EVALUATION OF FIELD PERFORMANCE OF GROUNDNUT VARIETIES THROUGH DIFFERENT VIGOUR TESTS

ABSTRACT

A field experiment was carried out to evaluate the field performance of groundnut varieties through different vigour tests during *Rabi*, 2023-24 at S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experimental material consisted of 10 groundnut varieties Narayani, Dharani, Dheeraj, TCGS-1694, Nithya Haritha, Kadiri-9, Kadiri-6, Kadiri Amaravathi, Kadiri-1812 and TAG-24 collected from different sources. In the preliminary experiment seed multiplication was done and the multiplied seed was used for conducting six vigour tests namely Germination test, speed of germination test, Seedling vigour index-I, Seedling vigour index-II, Accelerated ageing test, Electrical conductivity test in the laboratory using Completely Randomised Design with four replications. The multiplied seed was used for evaluating field performance using Randomised block design with three replications. Significant differences were found among the varieties based on vigour levels. Results with respect to field experiment showed that growth parameters *i.e.* field emergence percentage, days to 50 % flowering, days to maturity, number of branches per plant, number of pods per plant, pod yield per plant, kernel yield per plant, pod yield per plot, plant height, shelling percentage, 100 seed weight and harvest index varied significantly among different varieties based on different vigour levels. Varieties with higher vigour had shown higher field emergence percentage. Among the ten varieties Kadiri-6 had shown highest field emergence percentage. Significant correlation was observed among laboratory and field experiments. Vigorous varieties were able to perform better in terms of some of the field parameters and among all the vigour tests performed speed of germination test had high correlation with field emergence.

Key words : *field performance, vigour levels, correlation*, *Completely Randomised Design*, *Randomised block design*

INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is an important oilseed crop, belonging to the family Leguminosae. This self -pollinating plant species possesses a specific chromosome count of (2n=40). This crop is widely cultivated and consumed in various tropical and subtropical countries around the world. The plant's seed germinates and develops underground, a characteristic known as geotropism.

Groundnut is believed to be the native of Brazil. Its introduction to India occurred in the first half of the sixteenth century. It is grown on approximately 42 million acres worldwide. China is the world's leading producer of groundnut, followed by India, the United States, and Argentina. India is the largest exporter of groundnut globally. It is the third major oilseed of the world behind soybean and cotton.

Groundnut (*Arachis hypogaea* L.), is an important crop economically and nutritionally in many tropical and subtropical areas of the world. It is mainly used for oil production, It's seeds contain 43-55 percent oil, 24-26 percent protein, 45-48 percent fat, 3 percent fiber and 15- 18 percent carbohydrates. Hence Groundnut serves as a vital source of food and energy. However, despite its importance, groundnut cultivation faces challenges due to the uncertainty of the pod development, where seeds are developed underground resulting in variations in plant productivity. Before seeds are sown, effective screening of high-quality seeds for planting is crucial to improve the quality of crop yield. Knowing how well seeds will germinate (sprout) and picking seed batches with the best germination rates is an important step towards getting a successful harvest. Field emergence percentage reflects the practical viability of the seeds and their ability to overcome various environmental challenges. It offers farmers crucial information about expected stand establishment and potential yield. Field emergence tests offer a more realistic picture of how seeds will perform in the actual environment.

MATERIALS AND METHODS

The present experiment was conducted at Department of Seed Science and Technology, S.V. Agricultural College, Tirupati. Popular Groundnut varieties Narayani, Dharani, Dheeraj, TCGS-1694, Nithya Haritha released from RARS, Tirupati, Kadiri-9, Kadiri Amaravathi, Kadiri-6, Kadiri-1812 from ARS, Kadiri and Tag-24 from BARC, Trombay were collected and seed multiplication was taken up. The harvested seed was used for evaluating field emergence and other yield parameters. Each variety was sown in 4 rows of 5m length at spacing of 22.5cm between the rows and 10cm between the plants in a row in randomized block design. The recommended dose of N, P and K were applied. Full dose of phosphorous and potassium and half

dose of nitrogen were applied at the time of sowing while remaining is applied at 30 days after sowing. Gypsum @ 500 Kg ha^{-1} was applied at initiation of flowering period. Intercultural operations and irrigation schedules were followed as and when necessary. Need based plant protection measures were adopted to raise a healthy crop. Crop was harvested at maturity and yield parameters were recorded.

Field emergence (%):

The total seedlings emerged upto 15 days after sowing is considered and emergence percentage was calculated as per the formula.

$$\text{Field Emergence (\%)} = \frac{\text{Number of seedlings emerged}}{\text{Total number of seed sown}} \text{x100}$$

Plant height (cm):

Plant height was recorded from the randomly selected five plants from base of plant up to the growing tip at the time of harvest and the average height of the plants was expressed in cm.

Days to 50 % flowering:

The number of days taken by 50 percent of the population to produce flower was recorded as days to 50% flowering.

Days to maturity:

The number of days taken from the date of sowing to complete physiological maturity in the plot was recorded as days to maturity.

Number of branches per plant:

Numbers of branches from randomly tagged plants was recorded at harvest and expressed as number of branches per plant.

Number of pods per plant:

The average number of pods per plant were counted manually from randomly selected five plants and expressed as number of pods per plant.

Pod yield per plant (g):

Groundnut pods were harvested, stripped, dried and weighed from randomly selected five plants and pod yield per plant is recorded.

Kernel yield per plant (g):

Groundnut pods were harvested, stripped, dried and after shelling kernel yield per plant is weighed and expressed in grams.

Pod yield per plot (kg ha^{-1}) :

Groundnut pods were harvested, stripped, dried and weighed. Pod yield was computed per hectare (kg ha^{-1}) based on area of each net plot.

Shelling percentage :

From each plot 100 g of clean pods were taken and shelling percentage is calculated using formula

$$\text{Shelling per cent} = \frac{\text{Kernel Weight (g)}}{\text{Pod Weight (g)}} \text{ X } 100$$

100 seed weight (g):

Hundred seeds were counted at random from the harvested produce of each replication, weighed with an electronic weighing balance and recorded as 100 seed weight in grams.

Harvest index (%) :

Harvest index was calculated by using the formula given by Donald and Hamblin (1976).

$$\text{Harvest Index (HI)} = \frac{\text{Economic yield (kg)}}{\text{Biological yield (kg)}} \text{x} 100$$

The mean data obtained from the experimentation was statistically analysed and subjected to the Analysis of variance by adopting appropriate statistical methods as outlined by Panse and Sukhatme (1978). Correlation analysis was conducted between laboratory and field emergence.

RESULTS AND DISCUSSION

Field emergence:

Higher field emergence percentage (%) was recorded by Kadiri-6 (63.37 %). followed by Tag-24 (62.74 %) which was on par with Narayani (62.36 %) and were considered vigorous. The lowest field emergence (%) was recorded by Kadiri Amaravathi (35.60 %) followed by Kadiri-9 (47.53 %) which had low vigour potential. The results are in agreement with Perry, (1978).

Varieties	Field emergence (%)	Days to 50 % flowering	Days to maturity	Number of branches per plant
Narayani	62.36 (53.15)	27.67	95.33	5.47
Dharani	60.10 (44.58)	31.33	109.33	6.13
Dheeraj	57.77 (50.46)	32.67	108.67	5.87
Nithya Haritha	59.16 (51.27)	42.67	113.33	6.13
TCGS-1694	54.76 (48.72)	38.67	109.00	5.93
Kadiri-6	63.37 (51.82)	31.67	108.33	5.47
Kadiri-1812	48.01 (44.85)	60.67	128.33	9.73
Kadiri-9	47.53 (53.75)	41.67	118.33	5.53
Kadiri Amaravathi	35.60 (37.63)	63.33	126.67	7.87
Tag-24	62.74 (53.38)	29.33	100.00	6.60
Mean	**55.14 (48.95)**	**39.97**	**111.73**	**6.47**
S.Em. ±	**3.60**	**0.58**	**1.24**	**0.28**
C.D. (0.05)	**11.51**	**1.87**	**3.99**	**0.92**
C.V (%)	**11.31**	**2.54**	**1.93**	**7.72**

Table 1. Effect of vigour levels on field emergence (%), days to 50% flowering, days to maturity, number of branches per plant of groundnut varieties

(Figures in parenthesis indicates arcsine transformed values)

Varieties	Number of pods per plant	Pod yield per plant (g)	Kernel yield per plant (g)	Pod yield (kg^{-ha})
Narayani	17.93	12.67	8.26	2299.70
Dharani	18.87	22.27	15.13	2729.97
Dheeraj	16.47	18.33	10.66	3367.95
Nithya Haritha	25.13	17.53	14.73	5187.93
TCGS-1694	18.33	24.73	16.80	3189.91
Kadiri-6	16.27	20.87	13.40	2706.23
Kadiri-1812	19.20	20.00	13.80	3991.10
Kadiri 9	20.00	15.53	12.66	4416.42
Kadiri Amaravathi	25.20	27.40	19.13	3406.53
Tag-24	21.93	18.27	11.93	3135.51
Mean	**19.93**	**19.76**	**13.65**	**3443.13**
S.Em. ±	**0.70**	**1.61**	**1.04**	**237.59**
C.D. (0.05)	**2.25**	**5.17**	**3.34**	**705.82**
C.V (%)	**6.11**	**14.18**	**13.27**	**11.95**

Table 2. Effect of vigour levels on number of pods per plant, pod yield per plant, kernel yield per plant, pod yield of groundnut varieties

Varieties	Plant height(cm)	Shelling percentage (%)	100 seed weight(g)	Harvest index (%)
Narayani	27.53	68.53	25.67	36.65
Dharani	25.73	57.84	34.33	42.87
Dheeraj	30.73	68.54	40.00	46.41
Nithya Haritha	19.20	66.38	43.00	67.65
TCGS-1694	24.53	64.91	35.33	48.80
Kadiri-6	24.73	68.89	39.33	41.50
Kadiri-1812	21.60	67.84	35.33	56.29
Kadiri-9	24.33	69.74	41.33	52.30
Kadiri Amaravathi	26.33	69.42	41.33	43.73
Tag-24	14.53	68.05	26.67	53.69
Mean	**23.92**	**67.01**	**36.23**	**48.99**
S.Em. ±	**1.10**	**0.76**	**1.03**	**2.26**
C.D. (0.05)	**3.53**	**2.46**	**3.32**	**7.23**
C.V (%)	**7.99**	**1.98**	**4.96**	**7.99**

Table 3. Effect of vigour levels on plant height, shelling percentage, 100 seed weight, harvest index of groundnut varieties

Days to 50 percent flowering:

Highest number of days to 50 % flowering was recorded by Kadiri Amaravathi (63.33) followed by Kadiri-1812 (60.67). Lowest days to 50% flowering was recorded by Narayani (27.67) followed by Tag-24 (29.33). The results are in line with Maurya *et al*., (2014)

Days to maturity:

Number of days to maturity for different varieties ranged from 95.33 to 126.67. Highest was recorded by Kadiri-1812 (128.33) followed by Kadiri Amaravathi (126.67). Lowest days to maturity was recorded by Narayani (95.33) followed by Tag-24 (100.00). the results are in line with Maurya *et al*., (2014).

Number of branches per plant:

Highest number of branches per plant was recorded by Kadiri-1812 (9.73). Second highest number of branches per plant was recorded by Kadiri Amaravathi (7.87). Lowest number of branches per plant was recorded Narayani (5.47) which is on par with Kadiri-6 (5.47) followed by Kadiri-9 (5.53) The results in the present study are also in agreement with Bharathi (2010).

Number of pods per plant:

Number of pods per plant for different varieties ranged from 16.27 to 25.20. Highest number of pods per plant was recorded by Kadiri Amaravathi (25.20) followed by Nithya Haritha (25.13). Lowest number of pods per plant was recorded by Kadiri-6 (16.27) followed by Dheeraj (16.47). Findings of Bharathi (2010) support the current study.

Pod yield per plant (g):

Highest pod yield per plant was recorded by Kadiri Amaravathi (27.40g). Second highest pod yield per plant was recorded by TCGS-1694 (24.73g). Lowest pod yield was reported in Narayani (12.67g) followed by Kadiri-9 (15.53g). Maurya *et al*., (2014) noticed the prevalence of significant difference among the genotypes for pod yield per plant.

Kernel yield per plant (g)

Highest kernel yield per plant was recorded by Kadiri Amaravathi (19.13g) followed by TCGS-1694 (16.80g). Lowest pod yield was observed in Narayani (8.26g) followed by Dheeraj (10.66g). Findings of Maurya *et al*., (2006) support the current study

Pod yield per plot (kg ha^{-1})

Highest pod yield was recorded by Nithya Haritha (5187.93 kg ha^{-1}) followed by Kadiri-9 (4416.42 kg ha^{-1}). Lowest pod yield was reported in Narayani (2299.70 kg ha^{-1}) followed by Kadiri-6 (2706.23 kg ha^{-1}). Though Kadiri-6 was highly vigorous under favourable conditions in the laboratory has not shown similar performance in the field due to unfavourable conditions like it's suceptability to late leaf spot, stem rot and dry root rot diseases.

Nithya Haritha having performed satisfactorily in all other field parameters recorded highest pod yield. This may be due its high yield potential.

Plant height (cm):

Maximum plant height was recorded by Dheeraj (30.73cm) followed by Narayani (27.53cm). Minimum plant height was recorded by Tag-24 (14.53cm) followed by Nithya Haritha (19.20cm). Bharathi (2010) reported that the plant height increased with increase in age of the crop and attained maximum plant height at harvest

Shelling percentage (%)

Highest shelling percentage was recorded by Kadiri-9 (69.74%) and second highest shelling percentage was recorded by Kadiri Amaravathi (69.42%). Lowest shelling percentage was recorded by Dharani (57.84%) followed by TCGS-1694 (64.91%). The reports were in line with Maurya *et al.,* (2006).

100 seed weight (g)

Highest 100 seed weight was recorded by Nithya Haritha (43.00g) and second highest 100 seed weight was recorded by Kadiri-9 (41.33g) which was on par with Kadiri Amaravathi

(41.33g). Lowest 100 seed weight was recorded by Narayani (25.67g) followed by Tag-24 (26.67g).

Harvest index (%)

Highest harvest index was recorded by Nithya Haritha (67.65%) and second highest was recorded by Kadiri-1812 (56.29%). Lowest harvest index was recorded by Narayani (36.65%) followed by Kadiri-6 (41.50%). Reduction in the harvest index of Narayani was due to reduction in the economic yield whereas Nithya Haritha having highest pod yield per ha also had high harvest index when compared to other varieties.

Table 4. Correlation between laboratory parameters and field emergence

	Germination (%)	Root length(cm)	Shoot length(cm)	Seedling length(cm)	Root dry weight (g)	Shoot dry weight(g)	Seedling dry weight (g)	Speed of germination	SVI I	SVI II	EC of seed leachates	Germination (%) after AA	Field emergence (%)
Germination (%)	1	0.979**	0.959**	0.979**	0.602NS	0.797**	0.776**	0.928**	0.992**	0.855**	-0.880**	0.993**	0.732*
Root length (cm)		1	0.964**	0.992**	0.741*	0.872**	0.863**	0.979**	0.991**	0.924**	-0.880**	0.979**	0.717*
Shoot length (cm)			1	0.990**	0.682*	0.879**	0.859**	0.927**	0.982**	0.915**	-0.907**	0.965**	0.686*
Seedling length (cm)				1	0.719*	0.884**	0.869**	0.963**	0.996**	0.928**	-0.901**	0.981**	0.708*
Root dry weight (g)					1	0.882**	0.919**	0.814**	0.684*	0.892**	-0.608NS	0.619NS	0.401NS
Shoot dry weight(g)						1	0.996**	0.889**	0.861**	0.991**	-0.787**	0.812**	0.495NS
Seedling dry weight (g)							1	0.891**	0.844**	0.990**	-0.768**	0.792**	0.487NS
Speed of germination								1	0.951**	0.937**	-0.832**	0.923**	0.745*
SVI I									1	0.910**	-0.900**	0.990**	0.706*
SVI II										1	-0.826**	0.867**	0.559NS
EC of seed leachates											1	-0.866**	-0.565NS
Germination (%) after AA												1	0.685*
Field emergence (%)													1

**Correlation is significant at 0.01 level of probability * Correlation significant at 0.05 level of probability

From the correlation studies high level of correlation was found between the laboratory tests and field emergence. highest significant and positive correlation with field emergence was shown by speed of germination (r = 0.745). Germination test exhibited significant and positive correlation of r= 0.732 with field emergence. The results are in agreement with Krishnappa *et al.* (1999), Sridhar and Nagraja (2004) and Pandita *et al.* (2014). Root length and shoot length exhibited significant positive correlation of 0.717 and 0.686 respectively with field emergence. The results are in line with Vanangamudi (1987). Whereas seedling length had exhibited significant positive correlation of r = 0.708 with field emergence which is in between that of root and shoot length. Among all the laboratory parameters electrical conductivity is nonsignificant and negatively correlated with field emergence of the varieties. similar results were reported by Bishnoi and Delouche (1980), Krishnappa *et al.* (1999), Sridhar and Nagraja (2004). Germination percentage after accelerated ageing significantly and positively correlated with field emergence. Similar findings were reported by Kulik and yaklich (1982) and Noli *et al.* (2008). Root dry weight, shoot dry weight, seedling dry weight and seedling vigour index-II which is the product of germination percent and mean seedling dry weight had shown a non-significant correlation with field emergence.

STUDY OF VARIETAL DIFFERENCES IN GROUNDNUT

Significant variation was found among the ten different groundnut varieties with respect to laboratory and field parameters.

Ten groundnut varieties were evaluated for both laboratory and field performance. In the lab, Kadiri-6 exhibited highest germination percentage, speed of germination, root length, shoot length, seedling length, root dry weight, shoot dry weight, seedling dry weight, SVI-I, SVI-II, germination percentage after accelerated ageing and lowest electrical conductivity of seed leachates followed by Narayani. Kadiri Amaravathi showed least germination percentage, speed of germination, root length, shoot length, seedling length, root dry weight, shoot dry weight, seedling dry weight, SVI-I, SVI-II, germination percentage after accelerated ageing and highest electrical conductivity of seed leachates followed by Kadiri-9.

In the field trails, Kadiri-6 had highest field emergence percentage followed by Tag-24. Narayani is earlier in days to 50% flowering (27.67) and maturity (95.33) followed by Tag-24 (29.33, 100.00). On the other hand, Kadiri Amaravathi (63.33) took longer duration for flowering followed by Kadiri-1812 (60.67). Kadiri-1812 (128.33) has come to maturity later among all the varieties followed by Kadiri Amaravathi (126.67). Number of branches per plant were more in Kadiri-1812 (9.73) followed by Kadiri Amaravathi (7.87) and Narayani exhibited least number of branches per plant (5.47) followed by Kadiri-9 (5.53). Kadiri Amaravathi (25.20) had highest number of pods per plant followed by Nithya Haritha (25.13) and Kadiri-6 exhibited least number of pods per plant (16.27) followed by Dheeraj (16.47). Pod yield per plant was more in Kadiri Amaravathi (27.40g) followed by TCGS-1694 (24.73g) and Narayani (12.67g) exhibited least pod yield per plant followed by Kadiri-9 (15.53g).

Kadiri Amaravathi (19.13g) has highest kernel yield per plant followed by TCGS-1694 (16.80g) and Narayani (8.26g) exhibited lowest kernel yield per plant followed by Dheeraj (10.66g). Pod yield per plot was more in Nithya Haritha (5187.93 kg ha^{-1}) followed by Kadiri-9 (4416.42 kg ha^{-1}) and Narayani (2299.70 kg ha^{-1}) exhibited lowest pod yield per plot followed by Kadiri-6 (2706.23 kg ha^{-1}). Dheeraj (30.73cm) has highest plant height followed by Narayani (27.53cm) and Tag-24 (14.53cm) has least plant height followed by Nithya Haritha (19.20cm). Shelling percentage is more in Kadiri-9 (69.74%) and Dharani (57.84%) has least shelling percent followed by TCGS-1694 (64.91%). Nithya Haritha (43.00g) has highest 100 seed weight followed by Kadiri-9 (41.33g) and Kadiri Amaravathi (41.33g) and lowest 100 seed weight was exhibited by Narayani (25.67g) followed by Tag-24 (26.67g). Highest harvest index was exhibited by Nithya Haritha (67.65%) followed by Kadiri-1812 (56.29%) and Narayani (36.65%) has least Harvest index followed by Kadiri-6 (41.50%).

CONCLUSIONS

- There was significant difference among the ten varieties for all the field parameters. Kadiri-6 had highest field emergence percentage Nithya Haritha exhibited best field performance with respect to pod yield per plot, harvest index, 100 seed weight and number of pods per plant followed by Kadiri-9. With reference to days to 50% flowering and maturity, Narayani is earliest followed by Tag-24. Among all the varieties, Dheeraj is tall and Tag-24 is short in stature. Number of branches per plant were highest in Kadiri-1812 and least in Narayani and Kadiri-6. Shelling percentage was highest in Kadiri-9 and least was observed in Dharani.
- Kadiri-6 was found highly vigorous while Kadiri Amaravathi exhibited lower level of vigour.
- Varieties having high vigour have shown high field emergence.
- Among all the vigour tests performed speed of germination test had high correlation with field emergence.
- Vigorous varieties were able to perform better in terms of some of the field parameters.
- Significant correlation was observed between laboratory and field parameters, among laboratory tests and among field parameters.
- Significant variation was found among ten different groundnut varieties with respect to vigour levels and field performance.

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REFERENCES

Bharathi, M. 2010. Effect of seed size on seedling vigour and crop productivity in groundnut. Ph.D. Thesis. *Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad*.

Krishnappa, N., Narayanaswamy, S., Sreerama, R and Amarananjundeswara, H. 1999. Correlations between vigour tests and field emergence in groundnut. *Current Research - University of Agricultural Sciences (Bangalore)*. 28 (11/12): 160-16.

Kulik, M.M and Yaklich, R.W. 1982. Evaluation of vigor tests in soybean seeds relationship of accelerated aging, cold, sand bench, and speed of germination test to Field Performance. *Crop Science*. *22*(4): 766-770.

Maurya, C.l., Khan, A.A., Singh, P and Yadav, V. K.S. 2006. Studies of various vigour test and their correlation with field emergence in oat (*Avena sativa* L.). *Farm Science Journal*. 15(1): 73-74.

Maurya, M.K., Rai, P.K., Kumar, A., Singh, B.A and Chaurasia, A.K. 2014. Study on genetic variability and seed quality of groundnut (*Arachis hypogaea* L.) Genotypes. *International Journal of Emerging Technology and Advanced Engineering*. *4*(6): 818-823.

Noli, E., Casarini, E., Urso, G and Conti, S. 2008. Suitability of three vigour test procedures to predict field performance of early sown maize seed. *Seed science and Technology*. 36(1): 168-176.

Pandita,V.K., Patil, P., Tomar, B.S and Seth, R. 2014. Controlled deterioration and paper-piercing tests predict seedling emergence potential in okra seed lots. *Scientia Horticulturae*. 179: 21-24.

Panse, V.G and Sukhatme, P.V. 1985. Statistical Methods for Agricultural Workers. *Indian Council of Agricultural Research*. New Delhi. 150-157.

Perry, D.A. 1978. A vigour test for seeds of barley (*Hordeum vulgare*) based on measurement of plumule growth. *Seed Science and Technology*. 6:709-719.

Sridhar, G and Nagaraja, A. 2004. Studies on relationship between vigour tests and field emergence. *Mysore Journal of Agricultural Sciences*. 38(4): 551-553.

Vanangamudi, K. 1987. Evaluation of seed vigour tests in bajra. *Madras Agricultural Journal*. 74(1): 18-20.