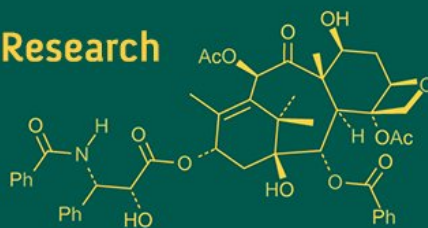


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Bhunesh Borikar
M.Sc. Ag. Horticulture
(Vegetable Science) Scholar,
Department of Horticulture,
School of Agriculture Science,
Technology & Research,
Sardar Patel University,
Balaghat, Madhya Pradesh,
India

Mohd Wamiq
Assistant Professor,
Department of Horticulture,
School of Agriculture Science,
Technology & Research,
Sardar Patel University,
Balaghat, Madhya Pradesh,
India

Prakash Ghodeswar
Assistant Professor,
Department of Horticulture,
School of Agriculture Science,
Technology & Research,
Sardar Patel University,
Balaghat, Madhya Pradesh,
India

Avadhesh Singh Choudhary
HOD, Department of
Horticulture, School of
Agriculture Science,
Technology & Research,
Sardar Patel University,
Balaghat, Madhya Pradesh,
India

Corresponding Author:
Mohd Wamiq
Assistant Professor,
Department of Horticulture,
School of Agriculture Science,
Technology & Research,
Sardar Patel University,
Balaghat, Madhya Pradesh,
India

Enhancing phosphorus levels to improve yield and quality of onions (*Allium Cepa* L.) var agrifound light red under Balaghat region

Bhunesh Borikar, Mohd Wamiq, Prakash Ghodeswar and Avadhesh Singh Choudhary

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Abstract

This investigation was conducted to assess the impact of phosphorus levels on the growth and yield of the onion variety 'Agrifound Light Red.' The study took place at the Horticulture Department's experimental fields, School of Agriculture Research and Technology, Sardar Patel University, Balaghat, Madhya Pradesh, during the Rabi season of 2023. The experiment followed a Randomized Block Design (RBD) with eight treatments, each replicated three times. The results clearly indicated that the T₅ treatment (N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha) outperformed other treatments in terms of vegetative growth, achieving a plant height of 70.22 cm at 90 days after transplanting (DAT) and 12.79 leaves per plant. It also promoted earlier maturity at 84.46 DAT and excelled in yield attributes, with an average bulb weight of 125.90 grams and a bulb yield of 23.31 t/ha. T₅ also delivered the highest net return and a favourable benefit-cost ratio of 3.63. Consequently, phosphorus application at 180 kg/ha is recommended for enhanced onion productivity and overall improvement under the conditions of Balaghat, Madhya Pradesh.

Keywords: Onion, phosphorus and benefit cost ratio, yield

Introduction

Onions are a commercially significant bulb crop valued for both their nutritional and flavour-enhancing properties, consumed widely by vegetarians and non-vegetarians alike. They possess various health benefits, functioning as stimulants, diuretics, expectorants, and antibacterial. Onions also play a role in heart health by reducing cholesterol and lipid levels, thereby preventing heart disease (Sharangi and Datta, 2005) [14]. Botanically classified as *Allium cepa* (L.), onions belong to the Amaryllidaceae family, which includes close relatives like garlic, scallions, leeks, and chives (Anonymous, 2020). Other species within the *Allium* genus, such as the tree onion (*Allium × proliferum*), the Canada onion (*Allium canadense*), and the Japanese bunching onion (*Allium fistulosum*), are also cultivated for food. Although several *Allium* species are termed "wild onions," *A. cepa* is the only species known to have been cultivated. Despite some varieties escaping cultivation and becoming established in the wild, the ancestral form of *A. cepa* remains unknown (McNeal *et al.*, 2002) [10]. Onions possess a chromosome number of 2n=16 (Firbasa and Amon, 2014) [5]. The historical lineage of onion species is poorly documented, and their geographic origin remains unclear due to ancient records in both western and eastern Asia. Nevertheless, domestication is thought to have taken place in West or Central Asia, potentially in Iran, western Pakistan, or Central Asia (Cumo, 2015) [4]. Though onions are typically cultivated as annuals and harvested in their first growing season, they are, in fact, biennial or perennial plants. Bulb development occurs when the onion plant reaches a specific day length. The plant is characterized by a fan of hollow, bluish-green leaves, with its bulbs consisting of compressed, underground stems surrounded by fleshy modified scales, or leaves. As Onion is a heavy feeder of mineral elements, nutrient management practices play an important role for good crop of onion like other crops. In the year 2021-22, Onion production in India covered an area of 5.36 million hectares, yielding a total production of 31.28 million tonnes (NHB, 2022). Maharashtra emerged as the leading state in both the area and production of onion in the year 2021-22, followed by Madhya Pradesh, Karnataka, and Gujarat. In Uttar Pradesh, the onion production

area amounted to 0.21 million hectares, resulting in a production of 5.08 million tonnes for the same year. Although onions are a temperate crop, they can be grown in a variety of climates, including tropical, subtropical, and temperate. Phosphorus is also one of the important macronutrients play a vital role in crop growth as it is involved in several key plant cellular activities like energy transfer, photosynthesis, transformation of sugars and starches and transfer of genetic characteristics from one generation to the next. It also promotes root proliferation that increases root volume and improves soil nutrient exploration. Phosphorus shortage restricted the plant growth and remains immature (Lodhi *et al.*, 2019) ^[9]. The effect of phosphorus on the formation and translocation of carbohydrates, roots development, nodulation, growth and other agronomic characters are well recognized. Phosphorus induces earliness in flowering and fruiting including seed formation. It is also evident that addition of phosphorus affects onion plant growth parameters such as number of leaves per plant, diameter of leaves- spread of plant, and plant height (Shaheen *et al.*, 2007) ^[15]. In the soils that are moderately low in phosphorus, onion growth and yield can be enhanced by applying phosphorus. Onions are more susceptible to nutrient deficiencies than most crop plants because of their shallow and unbranched root system, hence they require and often respond well to addition of fertilizer (Khokhar, 2019) ^[8]. Evaluating different levels of phosphorus for onion production is crucial because phosphorus plays a fundamental role in various plant growth processes, including root development, energy transfer, and photosynthesis. Onions, being shallow-rooted plants, rely heavily on soil phosphorus availability to ensure early root establishment and bulb formation. Insufficient phosphorus can result in poor root systems, delayed maturity, and reduced yield, while excessive phosphorus may cause nutrient imbalances and environmental concerns such as phosphorus runoff, leading to water pollution. Moreover, the optimal phosphorus requirement for onions can vary based on soil type, climatic conditions, and agricultural practices. Therefore, determining the appropriate phosphorus levels helps maximize onion growth and productivity while minimizing input costs and potential environmental impacts. It also supports sustainable agricultural practices by promoting efficient fertilizer usage and reducing waste. Phosphorus evaluation can lead to improved yield, bulb quality, and market value, making it a vital consideration for farmers aiming to achieve high productivity, profitability, and environmental stewardship in onion cultivation.

Material and Methods

The present investigation was done to understand the effect of different levels of phosphorus on plant growth and bulb yield of onion variety Agrifound Light Red. The details of the materials used, and the procedures adopted in the investigation, which was carried out at Field of Horticulture Department, School of Agriculture Research and Technology, Sardar Patel University, Balaghat, (M.P.) during the *Rabi* season of 2023. Balaghat District is located the south-eastern portion of the Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19' to 22°24' north latitude and 79°31' to 81°30' east longitude. The treatments were T₀ (Control), T₁ (RDF100% [NPK: 120:160:100 Kg/ha]), T₂ (N @ 120 kg/ha + P @ 140

kg/ha K @ 100 kg/ha each), T₃ (N @ 120 kg/ha + P @ 150 kg/ha K @ 100 kg/ha each), T₄ (N @ 120 kg/ha + P @ 170 kg/ha K @ 100 kg/ha each), T₅ (N @ 120 kg/ha + P @ 180 kg/ha K @ 100 kg/ha each), T₆ (N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each) and T₇ (N @ 120 kg/ha + P @ 200 kg/ha K @ 100 kg/ha each). The number of leaves were counted in randomly selected plants from each plot at 30, 60 and 90 days after transplanting. The average of number of leaves of each replication was recorded and subjected to statically analysis. The thickness of neck was measured in randomly selected plants from each plot at 30, 60 and 90 DAT using measuring tape. The days taken in maturing of bulb from days after transplanting was counted and recorded as days taken to maturity of bulb of onions in each replication and treatments. The yield was calculated by weighing the total bulb yield per plot. The readings for all the harvest per plot were recorded. The total bulb yield/hectare was calculated by unitary method formula given below:

$$\text{Bulb yield per hectare} = \frac{\text{Bulb Yield per plot}}{\text{Size of individual plot}} \times 10,000 \text{ m}^2$$

The percentage of total soluble solids of the fruit was determined with the help of Portable Hand Refractometer. The sample of juice for this purpose was taken from the strained juice. The observed value of T.S.S. was recorded from the scale of the instrument (0-32 range). The statistical analysis was conducted using Fisher and Yates (1967) ^[16].

Results and discussion

Plant height

Plant height in onion showed statistically significant differences present among various doses of combination applied. The maximum height of plant (36.42, 57.92 and 70.22 cm) in onion was found in treatment T₅ (N @ 120 kg/ha + P @ 180 kg/ha K @ 100 kg/ha each) observed at 30, 60 and 90 days after transplanting (DAT) respectively and was at par with T₆ (N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each) having 35.53, 55.32 and 66.39 cm respectively observed at 30, 60 and 90 days after transplanting (DAT). Minimum height of plant (23.94, 41.35 and 56.14 cm) was noted in T₀ (control) observed at 30, 60 and 90 days after transplanting (DAT) respectively. The superior plant height of onion observed under the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha can be attributed to the optimized balance of nutrients, particularly the increased phosphorus dose. Phosphorus plays a crucial role in root development, enhancing nutrient uptake efficiency, which supports better overall vegetative growth, including plant height. The elevated phosphorus level in this treatment likely promoted stronger root systems, leading to improved nitrogen and potassium absorption. Nitrogen, essential for vegetative growth, when complemented by optimal phosphorus and potassium, results in enhanced cell division and elongation, contributing to increased height. Compared to other treatments with lower phosphorus or different nutrient combinations, this specific NPK ratio creates an ideal environment for vigorous growth, surpassing the effects of the recommended dose of fertilizer (RDF) and other phosphorus levels in terms of enhancing onion plant height. Findings were in accordance with conclusions by Modak *et al.*, (2021) ^[11]; Ali *et al.*, (2022) ^[1].

Number of leaves per plant

The maximum number of leaves per plant (7.18, 9.36 and 12.79 leaves) in onion was found in treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) observed at 30, 60 and 90 days after transplanting (DAT) respectively and was at par with T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) having 6.78, 8.88 and 12.12 leaves respectively observed at 30, 60 and 90 days after transplanting (DAT). Minimum number of leaves per plant (3.61, 5.50 and 8.25 leaves) was noted in T₀ (control) observed at 30, 60 and 90 days after transplanting (DAT) respectively. The higher number of leaves per onion plant in the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha can be attributed to the enhanced nutrient availability, especially phosphorus. Phosphorus plays a vital role in cell division, root development, and energy transfer, which supports overall plant growth and vigour. The increased phosphorus level likely improved root growth, leading to better uptake of nitrogen and potassium, both essential for leaf production. Nitrogen, particularly at the 120 kg/ha rate, promotes vegetative growth by stimulating chlorophyll production and protein synthesis, which are crucial for leaf development. Potassium, meanwhile, aids in the efficient utilization of nitrogen and phosphorus. This optimal nutrient combination fosters robust plant growth, resulting in more leaves compared to treatments with lower phosphorus levels or the recommended dose of fertilizer (RDF), which may not provide the same synergistic effect on leaf proliferation. Similar findings were reported by Singh *et al.*, (2021) [16].

Neck thickness

The maximum neck thickness (2.32 and 2.75 cm) in onion was found in treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) observed at 60 and 90 days after transplanting (DAT) respectively and was at par with T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) having 2.24 and 2.58 cm respectively observed at 30, 60 and 90 days after transplanting (DAT). Minimum neck thickness (1.34 and 1.43 cm) was noted in T₀ (control) observed at 60 and 90 days after transplanting (DAT) respectively. The enhanced neck thickness in onion observed under the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha is largely due to the balanced and elevated nutrient supply, particularly phosphorus. Phosphorus is crucial for root growth, energy transfer, and cell division, contributing to overall plant strength and robustness. The higher phosphorus dose in this treatment likely resulted in improved root development, allowing more efficient uptake of nitrogen and potassium, which are essential for vegetative and structural growth. Nitrogen supports cell enlargement and protein synthesis, while potassium strengthens plant tissues, enhancing water and nutrient transport. This optimal combination encourages thicker neck formation by promoting sturdy, healthy growth. Compared to treatments with lower phosphorus levels or the recommended dose of fertilizer (RDF), this treatment provides a more favourable nutrient balance, leading to stronger onion necks and improved structural integrity. Similar findings were reported by Aryal *et al.*, (2021) [3] and Singh *et al.*, (2021) [16].

Days to maturity

The minimum days to maturity (84.46 days) was observed

with treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) at par with T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) with 87.26 days. Maximum days to maturity (105.01 days) was observed in T₀ (control). The earliness in maturity of onion observed in the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha can be attributed to the optimal nutrient combination, particularly the higher phosphorus level. Phosphorus plays a crucial role in energy transfer, root development, and reproductive growth, promoting quicker transition from vegetative to reproductive stages. The enhanced phosphorus availability in this treatment likely accelerated root development and nutrient uptake, enabling the plant to complete its growth cycle faster. Nitrogen at 120 kg/ha ensures adequate vegetative growth early on, while potassium improves nutrient translocation and stress tolerance, aiding in faster bulb development. This balanced nutrient supply creates ideal conditions for early growth and maturation. In comparison, treatments with lower phosphorus levels or the recommended dose of fertilizer (RDF) may not provide the same level of nutrient efficiency, leading to delayed growth and later maturity. Similar findings were reported by Aryal *et al.*, (2021) [3].

Leaf length

The maximum leaf length (59.34 cm) was observed with treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) followed by T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) with 55.70 cm. Minimum leaf length (30.80 cm) was observed in T₀ (control). The observed increase in leaf length of onions treated with nitrogen at 120 kg/ha, phosphorus at 180 kg/ha, and potassium at 100 kg/ha can be attributed to the optimal synergy of nutrients, particularly the higher application of phosphorus. Phosphorus is crucial for root development and energy transfer, which enhances nutrient uptake and promotes vigorous vegetative growth. The improved availability of phosphorus likely strengthened root systems, facilitating better nitrogen absorption, a vital element for vegetative growth and chlorophyll synthesis. The application of nitrogen at 120 kg/ha encourages cell elongation and division, which directly contributes to the formation of longer leaves. Additionally, potassium at 100 kg/ha plays a supportive role by enhancing water regulation, photosynthesis, and nutrient transport within the plant, thereby further aiding leaf expansion. This well-balanced NPK treatment supplies the essential nutrients required for sustained leaf growth, in contrast to lower phosphorus levels or the recommended fertilizer dose, which may not achieve the same nutrient efficiency and could result in shorter leaves. Similar findings were reported by Sapkota *et al.*, (2021) [13].

Bulb weight and bulb yield per hectare

The maximum bulb weight (125.90 grams) was observed with treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) at par with T₆ (N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each) with 124.35 grams. Minimum bulb weight (99.04 grams) was observed in T₀ (control). The maximum bulb yield per hectare (23.31 t/ha) was observed with treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) followed by T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) with 22.28 t/ha. Minimum bulb yield per hectare (12.01 t/ha) was observed in T₀ (control). The

higher bulb yield in onion under the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha can be attributed to the synergistic effect of these nutrients, particularly the increased phosphorus dose. Phosphorus plays a critical role in energy transfer, root development, and overall plant metabolism, which are crucial for early growth, bulb formation, and maturity. The elevated phosphorus level likely enhanced root growth, enabling more efficient uptake of nitrogen and potassium. Nitrogen, at 120 kg/ha, promotes vigorous vegetative growth, including leaf development, which is essential for photosynthesis and energy production, driving bulb growth. Potassium at 100 kg/ha strengthens plant tissue, improves water use efficiency, and supports the translocation of sugars and starches to the bulb, enhancing its size and quality. This balanced nutrient combination promotes an optimal growth environment, resulting in higher bulb yield compared to treatments with lower phosphorus levels or the recommended dose of fertilizer (RDF). In those treatments, nutrient uptake may be less efficient, leading to slower growth and smaller bulbs, while the higher phosphorus, nitrogen, and potassium levels in this treatment maximize yield potential. Similar findings were reported by Sapkota *et al.*, (2021) ^[13]; Singh *et al.*, (2021) ^[16].

Total soluble solids [TSS]

The maximum total soluble solids (19.63 °Brix) were observed with treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) followed by T₇ (N @ 120 kg/ha + P@ 200 kg/ha K @ 100 kg/ha each) with 18.66 °Brix. Minimum total soluble solids (13.54 °Brix) were observed in T₁ (RDF 100%). The improved total soluble solids (TSS) in onion observed in the treatment with N @ 120 kg/ha, P @ 180 kg/ha, and K @ 100 kg/ha can be attributed to the optimal nutrient balance and their roles in enhancing carbohydrate accumulation. The higher phosphorus level in this treatment significantly supports root development and energy transfer processes, facilitating better nutrient uptake and promoting

vigorous plant growth. Nitrogen, at 120 kg/ha, enhances vegetative growth and chlorophyll production, leading to increased photosynthesis. This increase in photosynthetic activity contributes to higher sugar synthesis and accumulation within the bulb. Moreover, potassium aids in regulating water balance and improving the plant's stress tolerance, further enhancing sugar concentration. The combined effect of these nutrients ensures that more carbohydrates are available for storage in the bulbs, resulting in higher TSS levels. In contrast, treatments with lower phosphorus levels or the recommended dose of fertilizer (RDF) may not provide the same level of nutrient efficiency, leading to reduced sugar accumulation and lower TSS. Similar findings were reported by Kadam *et al.*, (2018) ^[7].

Economics parameters

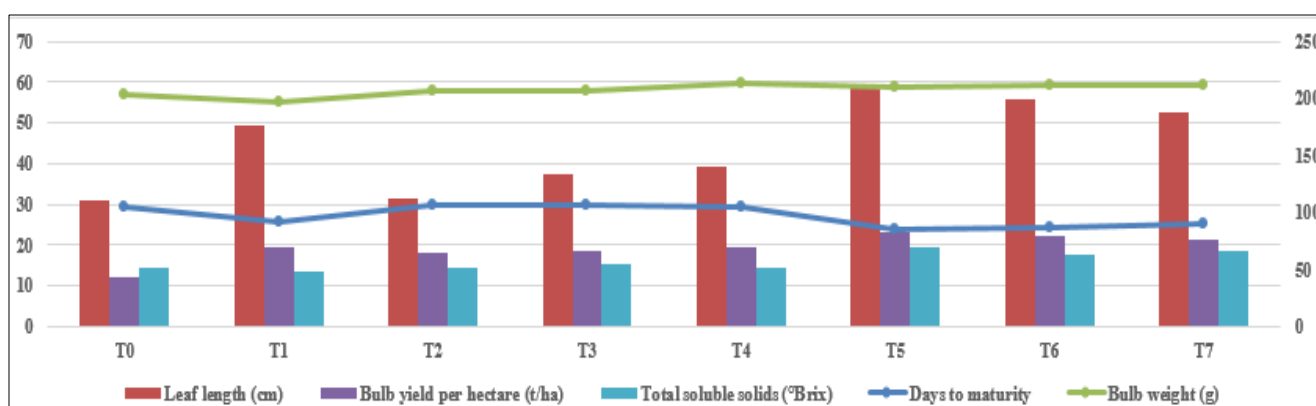
Maximum cost of cultivation incurred in treatment T₇ (N @ 120 kg/ha + P@ 200 kg/ha K @ 100 kg/ha each) with (Rs 1,61,548 ha⁻¹) and the minimum (Rs 1,48,432 ha⁻¹) was recorded in treatment T₀ (Control). Maximum gross returns were recorded in treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) with (Rs 5,82,791 ha⁻¹) followed by T₅ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) having Rs 5,57,096 ha⁻¹ and the minimum (Rs 3,00,250 ha⁻¹) was recorded in treatment T₀ (Control). Maximum net returns were recorded in treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) with (Rs 4,22,420 ha⁻¹) followed by T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) having Rs 3,96,137 ha⁻¹ and the minimum (Rs 1,51,818 ha⁻¹) was recorded in treatment T₀ (Control). Maximum benefit cost ratio was recorded in treatment T₅ (N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each) with (3.63) followed by T₆ (N @ 120 kg/ha + P@ 190 kg/ha K @ 100 kg/ha each) having 3.46 and the minimum (2.02) was recorded in treatment T₀ (Control). Similar findings were reported by Sapkota *et al.*, (2021) ^[13].

Table 1: Effect of different levels of phosphorus on growth parameters in onion

Treatment Symbols	Treatment combination	Plant height (cm)			Number of leaves per plant			Neck thickness (cm)	
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	At 60 DAT	At 90 DAT
T ₀	Control	23.94	41.35	56.14	3.61	5.50	8.25	1.34	1.43
T ₁	RDF100% [NPK: 120:160:100 Kg/ha]	26.92	42.96	58.47	4.52	6.54	9.67	1.63	1.81
T ₂	N @ 120 kg/ha + P @ 140 kg/ha K @ 100 kg/ha each	27.11	41.48	55.92	3.91	6.19	8.88	1.32	1.45
T ₃	N @ 120 kg/ha + P @ 150 kg/ha K @ 100 kg/ha each	29.02	47.36	61.61	4.10	6.49	9.22	1.70	1.73
T ₄	N @ 120 kg/ha + P @ 170 kg/ha K @ 100 kg/ha each	28.35	44.07	63.29	5.12	7.28	10.00	1.84	1.82
T ₅	N @ 120 kg/ha + P@ 180 kg/ha K @ 100 kg/ha each	36.42	57.92	70.22	7.18	9.36	12.79	2.32	2.75
T ₆	N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each	35.53	55.32	66.39	6.78	8.88	12.12	2.24	2.58
T ₇	N @ 120 kg/ha + P @ 200 kg/ha K @ 100 kg/ha each	33.62	51.41	63.20	6.34	8.14	11.24	1.84	2.44
CD _{0.05}		2.40	1.63	2.98	0.65	0.49	0.45	0.38	0.22
SE. m (±)		0.80	0.55	0.99	0.22	0.16	0.15	0.13	0.07

Table 2: Effect of different levels of phosphorus on days to maturity and yield parameters in onion

Treatment Symbols	Treatment combination	Days to maturity	Leaf length (cm)	Bulb weight (g)	Bulb yield per hectare (t/ha)	Total soluble solids (°Brix)
T ₀	Control	105.01	30.80	99.04	12.01	14.32
T ₁	RDF100% [NPK: 120:160:100 Kg/ha]	92.37	49.40	103.73	19.41	13.54
T ₂	N @ 120 kg/ha + P @ 140 kg/ha K @ 100 kg/ha each	106.36	31.28	99.96	18.29	14.29
T ₃	N @ 120 kg/ha + P @ 150 kg/ha K @ 100 kg/ha each	105.94	37.26	100.43	18.71	15.11
T ₄	N @ 120 kg/ha + P @ 170 kg/ha K @ 100 kg/ha each	104.33	39.29	108.26	19.64	14.38
T ₅	N @ 120 kg/ha + P @ 180 kg/ha K @ 100 kg/ha each	84.46	59.34	125.90	23.31	19.63
T ₆	N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each	87.26	55.70	124.35	22.28	17.76
T ₇	N @ 120 kg/ha + P @ 200 kg/ha K @ 100 kg/ha each	89.45	52.63	121.99	21.48	18.66
CD _{0.05}		2.22	7.15	2.48	1.02	0.64
SE. m (±)		0.71	2.38	0.79	0.34	0.24

**Fig 1:** Graphical representation of effect of different levels of phosphorus on days to maturity and yield parameters in onion**Table 3:** Economics as influenced by different treatments applied in Onion

Treatment Symbols	Treatment combination	Cost of cultivation (Rs)	Gross return (Rs)	Net return (Rs)	BC ratio
T ₀	Control	148432	3,00,250	1,51,818	2.02
T ₁	RDF100% [NPK: 120:160:100 Kg/ha]	159206	4,85,158	3,25,952	3.05
T ₂	N @ 120 kg/ha + P @ 140 kg/ha K @ 100 kg/ha each	158024	4,57,135	2,99,111	2.89
T ₃	N @ 120 kg/ha + P @ 150 kg/ha K @ 100 kg/ha each	158618	4,67,681	3,09,063	2.95
T ₄	N @ 120 kg/ha + P @ 170 kg/ha K @ 100 kg/ha each	159795	4,90,993	3,31,198	3.07
T ₅	N @ 120 kg/ha + P @ 180 kg/ha K @ 100 kg/ha each	160371	5,82,791	4,22,420	3.63
T ₆	N @ 120 kg/ha + P @ 190 kg/ha K @ 100 kg/ha each	160959	5,57,096	3,96,137	3.46
T ₇	N @ 120 kg/ha + P @ 200 kg/ha K @ 100 kg/ha each	161548	5,37,000	3,75,452	3.32

Selling price of Onion: Rs 25/kg

Conclusion

The overall results obtained from this present investigation clearly revealed that the application of T₅ (N @ 120 kg/ha + P @ 180 kg/ha K @ 100 kg/ha each) showed the better performance for vegetative growth (plant height of 70.22 cm at 90 DAT, number of leaves per plant with 12.79 leaves), earliness in maturity with 84.46 days after transplanting; yield attributes (bulb weight (125.90 grams), bulb yield (23.31 t/ha) of onion. T₅ also recorded highest net return with (Rs 4,22,420 ha⁻¹) and one of the best benefit cost ratios of 3.63. Thus, use of phosphorus @ 180 kg/ha may be

suggested for higher crop productivity along with overall betterment of onion under Balaghat (M.P.) conditions.

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