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CLIMATE SMART VARIETIES OF GROUNDNUT SUITABLE FOR SCARCE RAINFALL AGRO CLIMATIC ZONE OF ANDHRA PRADESH

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ABSTRACT

A field experiment was carried out to evaluate the influence of wet and dry spells on groundnut varieties in scarce rainfall agro climatic zone under rainfed conditions for two consecutive years during kharif 2022 and 2023 at AICRPDA, Agricultural Research Station, Ananthapur of Andhra Pradesh. Among groundnut varieties tested during wet spell of 2022, Kadiri Lepakshi (2635 kg/ha) followed by TCGS 1694 (1900 kg/ha) recorded higher pod yield when compared to other varieties tested. During drought year of 2023, TCGS-1694 recorded significantly higher pod yield when compared to other tested varieties with rain water use efficiency of 4.42 kg/ha mm. TCGS-1694 proved as the top climate resilient groundnut variety for scarce rainfall agro climatic zone of Andhra Pradesh, maintaining high pod yields (1556 -1900kg ha^{-1}), haulm yields (2,834-3,289 kg ha^{-1}), and superior rain water use efficiency (3.80-4.42 kg ha^{-1}mm) across wet and dry extremes. Kadiri Lepakshi proved ideal for high rainfall events (2,635 kg ha^{-1} pod yield), extreme while Nithya Haritha and K-9 showed consistent intermediate performance.

Keywords: Climate resilience, Drought tolerance, Rainfed groundnut, Rain water use efficiency, Wet and dry spells

INTRODUCTION

Andhra Pradesh comprises approximately 4.0 million hectares of rainfed land, with nearly 45% (1.6 million ha) located in the scarce rainfall agro climatic zone that includes Kurnool, Nandyal, Anantapuram and Sri Sathyasai districts with an annual average rainfall of 627, 747, 525 and 596 mm respectively (Yellamanda Reddy *et al.,* 2020).Out of the major rainfed crops grown in Andhra Pradesh, scarce rainfall zone occupies 4.0 lakh ha with groundnut (80%), 0.32 lakh ha with castor (92%), pigeon pea 1.53 lakh ha (59%), pearl millet 0.10 lakh ha (42%) and foxtail millet 0.08 lakh ha (61%). As part of the climate-smart agriculture approach, the adoption of climate-resilient crop varieties has the potential to build farmers' climate resilience but could also induce agricultural transformation in developing nations. Climate change such as erratic distribution of rainfall and higher frequency of extreme climatic events pose new challenges to groundnut production. Since many studies evaluating

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production systems for groundnut were performed prior to or during the 1970s and 1980s, groundnut cultivars used in those studies are no longer cultivated for production. In groundnut K9 and Dharani varieties are tolerant to drought (Radha Kumari and Sahadeva Reddy, 2019). Pavithra devi *et al.* (2015), reported that drought tolerant (ICGV 91114, K1375 and ICGV 02125) and drought susceptible (ICGV 01279, ICGV 98170 and ICGV 98175) varieties in groundnut. New cultivars may have different responses to nutrient, irrigation, and environmental factors. It is thus imminent to re-evaluate and modify currently adopted management practices and develop new guidelines towards improved groundnut productivity under ever-changing climate conditions. However, the crop productivity is fluctuating and highly influenced by the rainfall during crop growth period. In general groundnut always required moderate soil moisture and excess moisture and drought during pegging to pod development is undesirable. Extreme weather events at critical stages of crop growth can reduce yields or lead to crop failures also. However, information on the effect of extreme weather events during crop growth period on productivity of groundnut varieties is meagre and hence in this backdrop, the present study was conducted.

MATERIAL AND METHODS

A field experiment was carried out to study effect of wet and dry spells on groundnut varieties in scarce rainfall agro climatic zone under rainfed conditions for two consecutive years during kharif 2022 and 2023 at AICRPDA, Agricultural Research Station, Ananthapuramu, Andhra Pradesh". The experiment was laid out in Randomized Block Design and replicated thrice. The soils were red sandy loam in texture, near neutral in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and potassium. The treatments comprised of eight varieties viz., K-6, Kadiri Lepakshi, TCGS-1694, Nithyaharitha, Kadiri Harithandra, Kadiri Amaravathi, Dharani and K-9. An amount of 562 and 411 mm rainfall was received in 26 and 25 rainy days during the crop season of 2022 (21-6-22 to 10-10-22) and 2023 (10-6-23 to 12-10-23), respectively at the experimental site. During *kharif,* 2022 groundnut varieties faced wet spells at flowering to pegging (78.2 mm for 5 rainy days), pegging to pod development (182.6 mm for 5 rainy days) and pod development stages (97.8 mm for 4 rainy days) due to continuous rains in consecutive days. During 2023, dry spell of 14 days during flowering stage to pegging, 18 days during pod initiation to pod development and 19 days during pod maturity. Groundnut crop experienced 68 days of dry spell and 18 days of wet spells during 2022 and dry spell of 88 days during 2023. The rainwater use efficiency (kg ha^{-1} mm^{-1}) could be derived as ratio of pod yield attained by a treatment and crop seasonal rainfall received in a season as reported by Maruthi Sankar *et al*., (2013). The cost of cultivation was determined by considering inputs like seed and fertilizer costs, and agricultural operations from sowing to harvest. The gross return was computed as a product of yield and its market price (Rs. Kg^{-1}). Net returns were calculated by subtracting the total cost of cultivation from the gross returns obtained from the produce. The BCR was computed as a ratio of gross returns and cost of cultivation for each crop.

RESULTS AND DISCUSSION

During *kharif*, 2022 groundnut varieties *viz*. K-6, Kadiri Lepakshi, TCGS-1694, Nityaharitha, Kadiri Harithandhra, Amaravathi, Dharani, K-9 were tested for wet spells/high

rainfall events. These varieties faced wet spells at flowering to pegging (78.2 mm for 5 rainy days), peg formation to pod development (182.6 mm for 5 rainy days) and different stages of pod development (97.8 mm for 4 rainy days) due to continuous rains in consecutive days (Fig.1). Under these situations among groundnut varieties tested, Kadiri Lepakshi followed by TCGS 1694 recorded higher pod yield of 2635 kg ha^{-1} and 1900 kg ha^{-1}, haulm yield of 5101 kg ha^{-1} and 3289 kg ha^{-1} respectively compared to other varieties (Table 1). In 2023, although Kadiri Lepakshi still maintained a higher yield compared to most varieties, its performance dropped sharply to 882 kg/ha, reflecting its sensitivity to drought conditions. Harithandhra, on the other hand, showed an unusual increase in pod yield from 922 kg ha^{-1} in 2022 to 1357 kg ha^{-1}in 2023, suggesting its adaptability to the conditions in 2023. Further, higher net returns (Rs.1,12,063/ha), benefit cost ratio (2.79) and rainwater use efficiency (4.60 kg/ha mm) were realized with Kadiri lepakshi followed by TCGS 1694 (Table 2). During 2023, all the tested varieties were subjected to drought. During drought year of 2023, TCGS-1694 recorded significantly higher dry pod yield (1556 kg ha^{-1}) and haulm yield (2834 kg ha^{-1}) compared to other tested varieties with rain water use efficiency of 4.42 kg ha^{-1}mm. Some varieties, such as Harithandhra and Nitya Haritha, maintained stable haulm production across both years, indicating their consistent vegetative growth. The non-significant difference in 2023 indicates that the weather conditions may have had a uniform effect on vegetative biomass across the varieties. Overall, Kadiri Lepakshi and TCGS-1694 emerged as high pod-yielding varieties, while Amaravathi consistently produced high haulm yield. The year-to-year variation highlights the influence of environmental factors on yield components, emphasizing the need to consider both yield and stability in variety selection for different agro-climatic conditions.

Moisture stress during groundnut reproductive stages (especially pegging and pod filling) severely reduces pod set, dry matter accumulation and final yield in K-6, Kadiri lepakshi and Dharani during 2023 (Radha Kumari and Sahadeva Reddy,2019). Drought during these phases often causes greater yield loss than stress at vegetative stages. Naik *et al.,* 2023 reported that Kadiri lepakshi recorded 3840 kg ha^{-1} and 2666 kg ha^{-1} dry pod yield and kernel yield, respectively with 31.87% increase and 29.74% increase compared to TAG 24. Several groundnut varieties are known for their resilience to climate stress, particularly drought and heat. Some notable examples include Kadiri Lepakshi, Kadiri Harithandhra, Visishta, and K-6, which are well-suited for rainfed conditions and offer high yield potential. Other varieties like G2-52, TMV-2, and GPBD-4 have also demonstrated good drought tolerance and yield potential (Gangurde *et al.,* 2019). Sahadeva Reddy *et al.* (2016) reported that 93 per cent yield reduction in terms of pods in groundnut due to wet spells in Ananthapur district. Wet spell ranging from 5 to 10 days period during 2008 and 2020 immediately after first flush of flowering was found detrimental. Further, excess rains resulted in incidence of leaf spot disease and sucking pests like jassids which reduced the conversion of photosynthates to economic yield. TCGS-1694, Nithya Haritha and K9 are the most climate resilient varieties compared to K6 and Dharani. These results indicate that Kadiri Lepakshi and TCGS-1694 are superior for pod production, while Amaravathi ensures high biomass, emphasizing the need to select varieties for both productivity and stability.

Table 1. Effect of extreme weather events on filled pods, pod and yield in different varieties of groundnut during Kharif 2022 and 2023.

Varieties	'Filled pods per plant'		'Pod yield (kg/ha)'		'Haulm yield (kg/ha)'	
	2022	2023	2022	2023	2022	2023
K-6	13.6	9.1	1159	831	2693	2361
Kadiri Lepakshi	30.3	13.9	2635	882	5101	2709
TCGS-1694	21.5	17.2	1900	1556	3289	2834
Nitya haritha	17.4	15.7	1587	1325	2644	2662
Harithandhra	15.8	12.9	922	1357	2450	2986
Amaravathi	15.2	13.6	1446	1337	3532	2942
Dharani	12.6	13.3	1144	896	2588	2571
K-9	16.2	8.5	1483	1147	2995	2474
S.Em.±	1.3	1.09	89	102	309	178
C.D. at 5 %	4.1	3.28	270	305	937	NS

Table 2. Effect of extreme weather events on net returns, B:C ratio and rain water use efficiency in different groundnut varieties during Kharif 2022 and 2023.

Varieties	Net returns (Rs/ha)		B:C Ratio		RWUE (kg/ha mm)	
	2022	2023	2022	2023	2022	2023
K-6	16088	-1991	1.26	0.97	2.32	2.36
Kadiri Lepakshi	112063	1242	2.79	1.02	4.60	2.51
TCGS-1694	61807	44226	1.99	1.71	3.80	4.42
Nitya haritha	40920	29495	1.65	1.46	2.77	3.76
Harithandhra	1251	31562	1.02	1.50	1.61	3.86
Amaravathi	36235	30282	1.58	1.48	2.89	3.80
Dharani	14802	2149	1.24	1.03	2.29	2.55
K-9	36257	18114	1.58	1.29	2.87	3.26

Groundnut variety TCGS-1694 is climate resilient for extreme weather events followed by Nithya Haritha and K9 in scarce rainfall agro climatic zone of Andhra Pradesh.

CONCLUSION

Among the varieties tested, TCGS-1694 identified as the most climate resilient groundnut variety for scarce rainfall agro climatic zone of Andhra Pradesh, maintaining high pod yields (1556 -1900kg ha^{-1}), haulm yields (2,834-3,289 kg ha^{-1}), and superior rain water use efficiency (3.80-4.42 kg ha^{-1}mm) across wet and dry extremes. Kadiri Lepakshi proved ideal for high rainfall events (2,635 kg ha^{-1} pod yield), extreme while Nithya Haritha and K-9 provided consistent intermediate performance. Farmers should prioritise these

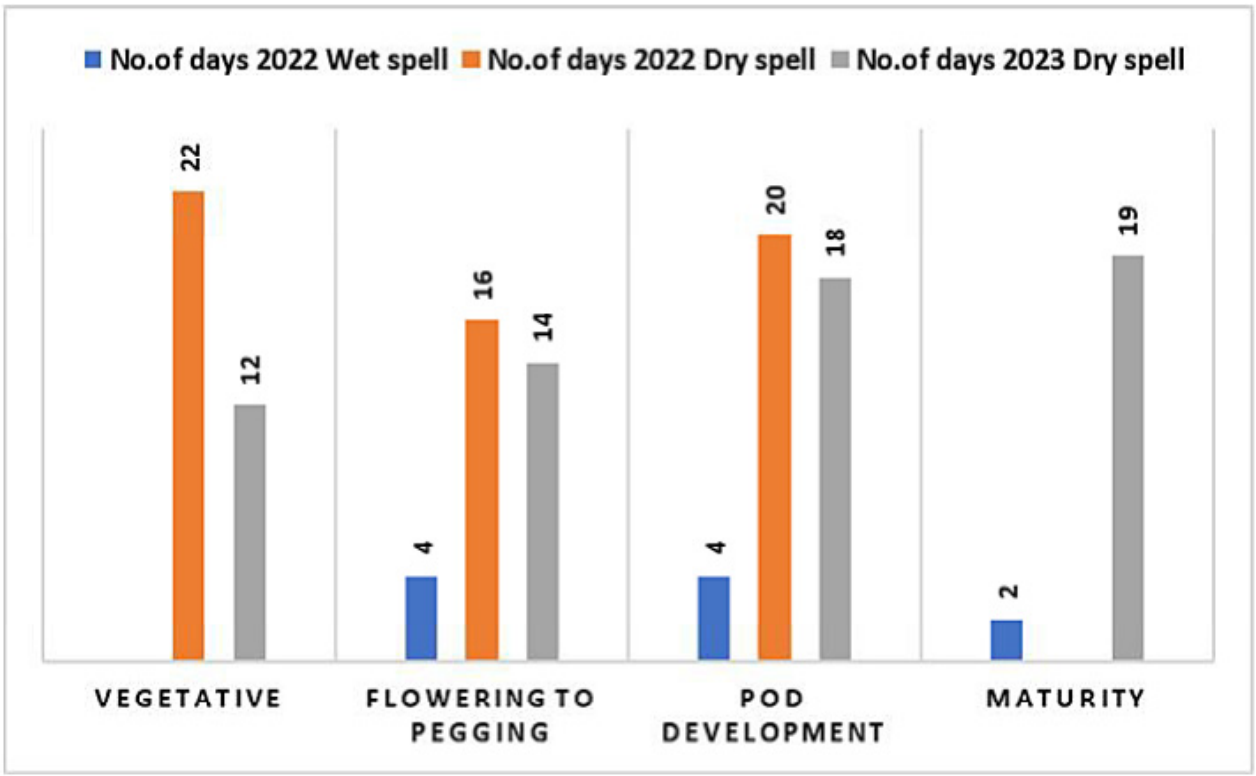

Fig.1. No.of days of dry and wet spell during crop growth stages in groundnut during 2022 and 2023

varieties -TCGS 1694 for dual resilience, Kadiri Lepakshi for wet conditions- to mitigate climate risks, enhance rainfed productivity (20-30% yield gain over susceptible checks like K-6), and improve economic returns (B:C ratio1.71-2.79) in challenging agro ecosystem of Ananthapur district.

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