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Assessment of drought resistant and high yielding groundnut variety for Sivaganga district of Tamil Nadu

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Abstract
A field trial was undertaken by Krishi Vigyan Kendra, Kundrakudi, Sivaganga District, during the rabi season of 2018–2019 to evaluate the performance of groundnut varieties with drought tolerance potential under rainfed farming situations. The experiment was carried out at a farmer's field in Avanipatty village, Thirupattur block, using a randomized block design with five treatments—T1: Dharani (TCGCS-1043), T2: VRI 8, T3: Kadiri 9, T4: VRI 2, and T5: TMV 7—each replicated seven times. Among the tested varieties, Dharani (TCGCS-1043) consistently outperformed others by recording higher germination (91.4%), plant height (64.3 cm), leaf area index (2.85), pod yield (18.5 q/ha), haulm yield (43.89 q/ha), and oil content (48.6%). It also yielded the highest net return (₹55,750/ha) and benefit–cost ratio (2.52). The findings suggest Dharani as a suitable, high-yielding, and drought-resilient groundnut variety for rainfed cultivation in Sivaganga District.

Keywords: Groundnut, dharani, rainfed, drought tolerance, yield, economics

Introduction
Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops grown in India, often referred to as the "poor man's cashew" and "wonder nut" due to its high nutritional and economic value. It is an essential dietary component for vegetarian populations, providing 40–50% oil, 20–40% protein, and 10–20% carbohydrates, depending on the variety.

In Tamil Nadu, groundnut occupies an estimated 3.47 lakh hectares, producing about 10.33 lakh tonnes annually, with an average productivity of 2,980 kg/ha. The state contributes approximately 8.64% to India's total groundnut production. In Sivaganga district, the crop is cultivated on about 1,670 hectares, yielding 3,835 tonnes (Season and Crop Report, 2023–24) [7]. Major blocks such as S. Pudur, Thirupattur, Kallal, Sivaganga, Kalaiyarkovil, and Thirupuvanam practice groundnut cultivation as a principal crop in their cropping systems.

Apart from its role as a cash crop, groundnut serves multiple purposes—its haulm is a valuable livestock feed, while oilcake from processing is a protein-rich component of animal rations. Additionally, the crop contributes to soil fertility through biological nitrogen fixation.

However, farmers in this region face several production challenges. Erratic rainfall and frequent dry spells during crop growth often lead to reduced yields, particularly when unsuitable varieties are grown under rainfed conditions. Limited awareness of drought-tolerant varieties, unbalanced fertilizer application, and inadequate knowledge of integrated pest and disease management further aggravate the problem. Drought during critical stages of crop growth severely impacts yield, although certain improved genotypes can sustain productivity through better physiological adaptations.

Considering these constraints, the present study was conducted to identify a groundnut variety that combines high yield potential with drought tolerance, ensuring better adaptability, farmer acceptance, and profitability under the rainfed conditions of Sivaganga district.

Materials and Methods
The on-farm trial was carried out by Krishi Vigyan Kendra, Kundrakudi, Sivaganga District, Tamil Nadu, during the rabi season of 2018–19. The study was implemented through a farmers' participatory approach involving seven farmers from Avanipatty village in Thirupattur block.

Sowing was scheduled according to the onset of the northeast monsoon and completed in December.

The experimental fields consisted of red soils with a pH of 7.4. Soil analysis revealed low available nitrogen (165 kg/ha), medium phosphorus (22 kg/ha), and high potassium (405 kg/ha). Land preparation was done using a country plough, and seeds were manually sown behind the plough.

Five groundnut varieties were evaluated

T1 – Dharani (TCGCS-1043)
T2 – VRI 8
T3 – Kadiri 9
T4 – VRI 2
T5 – TMV 7

The experiment followed a randomized block design with five treatments and seven replications. Recommended agronomic practices for groundnut, as outlined in the TNAU Crop Production Guide, were strictly followed. Farmers were provided with quality seeds, seed treatment materials (Trichoderma viride), and TNAU Groundnut Rich @ 5 kg/ha. Training sessions and method demonstrations were organized to enhance adoption of improved production technologies.

Data Collection and Parameters

Observations were recorded on growth attributes (germination percentage, plant height, leaf area index), yield components (number of mature pods/plant, test weight, seeds per pod, shelling percentage, pod and haulm yield, oil content), physiological traits (relative water content and water use efficiency), and economics (gross return, total cost, net return, benefit–cost ratio).

Relative water content (RWC) was estimated using the method of Barrs and Weatherley (1962). Fully expanded third leaves from the top were collected before irrigation cycles. Fresh weight (FW), turgid weight (TW), and dry weight (DW) were recorded, and RWC was calculated as:

RWC (%) = FW−DWTW−DW×100RWC (\%) = \frac{FW - DW}{TW - DW} \times 100RWC(%)=TW−DWFW−DW×100

Water use efficiency (WUE) was computed following Sinclair *et al*. (1984) [8]:

WUE=YWRWUE = \frac{Y}{WR}WUE=WRY

Where Y is the crop yield (kg/ha) and WR is the total water used (mm).

Growth and yield data were obtained from five randomly selected plants per plot. Dry matter production (DMP) was measured from plant samples collected from designated sampling rows. Statistical analysis was carried out using AGRES software.

Results and Discussion

1. Growth attributes

Significant variation was observed among the varieties for all measured growth parameters (Table 1). Dharani (TCGCS-1043) recorded the highest germination (91.4%), plant height (64.3 cm), leaf area index (2.85), and dry matter production (4,315 kg/ha). Early and uniform germination of Dharani likely contributed to an optimal plant stand, which in turn enhanced canopy development and photosynthetic efficiency, resulting in higher dry matter accumulation.

Varieties with larger seeds or slower establishment, such as TMV 7 and VRI 2, exhibited comparatively lower growth metrics. The trend observed in the present study is consistent with earlier reports by Aruna *et al*. (2017) [1], Kumari and Reddy (2019) [3], and Sahaja Deva *et al*. (2022) [5], who highlighted varietal differences in plant height and canopy development under drought conditions. Mensah and Okpere (2000) [4] also reported significant differences in growth among groundnut cultivars.

Table 1: Performance of drought tolerant varieties on growth attributes of Groundnut.

Treatments	Germination Percentage (%)	Plant height (cm)	Leaf Area Index	Drymatter Production (Kg/ha)
T_1 - Dharani (TCGCS-1043)	91.4	64.3	2.85	4315
T_2 - VRI 8	90.2	58.5	2.35	3689
T_3- Kadiri 9	89.5	47.3	2.41	3545
T_4 - VRI 2	85.4	45.8	2.39	3150
T_5 - TMV 7	74.5	55.5	2.12	3100
S Ed	7.8	4.9	0.2	320.4
CD (P=0.05)	16.5	10.4	0.5	682.2

2. Physiological parameters

At the critical growth stage, Dharani recorded the highest relative water content (85.5%), followed closely by VRI 8 (82.5%), while VRI 2 had the lowest (59.8%). Higher RWC values in Dharani indicate superior water retention capacity under moisture stress, which is crucial for maintaining cell turgidity and metabolic activity during drought spells.

Proline accumulation ranged from 17.8 to 21.8 µmol g^{-1} fresh weight, with Dharani showing the maximum (21.7 µmol g^{-1}). Elevated proline content under drought stress is a known adaptive mechanism, helping plants maintain osmotic balance and protect cellular structures. Similar findings were reported by Madhusudhan and Sudhakar (2014) and Gunes *et al*. (2008) [2], who linked higher proline levels with better stress tolerance in groundnut.

Table 2: Performance of drought tolerant varieties on relative water content and proline content of Groundnut.

Treatments	RWC (%)	Proline content (µmoles g^{-1} fresh weight)
T_1 - Dharani (TCGCS-1043)	85.5	21.7
T_2 - VRI 8	82.5	20.8
T_3- Kadiri 9	62.3	21.3
T_4 - VRI 2	59.8	21.8
T_5 - TMV 7	72.2	17.8
S Ed	6.5	1.9
CD (P=0.05)	13.9	4.0

3. Yield and economics

Dharani outperformed all other varieties in yield attributes, registering the highest number of mature pods per plant (17.5),

maximum test weight (40.3 g), highest oil content (48.6%), and superior pod yield (18.5 q/ha). It also produced the maximum haulm yield (43.89 q/ha) and shelling percentage (74.5%). The lowest values for most yield parameters were recorded in VRI 2.

In economic terms, Dharani generated the highest gross returns (₹92,500/ha) and net returns (₹55,750/ha) with a benefit–cost ratio of 2.52. The advantage of Dharani is attributed to its genetic potential, better drought tolerance, lower susceptibility to root rot, and superior yield components. These results are in agreement with the findings of Saravanan *et al*. (2018) [6] and Kumari and Reddy (2019) [3].

Farmer feedback indicated that Dharani was the most preferred variety due to its yield stability, pod size, and adaptability under rainfed conditions. The variety was ranked first in preference, with 74% of farmers expressing willingness to continue its cultivation.

Table 3: Performance of drought tolerant varieties on yield, halum yield and shelling percentage of Groundnut.

Treatments	No. of Matured pods / plant	Test weight (g)	No. of seeds per pod	Oil Content (%)	Yield (q/ha)	Haulm Yield (q/ha)	Shelling percentage (%)
T_1 - Dharani (TCGCS-1043)	17.5	40.3	2	48.6	18.5	43.89	74.5
T_2 - VRI 8	16.3	38.7	2	46.2	16.3	37.95	70.5
T_3- Kadiri 9	15.1	37.5	2	48.3	15.9	36.24	69.6
T_4 - VRI 2	14.5	32.5	2	43.5	13.3	33.25	63.5
T_5 - TMV 7	14.8	36.8	2	50.1	14.5	31.44	66.8
S Ed	1.4	3.3	0.01	4.26	1.41	3.29	6.24
CD (P=0.05)	3.0	7.1	NS	9.08	3.01	7.01	13.3

Table 4: Performance of drought resistant varieties cost economics of Groundnut.

Treatments	Gross Returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net Returns (Rs./ ha)	B:C ratio
T_1 - Dharani (TCGCS-1043)	92500	36750	55750	2.52
T_2 - VRI 8	81500	35750	45750	2.28
T_3- Kadiri 9	79500	34240	45260	2.32
T_4 - VRI 2	72500	37250	35250	1.95
T_5 - TMV 7	66500	36400	30100	1.83

Table 5: Farmer's Perception Parameters of Groundnut varieties

Treatments	Appropriateness to the accessible farming system (Y/N)	Likings (Varietal ranking)	Affordability (%)	Suggestions, for Change/Improvement, If any
T_1 - Dharani (TCGCS-1043)	Yes	I	74	Nil
T_2 - VRI 8	Yes	II	80	Nil
T_3- Kadiri 9	Yes	III	75	Small size pod low oil content
T_4 - VRI 2	Yes	V	65	Nil
T_5 - TMV 7	Yes	IV	72	Nil

Conclusion

The findings of this study clearly indicate that the groundnut variety Dharani (TCGCS-1043) is well-suited for rabi season cultivation in the rainfed environments of Sivaganga District. The on-farm testing (OFT) not only validated its superior performance in terms of yield and profitability but also enhanced farmer awareness and adoption of improved varieties and management practices. Notable gains were observed in farmer knowledge, acceptance of the new technology, and satisfaction with the results. Considering its adaptability, drought tolerance, and economic advantage, Dharani is recommended for widespread cultivation across similar agro-climatic zones.

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