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FORMATION OF 1000 SEED WEIGHT IN DYE-YIELDING PLANTS UNDER THE ECOLOGICAL CONDITIONS OF SURKHANDARYA AND INFLUENCING PHYSIOLOGICAL AND BIOCHEMICAL FACTORS

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Annotatsiya. Mazkur maqolada Surxondaryo ekologik sharoitida bo‘yoq beruvchi o‘simliklarda 1000 dona urug‘ vaznining shakllanishi va unga ta’sir etuvchi fiziologik hamda biokimyoviy omillar tahlil qilinadi. Tadqiqot davomida urug‘ shakllanish jarayoniga harorat, tuproq namligi, fotosintez intensivligi va o‘simlikdagi modda almashinuvi jarayonlarining ta’siri o‘rganildi. Natijalar shuni ko‘rsatdiki, optimal agroekologik sharoitlarda urug‘ vazni sezilarli darajada oshadi va bu o‘simlikning umumiy hosildorligiga bevosita ta’sir qiladi.

Kalit so‘zlar: bo‘yoq beruvchi o‘simliklar, 1000 dona urug‘ vazni, Surxondaryo viloyati, fiziologik omillar, biokimyoviy jarayonlar, fotosintez, hosildorlik.

Аннотация. В данной статье рассматривается формирование массы 1000 семян у красильных растений в экологических условиях Сурхандарьинской области и влияние физиологических и биохимических факторов. В ходе исследования изучено влияние температуры, влажности почвы, интенсивности фотосинтеза и метаболических процессов на формирование семян. Результаты показали, что при оптимальных условиях масса семян увеличивается и положительно влияет на общую урожайность растений.

Ключевые слова: красильные растения, масса 1000 семян, Сурхандарьинская область, физиологические факторы, биохимические процессы, фотосинтез, урожайность.

Abstract. This article examines the formation of 1000-seed weight in dye-yielding plants under the ecological conditions of the Surkhandarya region and analyzes the influence of physiological and biochemical factors. The study evaluates the effects of temperature, soil moisture, photosynthetic activity, and metabolic processes on seed development. The results indicate that optimal environmental conditions significantly increase seed weight and positively affect overall plant productivity.

Keywords: dye-yielding plants, 1000-seed weight, Surkhandarya region, physiological factors, biochemical processes, photosynthesis, productivity.

INTRODUCTION

In recent years, increasing attention has been given to dye-yielding plants due to their ecological value and potential use in sustainable agricultural systems. These plants are not only important as sources of natural pigments but also play a significant role in maintaining biodiversity and supporting environmentally friendly production. As noted by David Cardon[1],

[1] Cardon, D. (2007). *Natural Dyes: Sources, Tradition, Technology and Science*. London: Archetype Publications, pp. 205–215.

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natural dye plants represent an essential alternative to synthetic compounds and contribute to the development of eco-safe technologies in agriculture and industry.

Seed productivity is one of the key indicators of plant performance, and the weight of 1000 seeds is widely used as a reliable parameter for evaluating yield potential and biological efficiency. This reflects the combined influence of genetic characteristics and environmental conditions on seed formation. According to Lev Serebryakov[2], the development of reproductive organs in plants is closely linked to external ecological factors, which directly affect seed size, mass, and viability.

Under arid conditions, such as those observed in the Surkhandarya region, plant growth and seed formation are strongly influenced by temperature, soil moisture, and solar radiation. These factors determine the intensity of physiological processes, including photosynthesis, respiration, and nutrient accumulation. Hans Lambers emphasizes that plant productivity in dry regions depends on the balance between water availability and metabolic activity, which directly affects biomass formation and seed development.

In addition to environmental factors, biochemical processes within the plant play a crucial role in seed formation. The accumulation of carbohydrates, proteins, and secondary metabolites during the reproductive phase significantly influences seed weight and quality. According to Peter Taiz[3], the efficiency of photosynthesis and the transport of assimilates from leaves to developing seeds are decisive factors in determining final seed mass.

Despite the growing number of studies on plant productivity, the specific mechanisms underlying the formation of 1000-seed weight in dye-yielding plants under the ecological conditions of Surkhandarya remain insufficiently explored. Therefore, this study aims to analyze the formation of seed weight and to identify the key physiological and biochemical factors that influence this process under regional environmental conditions.

MATERIALS AND METHODS

The study was conducted under the ecological conditions of the Surkhandarya region, which is characterized by high temperatures, low precipitation, and intense solar radiation. Field experiments were carried out during the vegetation period of dye-yielding plants on experimental plots with uniform soil conditions. The soil type was classified as light sierozem with an average humus content of 1.2–1.5 percent and pH ranging from 7.2 to 7.8.

The research focused on the formation of 1000-seed weight as a key indicator of plant productivity. Seeds were collected at full maturity, cleaned, and dried to a constant weight. The weight of 1000 seeds was determined using a standard measurement method based on repeated sampling. The calculation was performed using the following formula:

$$M = \frac{m \times 1000}{n}$$

where M represents the weight of 1000 seeds in grams, m is the mass of the sample, and n is the number of seeds in the sample.

For example, if a sample of 200 seeds had a total mass of 4.2 grams, the calculated 1000-seed weight was:

[2] Serebryakov, L. N. (1962). *Plant Morphology*. Moscow: Higher School Publishing, pp. 134–145.

[3] Taiz, L., Zeiger, E., Møller, I. M., Murphy, A. (2015). *Plant Physiology and Development*. 6th ed. Sunderland: Sinauer Associates, pp. 320–340.

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$$M = \frac{4.2 \times 1000}{200} = 21 \text{ g}$$

Physiological factors influencing seed formation were evaluated through indicators such as photosynthetic activity, biomass accumulation, and moisture availability. Soil moisture was maintained at three levels: 60, 70, and 80 percent of field capacity. Moisture content was determined using the gravimetric method:

$$W = \frac{m_1 - m_2}{m_2} \times 100$$

where W represents soil moisture percentage, m_1 is the wet soil mass, and m_2 is the dry soil mass.

Biochemical parameters were assessed based on the accumulation of organic compounds in plant tissues during the reproductive stage. The content of carbohydrates and proteins in seeds was estimated using standard laboratory methods. The obtained data were analyzed using analysis of variance to determine the influence of environmental and physiological factors on seed weight. Differences between treatments were considered significant at a probability level of 0.05.

RESULTS AND DISCUSSION

The results of the study showed that the formation of 1000-seed weight in dye-yielding plants under the conditions of the Surkhandarya region significantly depended on moisture availability and physiological activity. The obtained data indicated that optimal soil moisture at 70 percent of field capacity provided the highest seed weight, while both deficit and excessive moisture negatively affected seed formation.

Table 1. Influence of soil moisture on 1000-seed weight formation

Moisture level (%)	1000-seed weight (g)	Biomass (g/plant)	Photosynthetic rate (%)
60%	18.4	42.1	72
70%	23.7	58.6	89
80%	20.2	49.3	80

The data show that increasing soil moisture from 60 percent to 70 percent resulted in a 28.8 percent increase in 1000-seed weight. However, further increase to 80 percent led to a reduction of approximately 14.8 percent compared to the optimal level. This indicates that excessive moisture reduces oxygen availability in the root zone and limits nutrient uptake.

The relationship between biomass accumulation and seed weight was also clearly observed. Plants grown under optimal conditions accumulated an average biomass of 58.6 grams per plant, which contributed to greater assimilate transport to seeds. According to physiological analysis, increased photosynthetic activity at 70 percent moisture level led to higher carbohydrate synthesis, which directly influenced seed mass formation.

Statistical analysis confirmed the reliability of the results. The variance between treatment groups was calculated as 25.6, while within-group variance was 6.4. Based on these values, the F-statistic was determined:

$$F = \frac{25.6}{6.4} = 4.0$$

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This value exceeded the critical threshold at a significance level of 0.05, confirming that soil moisture had a statistically significant effect on seed weight formation.

Biochemical analysis showed that carbohydrate content in seeds increased from 52 percent at 60 percent moisture to 68 percent at 70 percent moisture, while protein content increased from 14 percent to 18 percent. Under excessive moisture conditions, these values decreased slightly, indicating reduced metabolic efficiency.

Overall, the results demonstrate that the formation of 1000-seed weight is strongly influenced by the interaction of environmental, physiological, and biochemical factors. Optimal moisture conditions enhance photosynthesis, biomass accumulation, and nutrient transport, leading to improved seed development and higher productivity.

CONCLUSION

The study demonstrated that the formation of 1000-seed weight in dye-yielding plants under the ecological conditions of the Surkhandarya region is strongly influenced by environmental, physiological, and biochemical factors. Among the studied variables, soil moisture played a decisive role, with 70 percent of field capacity identified as the optimal level for maximizing seed weight and overall plant productivity.

It was established that optimal moisture conditions enhance photosynthetic activity, biomass accumulation, and assimilate transport to developing seeds. As a result, the 1000-seed weight increased significantly compared to both deficit and excessive moisture conditions. In contrast, insufficient water supply limited metabolic activity, while excessive moisture reduced oxygen availability in the root zone, negatively affecting nutrient uptake and seed development. Biochemical analysis confirmed that higher seed weight was associated with increased accumulation of carbohydrates and proteins during the reproductive stage. These compounds play a critical role in seed formation and directly determine seed quality and viability.

Overall, the findings indicate that the effective regulation of agroecological factors, particularly soil moisture, is essential for improving seed formation and productivity of dye-yielding plants. The results provide a scientific basis for optimizing cultivation practices in arid regions and can be used to enhance agricultural efficiency under similar environmental conditions.

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