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Impact of Agroclimatic Conditions on the Productivity of Groundnut (*Arachis hypogaea* L.) Cultivars in the *rabi* Season under Godavari Region

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ABSTRACT: In the *rabi* season of 2023, a field experiment was conducted at the Agricultural College Farm in Rajamahendravarm, ANGRAU, to investigate the influence of agroclimatic conditions in the Godavari zone on the growth, yield attributes, and overall yield of various groundnut cultivars under irrigated conditions. The experiment was performed on sandy loam soil during the 2022-23 *rabi* season using a randomized block design with 10 treatments, replicated three times. The treatments included Kadiri Lepakshi, Kadiri-6, Dheeraj, Kadiri Amaravathi, Kadiri-9, Dharani, Kadiri Chitravathi, Kadiri Harithandhra, Nitya Haritha, and TCGS-1694. The findings revealed that Kadiri-6 exhibited the highest plant height (44.9 cm), while Kadiri Lepakshi demonstrated superior performance in terms of the number of branches per plant (11.6) and dry matter accumulation (8898 kg ha^{-1}). Kadiri Lepakshi also outperformed other varieties in pod yield (3420 kg ha^{-1}), haulm yield (4836 kg ha^{-1}), and kernel yield (3420 kg ha^{-1}), indicating its overall superiority in the given agroclimatic conditions. These results suggest that Kadiri Lepakshi is the most suitable variety for cultivation in the Godavari zone under irrigated conditions. Further research could explore the long-term performance and economic benefits of this cultivar.

Keywords: High-yielding varieties, Leguminous crop, Productivity, Drymatter accumulation, Value added products and Haulm yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) stands out as a significant leguminous oilseed crop, often referred to as the "King of Oilseeds." Renowned for its nutritional richness, it boasts high levels of dietary fiber, minerals, and essential vitamins such as thiamine, riboflavin, and niacin. With oil content ranging from 48% to 51%, protein at 26-28%, and starch at 11.5%, groundnut is a versatile and nutritious commodity (Naresha *et al*., 2018). Beyond its conventional use, groundnut finds application in various value-added products like roasted and salted nuts, as well as peanut butter (Prasad *et al*., 2009).

On a global scale, groundnut cultivation spans 327 lakh hectares, yielding 539 lakh tonnes at a productivity rate of 1648 kg per hectare (FAOSTAT, 2021). In India, the crop covers 4.9 million hectares, producing 9.25 million tonnes with an average productivity of 1893 kg ha^{-1}. Andhra Pradesh contributes significantly, cultivating groundnut over 0.87 million hectares, yielding 0.78 million tonnes, and maintaining a productivity level of 894 kg ha^{-1} (Directorate of Economics and Statistics, Andhra Pradesh, 2020-2021).

The challenge of low groundnut productivity is predominantly attributed to rainfed cultivation and the absence of suitable varieties tailored to specific seasons and regions. Enhancing productivity requires the adoption of improved varieties alongside advanced management practices and technologies (Hanif *et al*., 2021). Varietal selection plays a pivotal role in the success of groundnut cultivation, with potential yield increases ranging from 30% to 89% through the adoption of high-yielding varieties (Reddy *et al*., 2000). In Andhra Pradesh, groundnut holds traditional significance in the Godavari zone, particularly in upland areas with untapped potential for increased production. Unfortunately, a lack of awareness among farmers regarding improved varieties and best management practices has led to lower productivity. The yield potential varies based on varieties and agro-climatic conditions. Weather, a crucial abiotic factor, significantly influences groundnut crop growth and yield (Anil *et al*., 2017). Despite this, there exists a notable gap in information regarding suitable high-yielding varieties for the upland areas of the Godavari zone in Andhra Pradesh. Hence, this study focuses on assessing the "Impact of agro-climatic conditions on the

productivity of groundnut (*Arachis hypogaea* L.) cultivars in the *rabi* season under the Godavari region."

MATERIAL AND METHODS

A field experiment was conducted on sandy loam soil at the Agricultural College Farm, Rajamahendravaram during the *rabi* season of 2022. The site is situated at an altitude of 46 meters above Mean Sea Level (MSL), with coordinates of 16° 06′N latitude and 081° 49′E longitude. The soils of the experimental site were sandy loam, slightly acidic in reaction, low in available nitrogen, organic carbon, and available phosphorus, but medium in available potassium.

The experiment was laid out in a randomized block design comprising 10 treatments: T1: Kadiri Lepakshi, T2: Kadiri-6, T3: Dheeraj, T4: Kadiri Amaravathi, T5: Kadiri-9, T6: Dharani, T7: Kadiri Chitravathi, T8: Kadiri Harithandhra, T9: Nitya Haritha, and T10: TCGS-1694. Each treatment was replicated three times with a row-to-row distance of 30 cm and a plant-to-plant distance of 10 cm. The recommended doses of 20 kg N, 40 kg P_2O_5, and 40 kg K_2O per hectare were applied using urea, single super phosphate, and muriate of potash, respectively. Thinning and gap filling were done as necessary, and weeding and hoeing were carried out depending on the intensity of weeds at critical stages of the crop-weed competition.

Observations were recorded on five randomly selected plants from each replication. The readings from these five plants were averaged replication-wise, and the mean data were used for statistical analysis. The recorded characteristics included primary branches per plant, dry matter accumulation (kg ha^{-1}), pods per plant, filled pods per plant, pod yield (kg ha^{-1}), hundred kernel weight (g), and kernel yield (kg ha^{-1}). The number of branches per plant and dry matter production were collected at intervals of 30 days during the growth season, while yield characteristics were measured at harvest.

RESULTS AND DISCUSSION

Weather Parameters and Their Impact on Crop Growth. Weather parameters, including rainfall, temperature, and humidity, are pivotal factors significantly impacting crop growth, with their collective influence crucial in determining the ultimate crop yield. During the crop growth period, the weekly mean maximum temperature exhibited variability, ranging from 30.4°C to 35.3°C, with an overall average of 32.3°C. Similarly, the mean minimum temperature ranged from 15.7°C to 24.3°C, establishing an average of 19.3°C. Additionally, the weekly mean relative humidity fluctuated widely, ranging from 40.3% to 91.5%. This variation in humidity levels significantly contributes to the overall environmental conditions experienced by the crops during their crucial growth stages, playing a key role in influencing various physiological processes in plants, such as transpiration rates and nutrient uptake. During this critical growth phase, the region received a total rainfall of 32.6 mm, distributed over three days characterized by rainy weather conditions. This precipitation is vital for sustaining crop health and fostering optimal growth. Adequate and well-distributed rainfall is essential for ensuring soil moisture content, a critical factor for nutrient absorption and overall plant development.

Growth Attributes. The growth parameters of groundnut, including plant height, number of branches per plant, and dry matter accumulation, exhibited significant variations among the different varieties, as outlined in Table 1. Kadiri-6 stood out by achieving the highest plant height at harvest (44.9 cm), performing on par with Dheeraj, Dharani, and TCGS-1694. This variance in plant height can be attributed to the intricate interplay between the genetic makeup of the variety and the environmental conditions in which it grows. Consistent with these findings, previous studies by Sreenivasulu *et al*. (2021) have reported similar impacts of genetic factors and environmental influences on plant height. Notably, among the ten evaluated varieties, Kadiri Lepakshi demonstrated a significantly higher number of branches per plant and greater dry matter accumulation, surpassing all other tested varieties. This superior performance aligns with the findings of Chandini *et al*. (2022); Akram *et al*. (2021), who reported that Kadiri Lepakshi's ability to produce more branches and accumulate greater dry matter is likely attributed to its exceptional genetic traits, such as prolific bearing, an extended growth duration, and an indeterminate growth habit. Conversely, Kadiri-6 exhibited a lower number of branches, and Dharani, while producing fewer branches, also resulted in lower dry matter production. These variations may be linked to inherent traits unique to each variety, such as growth habits and genetic predispositions. Understanding these nuances in growth parameters is crucial for selecting and managing groundnut varieties better suited to specific agroclimatic conditions and desired agricultural outcomes.

Yield. Pod, kernel, and haulm yields exhibited remarkable variations influenced by the tested varieties, as detailed in Table 1. Notably, Kadiri Lepakshi emerged as the top performer, producing significantly higher pod and kernel yields compared to other tested varieties. This elevated performance could be attributed to the improvement in yield-attributing characteristics, including the number of pods per plant, the number of filled pods per plant, the number of kernels per pod, and the shelling percentage observed in Kadiri Lepakshi. Similar findings have been reported by Chandini *et al*. (2022) ; Akram *et al*. (2021), affirming the superior pod and kernel yields of Kadiri Lepakshi. Conversely, Kadiri Amaravathi recorded lower pod yield, and the observed differences in yields among varieties may stem from their genetic potential to efficiently utilize and translocate photosynthates from source to sink. Groundnut pod yield is intricately linked to the partitioning ability of photosynthates, influencing growth parameters, developing pods, and ultimately contributing to increased pod yield (Labana *et al*., 1980).

Regarding haulm yield, Kadiri Lepakshi again stood out, recording the highest haulm yield significantly superior to all other varieties. TCGS-1694 followed

closely, with Kadiri Chitravathi, Kadiri-9, and Kadiri Harithandhra performing comparably. In contrast, Dheeraj displayed a lower haulm yield. This aligns with observations by Chandini *et al*. (2022); Akram *et al*. (2021); Kumari and Reddy (2017), highlighting Kadiri Lepakshi's consistent superiority in haulm yield. The observed differences are likely due to variations in morphological characters among the varieties, reflecting their genetic makeup and environmental interactions. Examining kernel yield, Kadiri Lepakshi again took the lead, recording significantly higher yields compared to all other varieties. TCGS-1694 ranked second in kernel yield, significantly outperforming the remaining varieties, except for Kadiri-9, Kadiri Chitravathi, and Dharani. Conversely, Kadiri Amaravathi recorded the lowest kernel yield. Consistent with findings by Chandini *et al.* (2022) ; Akram *et al*. (2021), Kadiri Lepakshi's higher kernel yield may be attributed to increased pod yield, influenced by higher shelling percentage, kernel yield per plant, seeds per pod, sound mature kernels, and kernel uniformity.

Table 1: Growth parameters and yield.

Treatments	Plant height	Branches plant^{-1}	Drymatter accumulation (kg ha^{-1})	Pod Yield (kg ha^{-1})	Haulm Yield (kg ha^{-1})	Kernel Yield (kg ha^{-1})
T_1-Kadiri Lepakshi	24.9	11.6	8898	3460	4832	2491
T_2-Kadiri-6	44.9	6.1	6543	2341	3582	1733
T_3-Dheeraj	39.5	6.3	6566	2362	3324	1748
T_4-Kadiri Amaravathi	35.7	7.5	6620	2138	3629	1309
T_5-Kadiri-9	34.2	7.6	7496	2793	3923	2039
T_6-Dharani	41.1	7.1	6992	2528	3634	1870
T_7-Kadiri Chitravathi	31.9	7.6	7709	2828	4101	1894
T_8-Kadiri Harithandhra	28.8	7.7	7141	2589	3752	1848
T_9-Nitya Haritha	30.9	7.3	6534	2276	3378	1607
T_{10}-TCGS 1694	39.4	8.0	7774	3036	4250	2156
SEm (±)	1.7	0.4	341	126.3	178	89.4
CD (P=0.05)	5.6	1.3	1091	404.3	567	286

CONCLUSIONS

Among the different varieties tested, Kadiri Lepakshi was found to be particularly well-suited for the uplands of the Godavari region, showing its superiority over the other varieties. In the absence of Kadiri Lepakshi, the next suitable varieties are TCGS-1694, Kadiri Chitravathi, and Kadiri-9.

FUTURE SCOPE

Further research should focus on the long-term performance and economic benefits of Kadiri Lepakshi, assessing its adaptability to varying agroclimatic conditions and resistance to pests and diseases. Nutritional profiling and soil health impact studies are essential for sustainable cultivation. Additionally, breeding programs can utilize Kadiri Lepakshi's superior traits to develop new varieties, while farmer training programs can enhance awareness and adoption of best practices. Exploring value-added product development and fostering collaborative research with agricultural institutions will drive innovation and improve market opportunities for groundnut cultivars in the Godavari zone.

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Conflict of Interest. None.

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