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The study investigated and compared the growth and yield performance of different green gram varieties specifically cultivated during the summer season in the Bundelkhand region of Uttar Pradesh

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Abstract
The present investigation entitled "Growth, yield and quality assessment of different summer green gram (Vigna *et al*.) varieties in Bundelkhand region of Uttar Pradesh" was carried out during the Zaid season 2022-23. The experiment was conducted at the Agriculture Research Farm of Brahmanand Mahavidyalaya Rath (Hamirpur) U.P. The Research Farm is situated in the southern part of the U.P. in the Bundelkhand region. The experiment was laid out in Randomized Block Design (Randomized Block Design (RBD)) with seven varieties (check variety, Mona, Soorya, IPM410-3, IPM2-3, Varsha, and Heera); varieties were taken from the Indian Institute of Pulses Research (IIPR) in Kanpur, Uttar Pradesh.
In the field trials conducted, The variety Varsha exhibited remarkable growth characteristics, surpassing all other varieties in plant height, dry matter accumulation, number of branches, total nodulation, and leaf area index (LAI). Following Varsha, Heera, and IPM2-3, showed some growth parameters but were ultimately outperformed by the exceptional results of Varsha. Moreover, Varsha demonstrated superior yield attributes regarding grain yield, straw yield, and biological yield.

Keywords: Growth assessment, yield attributes, quality assessment, summer green gram

Introduction
The pulses (A Pulse, Latin "puls" from Ancient Greek Poltos "porridge") are annual leguminous crops that play a pivotal role and occupy a unique position in Indian agriculture under their inherent capacity to grow on marginal land and provide protein-rich diet to people experiencing poverty and the vegetarians of the country. In addition to being a rich source of protein, pulses are part and parcel of sustainable agriculture since they are responsible for improving soil's physical, chemical, and biological properties and act as mini nitrogen factories. Therefore, they have been rightly described as 'Unique Jewels of Indian crop husbandry. Pulses are integral to the cropping system as they fit well in different crop rotations. The Bundelkhand region of India is primarily agrarian and vulnerable to natural calamities with low levels of industrialization and urbanization. Poor crop productivity, declining and irregular rainfall patterns, and poor income levels make livelihood uncertain in the region. Pulse crops assume a special significance to the farm economy in the Bundelkhand region, as do the daily diets of local inhabitants. Chickpeas, lentils, field peas, urban, mungbean, and pigeon peas are the major pulse crops cultivated in the region.
Data from the Department of Economics and Statistics, Department of Agriculture and Cooperation and Farmers Welfare, New Delhi, and the studies on pulses development in the Bundelkhand region of India were analyzed. Pulses account for 32% of total agricultural produce and occupy about 33.6% of the gross cropped area in the region. However, a decline in area coverage of pulses has been observed in the region, in contrast to an overall increase in the gross cropped area. The paper discusses the various challenges confronting pulse cultivation in the region and the possible intervention points for enhancing pulse production.
The Calorific value of green gram is 334 calories per 100 g, and its chemical composition is as follows: crude protein 24.0%, fat 1.3%, carbohydrate 56.6%, minerals 3.5%, lysine 0.43%,

methionine 0.10%, tryptophan 0.04%, calcium 124 mg, phosphorus 3.26 mg, and iron 7.3 mg.

Protein hunger is a major problem in the country, where the majority of the population adopts cereals and millet-based dietary habits. Quick maturity, versatile to different agro-climatic and soil situations, providing crop cover for soil conservation, the broad spectrum of over a dozen food legumes belonging to many genera and species of green gram, black gram, cowpea, pigeon pea, chickpea, and lentil form the linchpin of cropping systems in India.

This study aims to find suitable summer varieties in light of morphological performances and compare the yield contributing characters of different green gram varieties.

Materials and Methods

The experiment took place at the Agriculture Research Farm of Brahmanand Mahavidyalaya Rath (Hamirpur) U.P, situated in the southern part of the Bundelkhand region of Uttar Pradesh. The field was well-leveled and equipped with adequate irrigation and drainage facilities. Prior to the experiment, manual practices were employed to clear the field of remnants from previous crops and weeds.

The Bundelkhand region experiences a sub-tropical climate characterized by hot, sunny summers and dry, cold winters. It is located in the southern part of Uttar Pradesh, with a latitude and longitudinal range of 79.7° East and 25.5° North and an elevation of 526 feet from sea level. The average annual rainfall in the region ranges between 875-975 mm.

The experimental layout followed a Randomized Block Design (Randomized Block Design (RBD)) and included seven varieties: check variety, Mona, Soorya, IPM410-3, IPM2-3, Varsha, and Heera. These varieties were sourced from the Indian Institute of Pulses Research (IIPR) in Kanpur, Uttar Pradesh. Each treatment was replicated three times, dividing the experimental field into 21 plots.

The recorded data on different characteristics during the investigation were subjected to statistical analysis using the variance analysis technique for randomized block design, following Fisher's (1958) suggestions. If the calculated F values were found to be significant at a 5% significance level, critical differences were then computed to compare the effects of the two treatment levels.

Results and Discussion

Impact of Varietal Differences on Growth and Yield of Green Gram Cultivars Plant height (cm)

The data showcased in Table 1 effectively emphasizes the considerable influence that various treatments had on the mean plant height of Green Gram. It is noteworthy that across the growth period, there was a consistent and discernible upward trend in plant height up until the point of harvest. An intriguing pattern emerged from the data, revealing that plant height exhibited a gradual progression in the initial phase, spanning approximately 30 days, before transitioning into a notably accelerated growth phase between the 30 to 60-day intervals. Subsequently, there was a decline in plant height post the 60-day period. By the time of harvest, the average maximum plant height per plant reached a commendable 44.92 cm. Notably, distinct variations in plant height were evident among the different varieties at all growth stages, with the Varsha variety notably standing out due to its superior plant height compared to the other varieties. This particular observation is in line with the results documented by Yadahalli *et al*. (2006) [12] and Nayak *et al*. (2014) [9], thereby further reinforcing the importance and validity of varietal disparities in plant height.

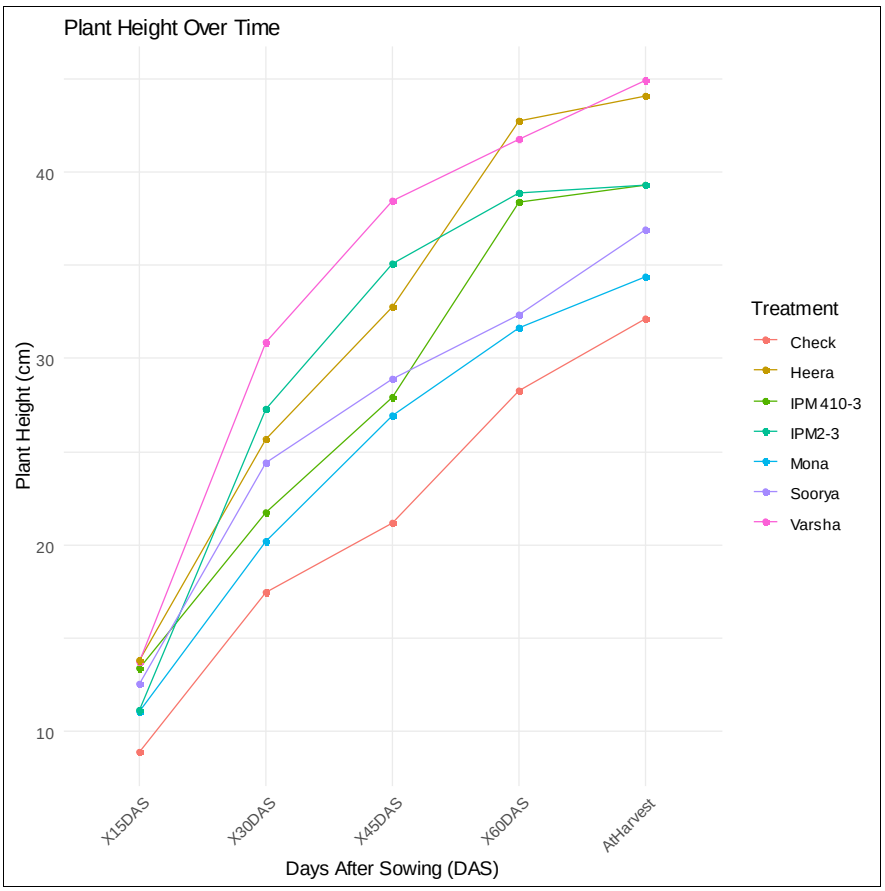

Fig 1: Plant Height Over Time

Table 1: Plant height (cm) at various stages of crop growth

Treatments	Plant height(cm)				
	15 DAS	30 DAS	45 DAS	60 DAS	At Harvest
V1: Check	8.90	17.48	21.20	28.30	32.14
V2: Mona	11.09	20.23	26.92	31.65	34.38
V3: Soorya	12.58	24.44	28.93	32.35	36.90
V4: I P M 4 1 0 - 3	13.41	21.78	27.90	38.40	39.27
V5: IPM2-3	11.17	27.29	35.06	38.87	39.31
V6: V a r s h a	13.74	30.85	38.48	41.77	44.92
V7: Heera	13.79	25.67	32.77	42.72	44.08
SEm±	0.43	0.85	1.29	1.66	1.28
CDat5%	NS	2.67	4.04	5.185	4.01

Functional leaves plant-1

The table presented in Table 2 provides a comprehensive view of the significant impact that various treatments had on the average number of functional leaves per Green Gram plant. The data clearly illustrate that at different stages - 30, 45, and 60 days after sowing (DAS), as well as at the time of harvest - the average number of functional leaves per plant exhibited distinct values: 32.57, 50.34, 25.48, and 13.43, respectively. Notably, once the plants reached the 45 DAS mark, there was a notable peak in the average number of functional leaves, followed by a decline attributed to leaf senescence. It is worth highlighting that Varsha emerged as the top performer in terms of the average number of functional leaves at 45 DAS, boasting a noteworthy figure of 58.00. This particular observation is in line with previous research findings by Nayak *et al*. (2014) [9] and Rathore *et al*. (2010) [11], reinforcing the validity and consistency of the results obtained.

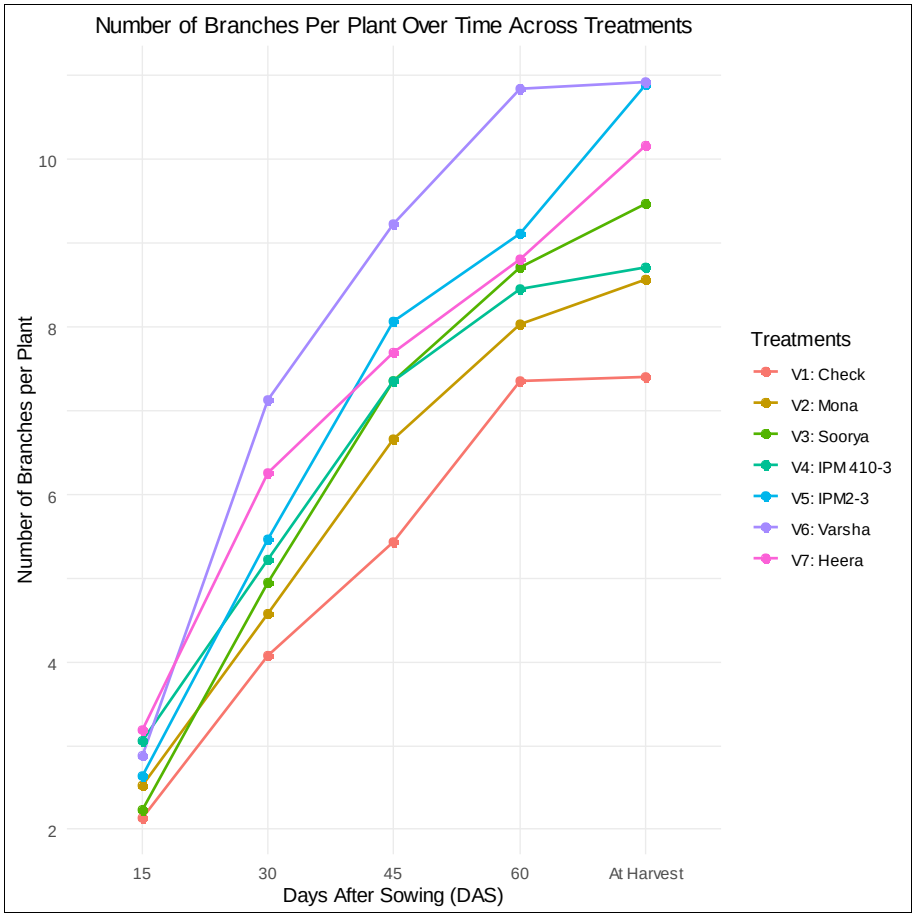

Fig 2: Number of Branches Per Plant Over Time Across Treatments

Table 2: Number of functional leaves per plant at various stages of plant growth

Treatments	No. of branches/plants				
	15 DAS	30 DAS	45 DAS	60 DAS	At Harvest
V1: Check	2.14	4.07	5.44	7.35	7.41
V2: Mona	2.53	4.57	6.66	8.04	8.57
V3: Soorya	2.23	4.95	7.35	8.71	9.47
V4: I P M 4 1 0 - 3	3.06	5.23	7.35	8.45	8.71
V5: IPM2-3	2.64	5.47	8.06	9.12	10.90
V6: Varsha	2.88	7.13	9.23	10.85	10.92
V7: Heera	3.19	6.25	7.69	8.81	10.17
SEm±	0.147	0.14	0.27	0.41	0.32
CDat5%	NS	0.44	0.84	1.28	1.01

Yield attributes of green gram

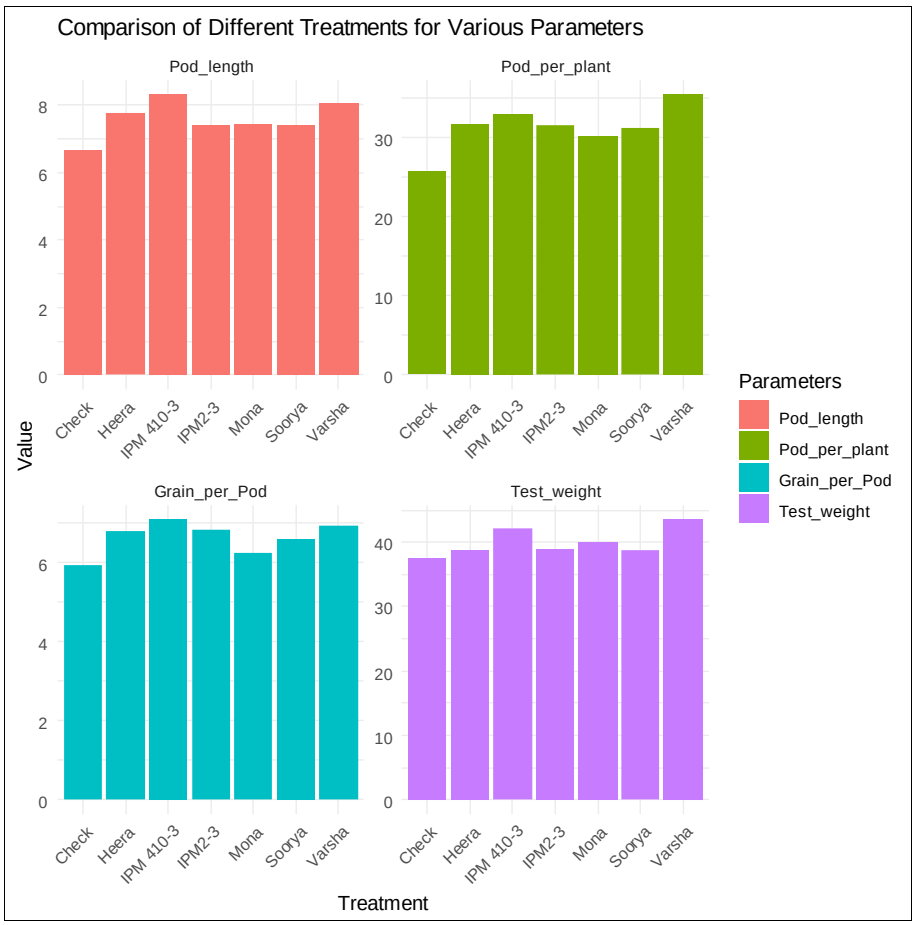

Fig 3: Comparison of Different Treatments for Various Parameters

Based on the comprehensive table analysis, it is evident that various yield attributes were meticulously observed and documented. For instance, the measurement of pod length, pod per plant ratio, grain per pod, and test weight provided valuable insights into the performance of different varieties. Notably, a distinct trend was observed where V1 exhibited the lowest test weight, while V4 and V6 displayed exceptional results in all yield attributes, particularly excelling in pod length, pods per plant, grain per pod, and test weight. Moreover, the data indicated that V6, in particular, attained the highest test weight during the evaluation process, closely followed by V4. Interestingly, these results suggest that V4 and V6 stand out as potential choices for farmers aiming to optimize their crop yield. Therefore, it is crucial for farmers to carefully consider these yield attributes when deciding on the most suitable variety to cultivate, ultimately leading to the achievement of maximum yield potential during the crucial harvest period.

Table 3: Effect of Yield attributes of a green gram as influenced different variety

Treatment	Pod length	Pod/plan t	Grain/Pod	Test weight
V1: Check	6.67	25.59	5.94	37.43
V2: Mona	7.46	30.06	6.24	40.07
V3: Soorya	7.39	31.15	6.61	38.78
V4: I P M 4 1 0 -3	8.33	32.82	7.12	42.22
V5: IPM2-3	7.41	31.58	6.85	38.97
V6: Varsha	8.04	35.44	6.96	43.64
V7: Heera	7.76	31.66	6.82	38.69
SE(m)	0.35	1.16	0.31	1.66
CDat5%	1.09	3.60	0.99	5.12

Effect of Grain Yield, Straw Yield, and Harvest Index

Based on the comprehensive analysis of the data collected, it is undeniably evident that plot V6 consistently outperformed the other monitored plots, namely V1, V5, and V7, in both grain and straw production. This strong and consistent performance highlights the superior growth and developmental conditions provided by plot V6, positioning it as an exemplar in terms of facilitating plant productivity. In stark contrast, the findings reveal that plot V1 consistently yielded the lowest output, suggesting the presence of inhibiting factors or adverse conditions that hindered the optimal growth of plants within that specific plot.

Moreover, plots V5 and V7 demonstrated relatively similar, yet noticeably lower, yields in comparison to V6. This pattern further reiterates the exceptional productivity levels associated with plot V6, making it a standout performer in terms of overall

biomass production. The data also showcased that V6 exhibited the highest biological yield among all the plots examined, thereby reinforcing its distinguished status as the most fruitful plot in our agricultural study. These insightful results underscore the paramount importance of carefully selecting optimal conditions and implementing effective management practices to enhance grain and biomass yields within agricultural plots. This emphasis on meticulous planning and strategic decision-making emerges as a critical factor in ensuring and maximizing agricultural productivity and sustainability.

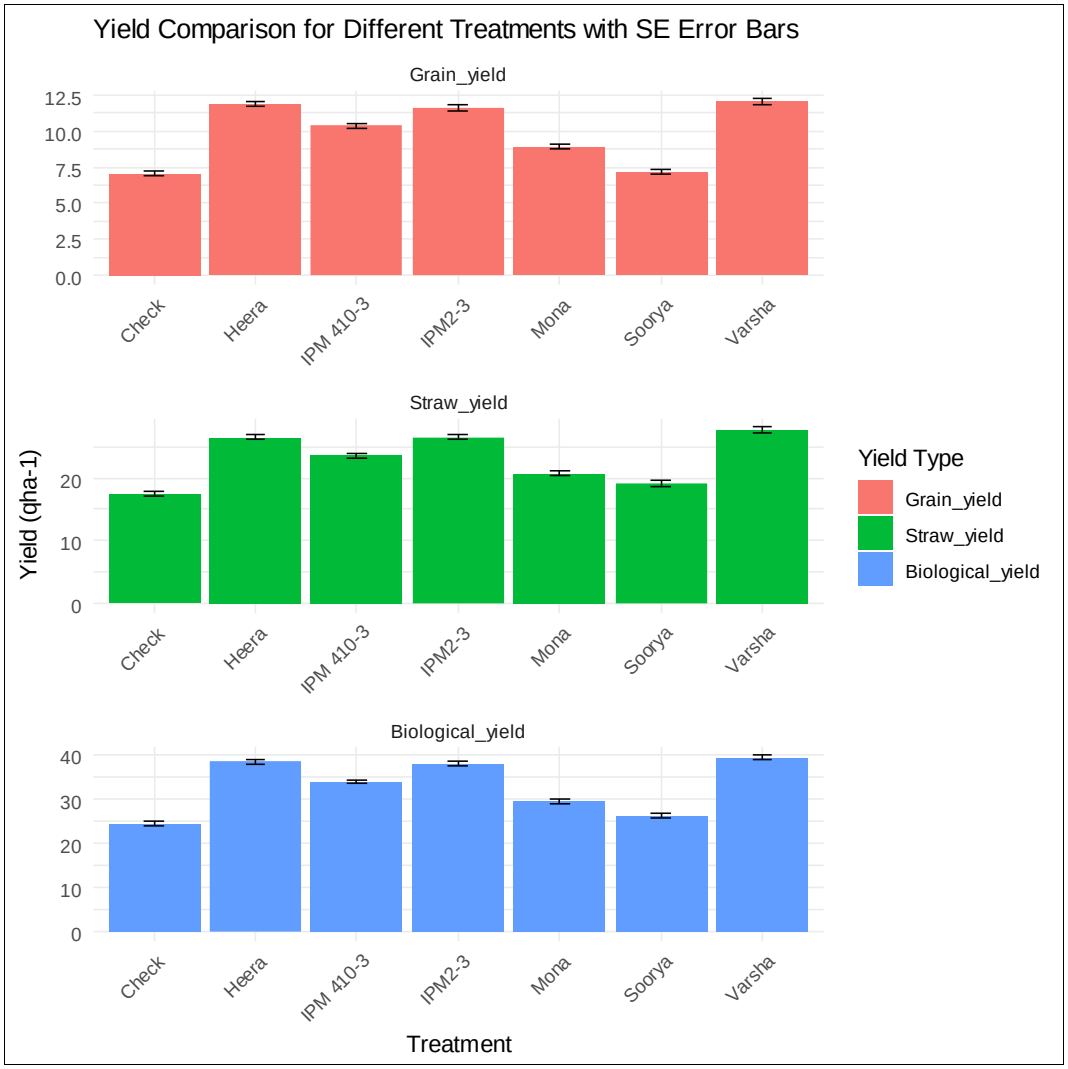

Fig 4: Yield Comparison for Different Treatments with SE Error Bars

Table 4: Effect of Yield attributes of a green gram as influenced by a different variety

Treatment	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Biological yield (qha^{-1})
V1: Check	7.05	17.46	24.51
V2: Mona	8.92	20.70	29.62
V3: Soorya	7.15	19.13	26.28
V4: IPM 410-3	10.37	23.62	33.99
V5: IPM 2-3	11.59	26.53	38.12
V6: Varsha	12.03	27.72	39.56
V7: Heera	11.84	26.55	38.58
SE(m)	0.183	0.414	0.461
CD at 5%	0.527	1.192	1.333

Conclusion

The study compared various plant varieties and found that The variety Varsha consistently outperformed them in various parameters. Varsha had the tallest plant height, the highest capacity for accumulating dry matter, the highest number of branches, and a significant lead in nodule-related metrics. It also excelled in Leaf Area Index (LAI) with a higher value than the other varieties. Varsha also showed superiority in pods per plant, grains per pod, and test weight compared to other varieties. Its yield outcomes were higher across multiple parameters, including grains yield, straw yield, and biological yield. However, there was no significant variance observed among the; different varieties in relation to the harvest index, indicating consistent performance across the varieties.

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