A Study On Impact Of Physiological Parameters On Growth And Yield Performance Of Garden Pea

Ankita Thakur[1], Neha Saini[2*], Sunil Prakash[3], Mahipal Singh[4]

[1]School of Agriculture, Uttaranchal University, Dehradun 248007, Uttarakhand, India. Email: ankitathakur200818@gmail.com
[2*]School of Agriculture, Uttaranchal University, Dehradun 248007, Uttarakhand, India. Email: neha.saini783@gmail.com
[3]School of Agriculture, Uttaranchal University, Dehradun 248007, Uttarakhand, India. Email: sonymt099@gmail.com
[4]School of Agriculture, Uttaranchal University, Dehradun 248007, Uttarakhand, India Email: drsinghudr@gmail.com

[*]**Corresponding Author:** Neha Saini
neha.saini783@gmail.com

Abstract
In summary, the growth and yield performance of garden pea (Pisum sativum) is intricately shaped by a complex interplay of physiological parameters. Key factors such as sunlight intensity, duration, and quality directly impact the cornerstone process of photosynthesis, influencing biomass accumulation. Water uptake, transpiration, nutrient uptake, temperature, and hormonal regulation collectively contribute to the intricate web of elements determining the success of pea crops, especially during critical stages like flowering and pod formation. Studies on growth parameters highlight the significance of traits like pod yield, shelled percentage, and genetic variability in overall yield shaping. Correlation and path analyses further underscore the importance of specific characteristics such as pod weight per plant, number of pods per plant, and plant height in influencing crop productivity. This comprehensive understanding emphasizes the necessity for tailored management strategies encompassing irrigation practices, nutrient optimization, and varietal selection to maximize the growth and yield potential of garden pea crops.

Keywords: Photosynthesis, Transpiration, Nutrient uptake, Pisum sativum etc.

Introduction:
Plant growth and development depend on water for processes such as transpiration, photosynthesis, and respiration. The distinctive capacity of water to regulate temperatures, dissolve vital life molecules, and facilitate gas exchange is indispensable for all terrestrial life. Transpiration plays a crucial role in activities like evaporative cooling, CO2 assimilation, maintenance of plant turgor, and uptake of mineral nutrients. Photosynthesis transforms CO2 into simple carbohydrates, while respiration releases energy obtained through photosynthesis. Additionally, respiration serves as a central metabolic hub, ultimately yielding the intricate organic molecules that constitute the foundation of plants. These complex carbon compounds, derived not only from CO2 but also incorporating mineral nutrients acquired from the soil, contribute to the overall plant structure and function.
Some of physiological parameters are as follows-

Photosynthesis:
Similar to all plants, Pisum sativum, commonly known as the pea plant, operates as an autotroph, harnessing sunlight to initiate the process of photosynthesis. Alongside carbon dioxide and water, this plant synthesizes glucose while emitting oxygen as a byproduct. This ecological role of the pea plant designates it as a producer, generating energy that benefits both itself and other organisms within the ecosystem. This energy is stored in the form of the carbohydrate starch, a polysaccharide consisting of thousands of glucose molecules linked together.
Photosynthesis, the process by which plants convert sunlight into energy, is the backbone of growth. The efficiency of photosynthesis directly influences the plant's ability to produce and accumulate biomass. Factors such as sunlight intensity, duration, and quality play a crucial role

Water Uptake and Transpiration:
Water is the elixir of life for the crops. The plant's ability to absorb water and transport it to various parts is vital for growth. Pea plants alleviate the effects of low-level drought, but long-term drought causes a significant reduction in grain yield in pea. Efficient transpiration, the process by which water is released from the plant through stomata, regulates temperature and nutrient uptake. Optimal irrigation practices are essential to maintain water balance, especially during critical stages like Flowering, Branching and pod formation.
Nutrient Uptake:

Peas have the capacity to repair atmospheric nitrogen. Specific bacteria that coexist with plant roots and peas develop a symbiotic interaction. The amount of N fixed by a pea crop will be decreased by excess N fertilizer, which will also delay crop maturity, raise the risk of disease, and decrease standability. Phosphorus levels must be sufficient for maximum production and early maturity. When phosphorus is lacking, top and root growth is inhibited, resulting in spindly stems with few branches. In general, pea crops require higher potassium requirements than cereal crops—often nearly twice as much potassium as nitrogen. Only 20-25 % of the plant potassium is in seed, however. the rest is in the leaves and stems and is normally returned to the soil. And micronutrients are essential for various physiological processes. Deficiencies or imbalances in nutrient availability can lead to nutrient stress, affecting the plant's ability to reach its full potential in terms of growth and yield.

Temperature:

Changes in the morphological traits, productivity, and fluorescence emission parameters of different varieties and lines of the species Pisum sativum L. in field conditions, both at normal and high temperature values. High temperatures stressed the plants during the reproductive stage (bud development to flowering phases), which is especially important for pea plants. The climatic characteristics of the years influence the morphological performances and productivity.Understanding the temperature requirements at each stage and choosing suitable varieties adapted to local climates is crucial for maximizing productivity.

Hormonal Regulation:

Plant hormones, such as auxins, gibberellins, and cytokinins, act as growth regulators. They influence cell elongation, division, and differentiation, playing a pivotal role in shaping the plant's architecture and reproductive success. Maintaining hormonal balance is crucial for ensuring proper tillering, flowering, and grain development.

Growth parameters:

Asif et al. (2002), investigated that the various traits contributing to yield, including earliness, pod yield, shelled percentage, and fresh grain yield, were examined in both local and exotic pea genotypes. A positive correlation was identified between pod yield and shelled percentage. Subsequent assessment of the existing germplasm highlighted the identification of elite lines with desirable characteristics related to earliness and grain yield through straightforward selection methods. The classification process unveiled specific elite genotypes exhibiting unique traits, suggesting their potential inclusion in hybridization programs aimed at enhancing pea cultivation.

Ramesh et al. (2002) examined various genotypes of garden pea, which encompassed five field pea genotypes, to assess genetic variation in yield and other traits. The evaluation revealed elevated estimates of broad-sense heritability and genetic advance for plant height, internode length, node of the first fruit, and number of pods per plant. Moreover, there was a notable level of heritability coupled with moderate genetic advance for mean pod weight and reducing sugar content in the edible grain. A substantial degree of phenotypic coefficient of variation and genotypic coefficient of variation was noted for several characteristics, including the number of pods per plant, weight of pods per plant, internode length, plant height, mean pod weight, and weight of grains per pod. Conversely, the variation was comparatively lower for the remaining characters under examination.

Ramesh and Tewatia (2002) conducted an analysis of correlation and path for diverse genotypes of garden peas, exploring the relationships between various traits. Strong positive associations were observed between pod weight per plant and the number of pods per plant, as well as with the number of grains per pod, mean pod weight, pod length, plant height, and grain weight per pod. The findings indicated that the number of pods per plant exhibited the most substantial direct genotypic effect on both pod weight per plant and grain weight per pod.

Singh et al. (2003) evaluated the genetic variability, heritability, and genetic advance across various traits, including pod length, number of pods per plant, number of seeds per pod, number of branches per plant, 100 grain weight, grain yield per plant, harvest index, and protein content. Notably, the extent of variability was more pronounced for pod length and the number of pods per plant within the F1 population. In bud generations, traits such as harvest index, pod length, number of seeds per pod, protein content, and 100 grain weight exhibited high heritability coupled with low genetic advance. These traits displayed a moderate influence from non-additive gene action, underscoring the importance of considering them during the selection process for achieving higher yields in pea cultivation.

Arya et al. (2004) conducted correlation and path analyses on diverse elite genotypes of peas. Notably, grain yield exhibited a significant and positive correlation with several factors, including the number of nodes, height at which the first pod appears, overall plant height, number of branches per plant, pod length, and 100-seed weight. The path analysis unveiled that the primary yield determinants were the number of nodes, height at which the first pod appears, the number of branches per plant, and 100-seed weight, despite the direct effect on 100-seed weight being negative. The number of pods per plant emerged as the factor exerting the most substantial direct influence on seed yield, followed by the height at which the first pod appears, overall plant height, node number at which the first pod appears, and the number of branches per plant.

Seema et al. (2005) conducted an investigation to assess the extent of genetic variability in a diverse set of pea genotypes. Analysis of variance for various traits revealed significant variations among the genotypes. The wide range of variability observed for pod yield per plant and plant height, coupled with elevated estimates of phenotypic and genotypic coefficients of variation, indicated the potential responsiveness of these traits to selection. Conversely, low phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were noted for pod length. A marginal difference between PCV and GCV was observed for the node at which the first flower appears, followed by the number of grains per pod and pod width, indicating that these traits were minimally influenced by environmental factors. Traits such as the node at which the first flower appears and the number of grains per pod exhibited the highest heritability along with substantial genetic gain, suggesting an additive gene action, thereby implying that selection could effectively improve these characteristics.

Sharma and Bora (2013) explored genetic variability and heterosis in vegetable pea (Pisum sativum L.). Traits such as plant height, days to first picking, 100 green pod weight, green pod yield, and days to 50% flowering exhibited elevated values of broad-sense heritability and genetic gain. This observation suggests the importance of additive gene actions in influencing these characteristics. Consequently, a selection program focusing on these traits is anticipated to be more effective in enhancing the yield parameters of garden pea.

Arya et al. (2014) examined that the F4 population resulting from six crosses to pinpoint the ideal characteristics for pea plants by assessing seed yield components. To gauge genetic variability and phenotypic correlation, nine traits were scrutinized in randomly selected plants from each cross. The analysis anticipated a model field pea plant characterized by leafiness, increased primary branches, a higher number of pods per plant, elongated pods, larger seed size, and a greater number of seeds per pod. The study highlighted those various qualitative traits significantly influenced yield-contributing characters, indicating that favoring leafy and round-seeded plants could contribute to achieving a higher yield.

Kallo et al. (2005) evaluated that the different genotypes of the pea vegetable on the growth of plant, seed, pod, and the morphological characters. These lines underwent assessment for morphological and biochemical traits related to plant, pod, and seed characteristics. Considerable variability was noted for all traits, with the most substantial variations observed in plant height and yield per plant. The first flowering node exhibited a positive and significant correlation with both days to flower and plant height. Additionally, there was a significant and positive correlation observed between pod length and average pod weight. Utilizing Ward's clustering method, the genotypes were broadly categorized into distinct clusters based on their traits.

Singh et al. (2005) conducted an analysis on various advanced generation lines of garden pea, applying correlation and path analyses at both phenotypic and genotypic levels. The correlation analysis revealed a positive association between fruit yield per plant and the number of pods per plant, number of seeds per pod, shelling percentage, and the number of days taken from sowing to maturity. Path coefficient analysis unveiled that the number of pods per plant and shelling percentage exerted the most significant direct impact on green pod yield. Hence, these traits merit considerable attention for improvement efforts in garden pea cultivation.

CONCLUSION –

In summary, the growth and yield performance of garden pea are intricately influenced by a myriad of physiological parameters. Photosynthesis, the cornerstone of plant energy production, is directly impacted by factors like sunlight intensity, duration, and quality, significantly affecting biomass accumulation. Water uptake and transpiration, essential for nutrient transport, are critical for maintaining optimal growth and yield, particularly during crucial stages like flowering and pod formation. Nutrient uptake, temperature, and hormonal regulation further contribute to the intricate web of factors determining pea crop success.

Extensive studies on growth parameters underscore the importance of traits such as pod yield, shelled percentage, and genetic variability in shaping overall yield. The correlation and path analyses emphasize the significance of specific characteristics like pod weight per plant, number of pods per plant, and plant height in influencing pea crop productivity. This collective understanding underscores the need for comprehensive management strategies, including tailored irrigation practices, nutrient optimization, and varietal selection, to maximize the growth and yield potential of garden pea crops.

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References:

1. Asif, J., A. Ghafoor and R. Anwar. 2002. Evaluation of local and exotic pea Pisum sativum germplasm for vegetable and dry grain traits. Pak. J. Bot. 34: 419-427.
2. Arya, S., B.P.S. Malik, R. Kumar and R. Dhari. 2004. Variability, correlation and path analysis in field pea (Pisum sativum L.). Har. Agric. Univ. J. Res. 34: 149-153
3. Ramesh, C., A.S. Tewatia, and M.S. Dahiya. 2002. Genetic variability and heritability studies in garden pea (Pisum sativum L.). Har. J. Hort. Sci. 31: 250-252.
4. Ramesh, C., and A.S. Tewatia. 2002. Character association and path analysis studies in garden pea (Pisum sativum L.). Har. J. Hort. Sci. 31: 94-96.
5. Singh, G., M. Singh, V. Singh and B. Singh. 2003. Genetic variability, heritability and genetic advance in pea (Pisum sativum L.) Prog. Agri. 3: 70-73.
6. Sharma, V.K. and L. Bora. 2013. Studies on genetic variability and heterosis in vegetable pea (Pisum sativum L.) under high hills condition of Uttarakhand, India. Afr. J. Agric. Res. 8: 1891- 1895.
7. Seema, M., U.K. Kohli and D.D. Kumar. 2005. Genetic variability studies in pea (Pisum sativum L.). Har. J. Hort. Sci. 34: 140-141.

8. Kallo, G., M. Rai, J. Singh, A. Verma, K. Rajesh, G. Rai and K. Vishwanath. 2005. Morphological and biochemical variability in vegetable pea (Pisum sativum L.). Veget. Sci. 32: 19-23.
9. https://www.researchgate.net/publication/309736355_Studies_on_pea_Pisum_sativum_L_growth_and_productivity_under_agroforestry_system_2_Yield_and_seed_quality_of_pea_under_alley_cropping_system_with_two_types_of_trees
10. https://albertapulse.com/pea-fertility-requirements/#:~:text=Pea%20crops%20generally%20need%20more,normally%20returned%20to%20the%20soil.
11. https://en.wikipedia.org/wiki/Photosynthesis
12. https://doiserbia.nb.rs/Article.aspx?ID=0534-00121902417K
13. https://www.researchgate.net/profile/Ikram-Bashir/publication/333579072_Character_Association_of_Yield_Attributing_Traits_in_Pea_Pisum_sativum_L_Germplasm/links/5cf536e592851c4dd024e661/Character-Association-of-Yield-Attributing-Traits-in-Pea-Pisum-sativum-L-Germplasm.pdf
14. https://www.ck12.org/book/ck-12-understanding-biodiversity/section/10.11/