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Marimuthu Subbaiyan
National Pulses Research Centre, Vamban, Pudukkottai 2.Seed centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Kathiravan Muthuselvan
National Pulses Research Centre, Vamban, Pudukkottai 2.Seed centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Correspondence
Marimuthu Subbaiyan
National Pulses Research Centre, Vamban, Pudukkottai 2.Seed centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Impact on the performance of Groundnut CO7 under drought situation in Pudukkottai district of Tamil Nadu

Marimuthu Subbaiyan and Kathiravan Muthuselvan

Abstract
Groundnut (*Arachis hypogaea* L.) is an important oil seed crop mainly grown under rainfed situation. Due to erratic rainfall and frequent drought during the crop growth period, groundnut yields are generally low and unstable under rainfed conditions. Drought during critical crop growth stages is crucial for yield in groundnut varieties. But tolerant genotypes may give better yield due to maintenance of physiological responses that were triggered during drought. Field experiment was conducted during *kharif* 2015 at farmers field through front line demonstration trials by Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vamban, Pudukkottai to study the impact of drought tolerant groundnut CO7 in Pudukkottai district of Tamil Nadu. The results revealed that on an average of ten different locations, the groundnut CO7 recorded the higher plant height of 50.10 cm, no. of pods per plant 38.99, higher pod yield of 2055 kg ha^{-1} and benefit cost ratio was higher 2.27 than groundnut VRI 2. Moreover 349 and 245 kg ha^{-1}, 10.66, Rs.17,466 ha^{-1} and 5.51 of Extension gap, technology gap additional return and Incremental cost benefit ratio respectively due to adaption of drought resistant groundnut CO7 with improved production technology than farmers practice, hence the farmers are interested to adopt this variety to get more income in Pudukkottai district.

Keywords: Groundnut, rainfed, pod yield, economics, Extension gap

Introduction
Groundnut, the king of oil seeds is one of the important legume crops cultivated predominantly under rain-fed conditions in the tropical and semi-arid tropical countries including India. It provides food and feed and a major source of oil, carbohydrates and proteins (Bhauso, *et al.*, 2014, Vaidya *et al.*, (2015) [1, 3] and Saravanan *et al.*, 2018) [1, 2, 3]**.** Its kernel is rich in both oil (43 - 55%) and protein (25 - 28%). In India, it is utilized as roasted nuts, salting, oil and in confectionery. It is not only grown for grain yield but also the haulm is important byproduct used for livestock feed by Reddy *et al.*, (2003) [4]. In Tamil Nadu, Pudukkottai is one of the major groundnut growing area, which is cultivated in an area of 19, 820 hectares in the country where unpredictable environmental conditions, uncertain rainfall and water shortage are limiting factors leads to yield of groundnut crop is very low. Abiotic stresses are an integral part of 'climate change', which can change soil-plant-atmosphere continuum thereby influencing the productivity of crops. During the entire season, the crop subjected to water deficit stress at one stage or another leading to drastic reduction in productivity. This necessitates development of cultivars; it can withstand water stress and still can be productive. Reduction in groundnut yield resulting from drought has been well documented by Reddy *et al.*, (2003) [3]. Drought during the pod and seed forming stages has been shown to reduce pod yield of peanut by 56-85% by Nageswara Rao *et al*., (1989) [5]. Other limiting factors include unavailability of high yielding drought resistant varieties. For these areas, there is urgent need to develop such high yielding varieties having resistance to drought stress, which limit the crop productivity. Groundnut yield in rainfed areas has been limited by drought stress because pod yield and other growth parameters have been severely affected. Hence, the study was planned with the objective of performance of drought tolerant groundnut variety with improved production technology under *kharif* season through front line demonstration trials in Pudukkottai district of Tamil Nadu.

Material and Methods
A field experiments were conducted during *kharif* season 2015 in ten locations at farmers field through front line demonstration testing trials through ICAR- Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vamban, Pudukkottai to study the Popularization of drought

tolerant groundnut CO7 with improved production technology in Pudukkottai district of Tamil Nadu. The soils of experiment site were light textured, shallow Alfisols, low in nutrients. In Pudukkottai, the minimum and maximum temperature is 21 and 39 °C respectively and average annual rainfall of 921.5 mm and rainfall is erratic with prolonged dry spells of 45 – 50 days and annual rainfall 840 mm with 52 rainy days. The total rainfall received during the experimental period was 470.30 mm distributed in 24 rainy days.

A total 10 demonstrations in area of 4 hectares were conducted on farmers' field in 7 villages comprising of 3 blocks *viz*., Kalyanipuram, Kothakottai, and Kurunthadimanai villages of Thiruvarankulam block, Poovaimanagar, Poovatrakudi and Seemanur villages of Aranthangi block and Kuvattupatti village of Annavasal block of Pudukkottai district in Tamil Nadu. Each demonstration was conducted on an area of 0.4 ha, adjacent to the demonstration plot was kept as farmers' practices. All the 10 farmers active participants and 100 % target achieved. The groundnut CO7 was selected for this experiment, which is an elite high yielding drought tolerant groundnut variety, which was developed at Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2013. It was developed from a Derivative of the cross ICGV 87290 x ICGV 87846 and has the following features are high yielding, matures in 100- 105 days and tolerant to drought.

The improved production technologies *viz*., the drought resistant and high yielding variety of groundnut CO7 with quality seeds was used. Seed sowing was done during July 2015 with a seed rate of 120 kg ha^{-1}. The line sowing was done with recommended row spacing was 30cm plant to plant spacing was 10 cm because excess population adversely affects growth and yield of crops. Seed treated with talc formulation of *Pseudomonas fluorescens* @ 10 g kg^{-1} of seed. Finally seeds was treated with biofertilizer with *Rhizobium* culture @ 600 g ha^{-1} along with Phosphobacteria @ 600 g ha^{-1} of seeds), which was developed at TNAU using rice kanji as binder. In case of local check plots, existing farmer's practice *viz*., broad casting of seed, No seed treatment, No weed management and only FYM and no fertilizer application were followed by farmers.

The recommended dose of fertilizer for groundnut was applied at the rate 10 kg N + 10 kg P_2O_5 + 45 kg K_2O + 10 kg S ha^{-1}. Sulphur was applied in the form of gypsum as a source of phosphorus. Micro nutrient *viz*., application of boron @ 5 kg ha^{-1} under rainfed condition was applied as basal. For yield improvement through increasing the physiological, biochemical attributes, foliar spray of groundnut rich @ 5 kg ha^{-1} at peak flowering and pod filling stages was done. Pheromone traps was set up @12 ha^{-1} against *Spodoptera litura* and monitored the activity of the pest and to synchronize the pesticide application. The biometric observation *viz*., germination percent, plant population, plant height, yield attributes and yield were recorded and field emergence and economics were worked out. Different parameters as suggested by Yadav *et al.*, (2004) [6] was used for gap analysis, technology index and calculating the economics parameters of groundnut. The details of different parameters and formula adopted for analysis are as under

Extension gap = Demonstration yield - Farmers' practice yield

Technology gap = Potential yield – Demonstration yield

Technology index = Potential yield – Demonstration yield/Potential yield x 100

Additional cost (Rs.) = Demonstration Cost (Rs.) - Farmers' Practice Cost (Rs.)

Additional returns = Demonstration returns (Rs.)- Farmers' practice returns (Rs.)

Incremental B: C ratio =Additional Returns/ Additional Cost.

Groundnut yield attributes and yield was recorded at the time of harvesting. The groundnut pod produced under improved production technology was sold @ Rs.50 kg^{-1}.

Results and Discussion

Growth parameter

The results revealed that the groundnut plant population was recorded ranged from 22.92 to 25.44 plants m^{-2}, field emergence 69.45 to 77.09 per cent and plant height 48.32 to 52.67cm. The mean value of groundnut plant population 24.10 plants m^{-2}, plant height 50.10 cm and field emergence 73.02 per cent, (Table 1). It was least in farmer practice at 15 DAS and at harvest. Higher plant height in CO 7 may be attributed to the variety, which tends to germinate and establish early compared to local variety and farmer practice. Similar increase in plant height with large seeds was also observed by Singh *et al*. (1998) and Nandania *et al*, 1998) [7, 8]. The significant differences among the different varieties of groundnut for plant height throughout the growth period Mensa *et al*, (2000) [9].

Yield parameters and Yield

The groundnut CO7 reported as drought tolerant and produced higher no. of pods per plant ranged from 35.34 to 43.70, pod yield 1969 to 2178 kg ha^{-1}, kernel yield 1372 to 1559 kg ha^{-1} and shelling percentage 68.57 to 71.69 per cent. On an average of ten different locations the groundnut CO7 gave the highest no. of pods per plant 38.99, pod yield 2055 kg ha^{-1}, kernel yield 1439 kg ha^{-1} and shelling percentage 69.98 % respectively (Table 1&2). Groundnut yield in the district is highly variable and determined by rainfall. Nevertheless, groundnut can survive long dry spells and is a valuable source of fodder during dry years by Saravanan *et al.*, (2018) [2].

Table 1: Performance of growth, yield attributes and yield of drought resistant groundnut CO7

Sl. No	Name of the farmers	Plant population (Nos/ m^2)		Field emergence (%)		Plant height (cm)		No.of pods/ plant		Pod yield (kg ha^{-1})	
		IPT	FP	IPT	FP	IPT	FP	IPT	FP	IPT	FP
1	R.Pragathambal W/o. K. Rajendran Kalyanipuram	25.02	19.77	75.82	64.45	51.23	46.62	42.41	36.05	2159	1792
2	C. Amirthavalli W/o. Chelladurai Kothakkottai	24.36	19.24	73.82	62.75	50.37	45.84	39.62	33.68	2071	1719
3	K. Muthukumar S/o. Karuppaiah Kothakkottai	23.29	18.40	70.58	59.99	48.91	44.51	36.85	31.32	1978	1642
4	M. Saroja W/o. KLC. Marimuthu Poovaimanagar	23.18	18.31	70.24	59.70	48.39	44.03	35.42	30.11	1972	1637
5	P. Thavamani 6W/o. Pandiyan Poovatrakudi	23.11	18.26	70.03	59.53	48.32	43.97	35.34	30.04	1969	1634
6	R. Karuppaiah S/o. Ramaiya Kurunthadimanai	25.44	20.10	77.09	65.53	52.67	47.93	41.95	35.66	2178	1808
7	D. Shanthi W/o. N. Devendran Kurunthadimanai	22.92	18.11	69.45	59.03	49.29	44.85	36.72	31.21	1971	1636
8	M. Jeeva S/o.K.P. Murugan Kuvattupatti	24.07	19.02	72.94	62.00	49.95	45.45	37.96	32.27	2016	1673
9	P. Rengaraj S/o. Perumal Seemanur	24.98	19.73	75.70	64.35	51.38	46.76	43.7	37.15	2144	1780
10	D. Suresh S/o. Dhanaraju Kothakkottai	24.61	19.44	74.58	63.39	50.53	45.98	39.92	33.93	2090	1735
	Mean	24.10	19.04	73.03	62.07	50.10	45.59	38.99	33.14	2055	1705

Table 2: Performance of drought resistant groundnut on economics and gap analysis, technology index and calculating the economics parameters

Sl. No	Kernel yield (kg ha^{-1})		Shelling %		BCR		EG (kg/ha)	TG (kg/ha)	TI	AR (Rs/ha)	Incr. BCR
	IPT	FP	IPT	FP	IPT	FP					
1	1548	1168	71.69	65.20	2.38	2.12	367	141	6.13	18352	5.93
2	1449	1152	69.97	67.00	2.29	2.06	352	229	9.96	17604	5.03
3	1383	1074	69.94	65.42	2.18	1.92	336	322	14.00	16813	6.43
4	1375	1115	69.72	68.10	2.17	1.92	335	328	14.26	16762	5.96
5	1372	1085	69.66	66.40	2.16	1.92	335	331	14.39	16737	5.54
6	1559	1229	71.55	68.00	2.41	2.18	370	122	5.30	18513	4.97
7	1363	1060	69.17	64.81	2.18	1.92	335	329	14.30	16754	6.43
8	1382	1054	68.57	63.00	2.23	1.99	343	284	12.35	17136	5.42
9	1511	1196	70.48	67.20	2.37	2.12	365	156	6.78	18224	5.59
10	1444	1157	69.07	66.70	2.31	2.10	355	210	9.13	17765	4.51
Mean	1439	1129	69.98	66.18	2.27	2.03	349	245	10.66	17466	5.51

EG-Extension gap, TG- Technology gap, TI- Technology Index, AR- Additional return, Incr.BCR- Incremental Benefit Cost Ratio

Economics and gap analysis, technology index and calculating the economics parameters

The gross and net returns were Rs. 1, 02740 and Rs. 57, 438 ha^{-1} respectively by cultivating CO7 as against Rs.85,274/- and Rs.43,144/-ha respectively in the check variety VRI 2 (Fig.1). Due to higher groundnut pod yield the benefit cost ratio was also higher 2.27. The probable reason were drought withstand genotype and lesser incidence of root rot disease coupled with higher number of pods plant $^{-1}$ resulting higher pod and haulm yield, these results were in agreement with the findings of Vindhiyavarman *et al.*, (2010) [10]. Moreover 349 and 245 kg ha^{-1}, 10.66, Rs.17,466 ha^{-1} and 5.51 of Extension gap, technology gap additional return and Incremental cost benefit ratio respectively (Table 2) due to adaption of drought resistant groundnut CO7 than existing variety with improved production technology.

Conclusion

Groundnut variety, CO 7 with improved production technology recorded 15 per cent more number of pods per plant, 17 per cent higher pod yield, good withstand under drought condition and performed very well, higher additional return and Incremental cost benefit ratio compared to VRI 2 variety with farmer practice under rainfed condition. Farmers were very satisfied with CO 7, as the crop did not suffer from a dry spell of 15-19 days without rain. Hence, the farmers are interested to adopt this groundnut variety CO 7 for rainfed cultivation to get more income in Pudukkottai district.

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