in soybean grown in the stubble-field. In the variant of the calculated fertilizer rates, the growth of the leaf surface area was observed from the stage of bean formation to the middle of the stage of grain ripening (Figure). Wet and dry biological mass also changed due to changes in leaf surface area depending on fertilizer rates and irrigation regimes. In a number of studies, a directly proportional change of biomass depending on the leaf surface area in crops is noted. B.P. Bedenko notes that as the leaf surface grows, the yield of plants does not always increase; it increases up to a certain limit, and then the growth stops completely [6].

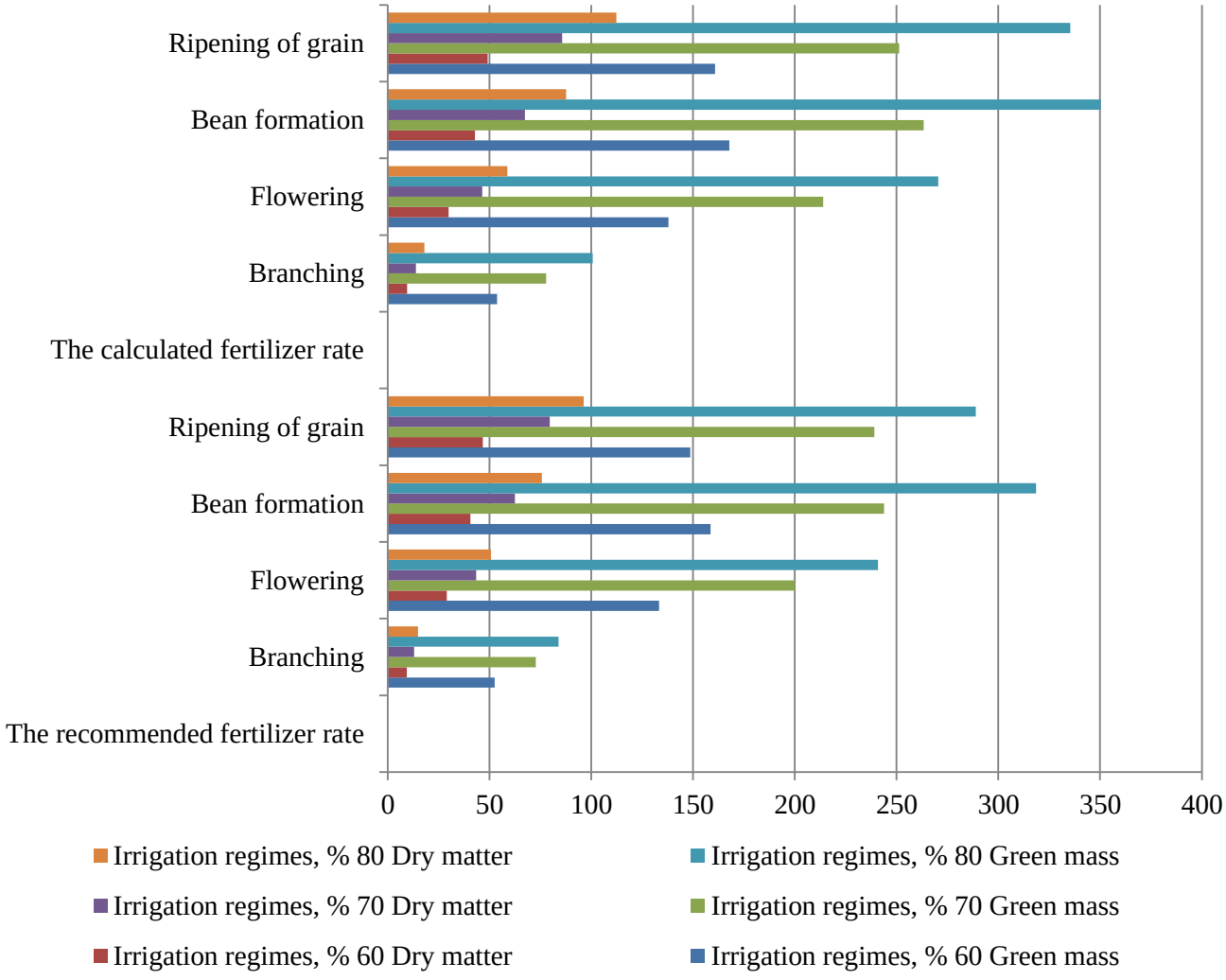

Figure. Dynamics of accumulation of green mass and dry matter, cwt/ha

The results of the study show that the amount of dry matter collected in soybeans grown in the stubble-field can be much higher when optimal conditions for the development of soybeans are created in Absheron. So, the soil-climate conditions of Absheron have a positive effect on the cultivation of soybeans in the stubble-field and are beneficial for the normal development of plants.

Green mass growth and dry matter accumulation indicators are given in the figure, depending on the irrigation regimes and fertilizer rates in the soybean plant. Irrigation regimes and fertilizer rates significantly affected the growth of above-ground mass of soybean plant. Before irrigation,

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when the soil moisture was 80%, the green mass of plants was 350.4 cwt/ha in the variant of the calculated fertilizer norms, and 318.6 cwt/ha in the variant of the recommended fertilizer norms. The smallest indicator was obtained when the soil moisture was 60% before irrigation. Among the options shown at the flowering stage, the variation interval of green mass accumulation of plants was 107.5-132.5 cwt/ha, depending on the fertilizer rates. The accumulation of green mass in plants ends at the stage of grain ripening. Later, the green mass decreases due to the yellowing and shedding of the leaves. The accumulation of dry matter in plants coincides with the maximum growth of the leaf surface. In all variants, the maximum amount of dry matter was recorded at the flowering stage. Up to the stage of grain ripening, dry matter was accumulated due to the increase of the total mass of plants, and then due to the ripening of grain [1, 4].

The study of daily growth dynamics of dry matter in ontogenesis is also of great importance in the formation of soybean plant. The characteristics of the daily growth of dry matter and its dynamics during ontogenesis depend not only on the developmental stages of plants but also on environmental factors, including soil fertility, water supply, temperature, sowing density, mineral nutrition, etc. The daily increase of dry matter in the flowering stage, depending on the fertilizer rates, is 0.40-0.53 g/day when the soil moisture is as much as 60% of the minimum moisture capacity before irrigation; when it is 70%, it is 0.67-0.90 g/day; and when it is 80%, it is 0.93-1.36 g/day. The daily increase of dry matter in the stage of bean formation was less than the increase in the flowering stage. Before irrigation, the daily increase of dry matter was 0.26-0.50 g in the variant with the minimum moisture capacity from 60% to 80% and the recommended fertilizer rate, and 0.29-0.67 g when increasing the fertilizer rate. More dry matter was obtained at the stage of full ripening of the grain.

From the above, it can be seen that the green mass and dry matter of the soybean cultivated in the stubble-field were more accumulated in all irrigation regimes in the variant of the calculated fertilizer norms than in the recommended variant. The amount of green mass and dry matter with the same fertilizer rates was higher in the variant with the minimum moisture capacity of 80% in the soil before irrigation. The effects of different irrigation regimes and fertilizer rates on soybean grain yield were also different. Thus, the obtained productivity depended on the leaf surface area and the change of wet and dry biomass. The smallest indicator of the yield before irrigation was 10 cents in the variant with soil moisture of 60%, and the highest indicator, when the soil moisture was 80%, was 28.9 cwt/ha in the variant of the calculated fertilizer rate and 25.8 cwt/ha in the variant of the recommended fertilizer rate. The research and investigation of economic efficiency indicators in soybean cultivation is also of great importance (Table 2).

Table 2

ECONOMIC INDICATORS OF SOYBEAN CULTIVATED IN STUBBLE-FIELD

Irrigation regimes according to fertilizer rates, %		*Productivity, c/ha*	*Gross income, manat*	*Expenses incurred, manat*	*Net income, manat*	*Cost of 1 centner of product, manat*	*Profitability, %*
Fertilizer rates	*Irrigation regime*						
The recommended ($N_{60}P_{60}K_{60}$)	60	10.0	400	253.13	146.87	25.31	58.02
	70	20.8	832	268.63	563.37	12.91	209.72
	80	25.8	1032	287.23	744.77	11.13	259.29
The calculated ($N_{90}P_{120}K_{85}$)	60	10.9	436	265.85	170.15	24.39	64.00
	70	22.8	912	281.35	630.65	12.34	224.15
	80	28.9	1156	299.95	856.05	10.38	285.40

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As can be seen from the table, the research conducted by us in the variant with soil moisture from 60% to 80% of the minimum moisture capacity before irrigation, the level of profitability was economically efficient by reducing the cost of 1 centner of the product at the recommended fertilizer rate. However, the highest profitability was obtained at the calculated fertilizer rate and the variant with soil moisture of 80%. In this variant, the cost of 1 centner of soybean grain was 10.38 manats, and the level of profitability was 285.40%. With the increase of soil moisture from 60% to 70% before irrigation, depending on the fertilizer rates, the profitability of soybean grown in the stubble-field increased from 209.72% to 224.15%.

Among the variants we researched, the highest net income was obtained in the variant of calculated fertilizer rate with soil moisture of 80% and was 856.05 manats per hectare.

Thus, by growing two grain crops in a year, the amount of food obtained from a single area increases significantly, and the intensity of farming per hectare of irrigated land increases. At the same time, weeding of crops reduces the cost of 1 centner of crops, the level of profitability and net income per hectare increases.

Result

It was determined that it is possible to obtain high grain and green mass from soybeans cultivated in the stubble-field of Absheron.

The amount of green mass and dry matter collected varies in direct proportion to the leaf surface area, depending on fertilizer rates and irrigation regimes.

According to the results of the conducted research, it has been proven that it is more economically efficient to obtain two crops in one year: the first — 39.0 cwt/ha from barley sown in the fall of the previous year, and the second — 28.9 cwt/ha from soybeans cultivated in the field, i.e. 67 from 1 ha of land per year, 9 cwt/ha crop was purchased.

According to the results of the conducted research, it has been proven that it is more economically efficient to buy two crops in one year: the first — 39.0 cwt/ha from barley sown in the autumn of the previous year; and the second — 28.9 cwt/ha from soybeans cultivated in the stubble-field; totally 67.9 cwt/ha crops were obtained from 1 ha per year.

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