THE YIELD AND QUALITY OF GREEN MASS OF *GLYCINE MAX* GROWN IN THE CENTRAL ZONE OF THE REPUBLIC OF MOLDOVA

ȚÎȚEI Victor

"Alexandru Ciubotaru" National Botanical Garden (Institute) of Moldova State University, Republic of Moldova, MD 2002 Chisinau, 18 Pădurii str.
Corresponding author's email: vic.titei@ gmail.com

Abstract. *Soybean, Glycine max, is considered one of the most important agricultural plants for human and animal nutrition. We investigated the yield and quality indices of the green from local cultivar 'Aura' of soybean, Glycine max, cultivated under non-irrigated conditions, in the experimental plot of the Central zone, Republic of Moldova. The results revealed that the soybean green mass yield was 3.83 kg/m^2 or 1.07 kg/m^2 dry matter. The biochemical composition and forage value of the dry matter were as follows: 17.5% CP, 8.6% ash, 31.0% CF, 33.2% ADF, 52.0% NDF, 6.1 % ADL, 9.1% TSS, 27.1% Cel, 18.8% HC, 630 g/kg DDM, RFV= 113, 12.41 MJ/kg DE, 10.19 MJ/kg ME and 6.21 MJ/kg NEl. These findings suggest that the local cultivar 'Aura' of soybean (Glycine max) may be cultivated as forage crops and the harvested biomass may be used as a part of diverse livestock diets.*

Keywords*: biochemical composition, Glycine max, forage value, green mass, local cultivar 'Aura', yield*

For the sustainable development of agriculture and the cost-effective production of meat, milk, and other animal-derived raw materials for various industries, farmers require an affordable and readily available source of forage that is rich in protein and essential nutrients to support the health and productivity of farm animals (COȘMAN et al., 2023). *Fabaceae* plants play a major role in developing sustainable agriculture, due to their symbiotic relationship with nitrogen fixing bacteria, which help improving the physical properties of soil and fertility, contribute to preventing erosion and plant root diseases, and have a positive influence on the yield and quality of the plants cultivated after them on the same land. *Fabaceae* plants are an important source of proteins – a key element of human and animal nutrition. The genus *Glycine* Willd. is one of the most important genera in *Fabaceae* family. It is divided into two subgenera: *Glycine* Willd. – with 25-30 wild perennial species and *Soja* (Moench) F.J. Herm – with 2 annual species, *Glycine max* (L.) Merr.) and *Glycine soja* Sieb. and Zucc. Soybean (*Glycine max*, syn. *Glycine hispida, Glycine angustifolia, Soja japonica*), a species native to East Asia, was first domesticated in ancient China around 1100 B.C. and was introduced to Europe by the 1700s. Soybean is considered one of the most important agricultural crops for

human and animal nutritions. Its seed is high in protein (35-42%), oil (18-23%) and other nutrients that are beneficial for human and animal health. Soybean is valued not only as a food source but also as a raw material for various industrial products, bioenergy, and forage. It serves as a reliable source of high-quality forage during late summer and autumn, particularly when other forages such as brassicas, perennial grasses, and legumes have already been harvested or are unavailable. Harvested soybean plants can be utilized as fresh biomass, hay, silage, or as a protein-rich supplement to other forages with deficient protein content (BLOUNT et al., 2013; HEUZÉ et al., 2016; BAŞARAN et al., 2017; TABACCO et al., 2017; ZANINE et al., 2020; IQBAL et al., 2021; HONG, 2022; THOMPSON et al., 2023; SUN et al., 2024; YÜCESOY & GARIPOĞLU, 2025). In Romania, Bulgaria, and the Republic of Moldova, soybean breeding and cultivation have a history spanning over 100 years. Today, all three countries are following this heritage through breeding and registering new soybean varieties well adapted to local cropping conditions (DIMA 2015). The soil and climate conditions in the Republic of Moldova, particularly in the central and northern regions, are favorable for soybean cultivation. According to data provided by the National Bureau of Statistics, between 2000 and 2024, the annual area of land sown with soybeans in Moldova ranged from 20,000 to 63,000 hectares, representing 1.5% to 4.1% of the total area cultivated with herbaceous crops. Recently, there has been a noticeable increase in farmer interest in expanding soybean cultivation. The Catalogue of Plant Varieties of the Republic of Moldova currently includes 33 registered soybean cultivars, of which 14 local cultivars are nongenetically modified organisms. The goal of this research was to evaluate the yield and quality of green mass from soybean cultivar *Glycine max* 'Aura' grown under the conditions of the Central Zone of the Republic of Moldova.

MATERIALS AND METHODS

The local cultivar 'Aura' of soybean, *Glycine max*, created at the "Selectia" Research Institute of Field Crops Bălți and cultivated in the non-irrigated experimental plot of the "Alexandru Ciubotaru" National Botanical Garden (Institute), Central zone, Republic of Moldova, served as research subjects and the traditional forage crops: alfalfa (*Medicago sativa*) and corn (*Zea mays*) were used as control variants. The experiment was conducted using a randomized complete block design with four replications. Each experimental plot measured 50 m². Soybean and corn were sown on early May. Soybean was sown at a depth of 4.0 cm, with rows spaced 45 cm apart, while corn was sown with a row spacing of 70 cm. Green

biomass was harvested manually. Soybean samples were collected at the early pod stage, corn at the kernel milk stage, and alfalfa at the third cut. The leaf-to-stem ratio was determined by separating the leaves from the stems, weighing them individually, and calculating the ratio of leaf to stem mass. The harvested plants were chopped into 1.5-2.0 cm pieces using a laboratory forage chopper. The dry matter content was determined by drying the samples at 105°C until a constant weight was achieved. For biochemical analysis, the plant samples were dried in a forced air oven at 60°C, milled in a beater mill equipped with a sieve with diameter of openings of 1 mm and some assessments of the main biochemical parameters: crude protein (CP), ash, acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), total soluble sugars (TSS) were done by near infrared spectroscopy (NIRS) technique PERTEN DA 7200. The concentration of hemicellulose (HC), cellulose (Cel), digestible dry matter (DDM), digestible energy (DE), metabolizable energy (ME), net energy for lactation (NEl) and relative feed value (RFV) were calculated according to standard procedures.

RESULTS AND DISCUSSION

Based on the analysis of biomorphological characteristics and productivity, it was observed that soybean plants of the local cultivar 'Aura' reached 107-113 cm in height at the early pod stage, producing a green biomass yield of 3.83 kg/m², with a dry matter content of 28.0% and 61.7% consisting of leaves and pods. Different results regarding the green mass productivity of soybean plant, depending on cultivars and management practices, are given in the specialized literature. SHEAFFER et al. (2001) reported that dry matter yield of forage soybeans was 9.5-10.3t/ha. KOIVISTO et al. (2003) revealed that forage soybeans cultivars are able to produce up to 12 t/ha dry matter in southern England. AÇIKGÖZ et al. (2013) found that dry matter yield of forage soybean varied from 8.25 to 15.80 t/ha. MIHAILOVIC et al. (2013) mentioned that highest soybeans cultivar yield achieved 82.4 t/ ha green forage and 18.4 t /ha of dry matter. LEE et al. (2014) found that the average fresh forage yield of cultivated soybeans was 4.4-16.3 t/ha or 0.9-4.9 t/ha dry matters, while of wild soybean were 6.1 - 9.9 t/ ha fresh forage and 1.3-2.9 t/ ha dry matters, respectively. SERBESTER et al. (2015) mentioned that forage productivity of monocrop soybean was 29.9-32.5 t/ha green forage and 5.9-7.8 t/ha dry matter. SÜRMEN & KARA (2017) found that the herbage yield in pure culture of soybean was 15.2-25.2 t/ha green mass or 5.9-6.7 t/ha hay, but in buckwheat-soybean mixture 14.3-31.0 t/ha green or 4.8-11.09 t/ha hay. THU HONG et al.

(2021) remarked that soybean foliage yield was 38.9 t/ha with 23.9% dry matter content. HOMAN et al. (2021) showed that the forage soybean in pure culture achieved 134.8 cm plant height, 32.9 t/ha biomass yield and 9.7t/ha dry matter. IQBAL et al. (2021) reported that soybean forage productivity varied from 21.0 to 28.8 t/ha herbage yield and 5.1 to 7.3 t/ha dry matter. MOSSIE et al. (2021) revealed that soybean herbage dry matter productivity varied from 6.9 to 9.7 t/ha. STERNA et al. (2023) remarked that forage productivity of studied soybean cultivars harvested in different development stages was 13.5-34.7 t/ha green forage or 3.9-11.2 t/ha dry matter. THOMPSON et al. (2023) reported that dry matter yield of studied soybean cultivars was 1294-1744 kg/ha. The biochemical composition, nutritive and energy value of the fresh mass from soybean plants is presented in Table 1. A comparative analysis of the biochemical composition revealed that soybean fresh forage had higher crude protein content (175 g/kg) as compared to the third cut of alfalfa fresh forage (141 g/kg) and corn fresh forage (84 g/kg). The concentrations of crude fiber, neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) in soybean forage were lower than those in alfalfa but higher than those in corn forage. The mineral content in soybean forage was comparable to that of alfalfa and higher than that of corn forage. The total soluble sugar (TSS) content in soybean fresh forage was higher than in alfalfa but lower than in corn forage. The hemicellulose content in soybean forage did not differ significantly from that in alfalfa but was lower than in corn. As compared to alfalfa, soybean fresh forage showed favorable values for dry matter digestibility (DMD), relative feed value (RFV), metabolizable energy (ME), and net energy for lactation (NEl), although these values were lower than those found in corn forage. Some authors mentioned various findings about the biochemical composition and nutritional value of whole plants of soybean. SHEAFFER et al. (2001) found that the forage quality of the herbage from soybean cultivars was characterized by the following indices: 12.5-16.2% CP, 44.7-54.1% NDF, 40.3-49.2% ADF. KOIVISTO et al. (2003) reported that the dry matter content and the nutrient composition of soybean cultivars harvested in October were: 177-225 g/kg DM with 10.0-15.3% CP, 38.4-45.0% NDF, 27.9-34.2% ADF, but soybean cultivars harvested in November, 194-247 g/kg DM, 12.5-16.3% CP, 65.3-82.5% NDF, 50.4-63.5% ADF, respectively.

Table 1.
The biochemical composition and nutritional value of fresh mass from *Glycine max*

Indices	*Glycine max*	*Medicago sativa* (third cut)	*Zea mays*
Crude protein, g/kg DM	175	141	84
Crude fibre, g/kg DM	310	383	248
Minerals, g/kg DM	86	90	52
Acid detergent fibre, g/kg DM	332	393	271
Neutral detergent fibre, g/kg DM	520	579	474
Acid detergent lignin, g/kg DM	61	66	48
Total soluble sugars, g/kg DM	91	69	336
Cellulose, g/kg DM	271	327	223
Hemicellulose, g/kg DM	188	186	203
Digestible dry matter, g/kg DM	630	583	678
Relative feed value	113	94	133
Digestible energy, MJ/ kg	12.41	11.57	13.28
Metabolizable energy, MJ/ kg	10.19	9.50	10.90
Net energy for lactation, MJ/ kg	6.21	5.51	6.91

UNDERSANDER et al. (2007) stated that soybean forage contained 11.4-19.5% CP, 21.4-30.0% CF, 43.8-47.5% NFE, 59.6-64.1% NDF, 39.6% ADF, 3.8-4.7% ADL, 31.5-37.2% Cel, 16.0% HC, 18.3-18.4 MJ/kg GE. DIAS et al. (2010) mentioned that the dry matter content and the nutritional quality of forage soybean was 287.7-370.5 g/kg DM, 7.00-8.77% ash, 10.9-15.4% CP, 44.6-55.50% NDF, 40.6-49.4% ADF. BOHNER et al. (2012) found that quality indices of soybean forages depending on the row spacing and growing stages were: 18.1-20.1% CP, 38.6-45.7% NDF, 28.0-30.0% ADF. ACIKGOZET al. (2013) reported that the herbage quality of soybean plants, depending on cultivars, was as follows: 16.3-16.8% CP, 36.2-36.9% NDF, 29.2-29.7% ADF, 62.6-63.6% TDN, and RFV=166.2-170.9. BLOUNT et al. (2013) reported that the dry matter content and nutrient value of soybean forage harvested mass were: 240-560 g/kg DM, 167-246 g/kg CP, 419-567 g/kg NDF, 58.2-61.4% IVDOM. LEE et al. (2014) mentioned that the forage quality of *Glycine soja* plants was 16.1-18.2% CP, 40.4-43.5% NDF, 27.5-31.7% ADF and RFV=139-158, but the forage quality of *Glycine max* 17.9-21.3% CP, 40.2-42.0% NDF, 26.1-30.0% ADF and RFV=146-161, respectively. ASEKOVA et al. (2016) found that the forage quality parameters of soybean plant were: 10.9-25.7% CP, 37.4-66.6% NDF, 22.6-38.1% ADF. HEUZE et al. (2016) remarked that the average feed value of soybean fresh mass

was: 24.0% DM, 15.7% CP, 31.2% CF, 48.1% NDF, 31.2% ADF, 5.8% lignin, 9.3% ash, 14.8 g/kg Ca, 2.7 g/kg P, 64% DOM, 18.9 MJ/kg GE, 11.6 MJ/kg DE and 9.2 MJ/kg ME. NKOSI et al. (2016) remarked that the dry matter content and the chemical composition of soybean cultivars were as follows: 268.0-333.0 g/kg DM, 16.97-17.67% CP, 40.44-45.31% aNDF, 30.44-31.29% ADF, 6.46-6.75% ADL, 6.43-7.20% WSC, 17.07-18.21 MJ/kg GE. AVRAMENKO & NAUMOVA (2018) reported that the local soybean cultivars harvested in different stages of development contained 13.2-18.9% CP, 9.3-15.4% CF, 9.19-15.08% ash. TABACCO et al. (2018) found that whole soybean plants, depending on the stage of maturity, contained 22.0-37.4% DM, 16.7-25.0% CP, 3.1-6.8% fats, 35.4-47.0% NDF, 26.7-38.3% ADF, 5.7-9.1% ADL, 3.6-7.6% WSC, 1.2-8.1% starch, 8.0-11.6% ash. PEIRETTI et al. (2018) remarked that the herbage quality of soybean plant in the vegetative stage was 185.1-190.5 g/kg DM, 14.26-14.77% ash, 25.77-30.11% CP, 45.32-50.80% NDF, 32.77-35.65% ADF, 5.80-6.47% ADL, 876.5-880.7 g/kg IVTD, 17.5-18.1 MJ/kg GE, but in the generative stage: 181.9-204.4 g/kg DM, 9.25- 10.15% ash, 15.38-22.85% CP, 45.42-66.27% NDF, 37.18-42.54% ADF, 6.95-8.12% ADL, 775.9-842.1 g/kg IVTD, 18.0-18.5 MJ/kg GE. According to NADEEM et al. (2019), the nutritional quality indicators of soybean forage were: 19.86-27.70% CP, 32.03-33.86% NDF, 25.53-28.10% ADF, 4.80-6.33% lignin, 3.4-9.7% starch, 7.73-10.53% WSC, 7.89-10.53% ash, 656.6-666.7 g/kg TDN, 1.55-1.58 Mcal/kg NEl, RFV=213.33-223.33. GUREEVA & USHAKOVA (2020) mentioned that soybean contained 14.4% CP, 7.2% ash, 20.4% CF, 43.2% NFE, 128.0 g/kg DP, and 10.2 MJ/kg ME. OMOKANYE (2020) mentioned that the dry matter from tested soybean varieties contained 11.9-16.8% CP, 29.7-40.1% NDF, 23.7-31.9% ADF, 641-700 g/kg TDN, 1.45-1.61 Mcal/kg NEl, RFV= 149-220. ZANINE et al. (2020) reported that the harvested soybean genotypes contained 44.30-54.13% stems, 28.20-48.12% leaves; 0-25.6% pods, 156.9-180.8 g/kg DM and their biochemical composition was: 14.45-16.09% CP, 8.30-14.00% ash, 48.44-59.79% NDF, 41.74-49.60% ADF, 3.18-2.64% HC. THU HONG et al. (2020) revealed that the dry matter content and the chemical composition of soybean foliage was 239g/kg DM, 91.9% OM, 15.9% CP, 27.8% ADF, 64.0% NDF. IQBAL et al. (2021) mentioned that the nutritional quality of forage soybean was 18.21-21.9% CP, 1.70-1.97% EE, 23.0- 26.2% CF and 9.3-11.2% ash. ZAEEM et al. (2021) mentioned that the forage nutritional quality of monocropping soybean was: 18.4% CP, 14.9% ash, 43.9% NDF, 35.1% ADF, 6.7% WSC, while of monocropping corn respectively 10.7% CP, 6.4% ash, 57.7% NDF,

37.3% ADF, 15.6% WSC. As a result of previous research, ŢÎŢEI (2022) established that the concentration of nutrients in the dry matter of the green mass from *Glycine max* 'Clavera' was 178 g/kg CP, 286 g/kg CF, 94 g/kg ash, 310 g/kg ADF, 484 g/kg NDF, 49 g/kg ADL, 142 g/kg TSS, 261 g/kg Cel, 174 g/kg HC, with nutritive and energy value 68.6% DMD, 63.4% DOM, RFV = 124, 12.73 MJ/kg DE, 10.48 MJ/kg ME and 6.46 MJ/kg. THOMPSON et al. (2023) mentioned that the nutritive value of soybean cultivars was: 15.9-17.4% CP, 38.4-40.4% NDF, 29.4-32.2% ADF, 2.40-2.53 Mcal/kg DE, 554-574g/kg TDN. MOSSIE et al. (2024) mentioned that the chemical composition and *in vitro* dry matter digestibility of soybean genotypes was: 14.0-21.5% CP, 34.8-51.1% NDF, 22.7-37.4% ADF, 7.5-8.2% ADL and 599.8-904 g/kg IVDMD. SUN et al. (2024) revealed that the nutritional compositions and feeding quality of studied soybean varieties were: 22.8-31.8% CP, 0.5-2.5% EE, 36.3-61.4% NDF, 21.4-38.9%ADF, RFV=94-182. TASSONE et al. (2025) reported that soybean forage contained 199.9 g/kg DM with 15.39% CP, 1.53% EE, 7.21% NFC, 66.28% NDF, 42.54% ADF, 8.13%ADL, 9.52% ash, 675 g/kg DMD and RFV=95. YÜCESOY & GARIPOĞLU (2025) mentioned that the nutrient content of soybean plant according to different varieties was as follows: 18.17-20.48% CP, 39.49-42.16% NDF, 28.54-30.56% ADF.

CONCLUSIONS

The local soybean cultivar *Glycine max* 'Aura' demonstrated an optimal fresh biomass yield and favorable forage quality, making it a suitable option for inclusion in diverse livestock feeding systems. Additionally, it may serve as an excellent forecrop for cereals and grass forage crops, contributing to improved crop rotation and sustainable agricultural practices.

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