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PERFORMANCE OF GROUNDNUT (*Arachis hypogeae* L.) UNDER DIFFERENT TILLAGE AND NUTRIENT MANAGEMENT PRACTICES

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ABSTRACT

A field experiment was conducted in sandy clay loam soils of Dryland farm at S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh in split-plot design with three replications to study the performance of groundnut under different tillage *viz*., conventional tillage (M_1), deep ploughimg with disc plough upto a depth of 30 cm (M_2), vertical tillage with subsoiler upto a depth of 40 cm at 1 m interval (M_3), vertical tillage with subsoiler upto a depth of 60 cm at 1 m interval (M_4) and nutrient management practices *viz.,* control (S_1), 50% RDF (S_2), 75% RDF (S_3), 100% RDF (S_4), 125% RDF (S_5), respectively. The results revealed that growth characters of groundnut such as plant height, leaf area index and dry matter production were higher with M_4 while at their lowest with conventional tillage practice (M_1) during both the years of experimentation. However, the yield attributes *viz*., number of filled pods plant^{-1}, 100-pod and 100-kernel weight, pod yield of groundnut were significantly higher with M_3 while at their lowest with conventional tillage practice (M_1) during both the years of experimentation. Among the nutrient management practices tested, the growth parameters recorded were higher with 125% RDF (S_5) while at their lowest with control (S_1) treatment during both the years of experiment. However, the yield attributes were significantly higher with 100% RDF (S_4) which was closely followed by 75% RDF (S_3) while at their lowest with control (S_1) treatment during both the years.

KEYWORDS: Groundnut, Nutrient management, Tillage, Vertical tillage, Yield**.**

INTRODUCTION

Groundnut (*Arachis hypogeae* L.) is one of the major oilseed crops of the country, but its production and productivity needs to be significantly enhanced. Tillage is one of the fundamental agro-technical operations in agriculture because of its influence on soil properties and crop growth which involves physical modification of soil properties for the purpose of promoting crop production. Soil physical properties like bulk density, water holding capacity, penetration resistance and aggregate stability are strongly influenced by tillage practices. In recent years, ploughing at the same depth year after year or continuous use of tractor drawn cultivators or rotovators for years together under conventional tillage systems usually caused sub-soil compaction resulting in hard pan formation. Vertical tillage (subsoiling) with subsoiler, which loosens the subsoil without inverting it is aimed at stimulating greater and faster penetration of roots at increasing the availability of nutrients and moisture to plants (Vaghasia *et al*. 2007). Vertical tillage enhances or re-establishes the soil profile structure allowing rapid infiltration. Hard pan could be alleviated with the help of deep soil loosening equipment like subsoiler. Subsoiler improves soil structure by establishing a system of deep cracks and fissures in the subsoil, facilitating downward movement of water, air and roots. Groundnut productivity is low due to imbalanced fertilizer applications. Though, the response of crop to fertilizer applications is well known and most of the farmers seldom apply higher doses of fertilizers. Like any other crop, the productivity of groundnut in light soils is very low which can be improved with optimum nutrient management practices. Keeping these inview, the present experiment was conducted to findout the best tillage and nutrient management practice for groundnut cultivation during *kharif* in sandy clay loam soils.

MATERIAL AND METHODS

A field experiment was conducted at Dryland farm of S.V. Agricultural College, Tirupati campus (13.5^{o}N latitude and 79.5^{o}E longitude at an altitude of 182.9 m above mean sea level) of Acharya N.G. Ranga Agricultural

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University, Andhra Pradesh, during *kharif*, 2015 and 2016. The soil was sandy clay loam in texture and neutral in soil reaction with available nitrogen of 212 kg ha^{-1} and medium in available phosphorous of 23 kg ha^{-1} and potassium of 221 kg ha^{-1}. Twenty treatmental combinations of four tillage practices *viz.*,conventional tillage (M_1), deep ploughing with disc plough upto a depth of 30 cm (M_2), vertical tillage with subsoiler upto a depth of 40 cm at 1 m interval (M_3) and vertical tillage with subsoiler upto a depth of 60 cm at 1 m interval (M_4) and five nutrient management practices *viz*., control (S_1), 50% RDF (S_2), 75% RDF (S_3), 100% RDF (S_4) and 125% RDF (S_5) were laid out in split-plot design with three replications. The groundnut variety '*Dharani*' was sown on 25 June 2015 during *kharif*, 2015 and on 06 June 2016 during *kharif*, 2016. The experimental field was ploughed as per the treatment details *i.e.*, M_1 - field was ploughed twice with a tractor drawn cultivator; M_2 - field was initially ploughed with disc plough upto a depth of 30 cm followed by tractor drawn cultivator; M_3 - the field was initially subsoiled with a subsoiler upto a depth of 40 cm at 1.0 m interval followed by tractor drawn cultivator; M_4 - the field was initially subsoiled with subsoiler upto a depth of 60 cm at 1.0 m interval followed by tractor drawn cultivator. The field was finally levelled with tractor drawn levelling blade. Fertilizer doses were applied as per the treatments *i.e.*, S_1 - control where no fertilizers were applied; S_2 - 50% RDF - 10 kg N, 20 kg P_2O_5, 25 kg K_2O, 12.5 kg $ZnSO_4$ as basal application and 250 kg gypsum at 40 DAS ha^{-1} were applied; S_3 - 75% RDF - 15 kg N, 30 kg P_2O_5, 37.5 kg K_2O, 18 kg $ZnSO_4$ as basal application and 375 kg gypsum at 40 DAS ha^{-1} were applied; S_4 - 100% RDF - 20 kg N, 40 kg P_2O_5, 50 kg K_2O, 25 kg $ZnSO_4$ as basal application and 500 kg gypsum at 40 DAS ha^{-1} were applied; S_5 - 125% RDF - 25 kg N, 50 kg P_2O_5, 62.5 kg K_2O, 32 kg $ZnSO_4$ as basal application and 625 kg gypsum at 40 DAS ha^{-1} were applied through urea, single super phosphate, muriate of potash, zinc sulphate and gypsum, respectively to the respective plots as per the treatments. No major pest and disease problems were observed. All the agronomic management practices were followed as per the university recommendations for raising the crop. Growth and yield parameters were collected at harvest. The rainfall received during crop growing period was 644.9 mm within 32.0 rainy days during *kharif*, 2015 and 476.2 mm within 25 rainy days during *kharif*, 2016.

RESULTS AND DISCUSSION

Among the four tillage practices evaluated, the growth characters *viz*., plant height, leaf area index, total dry matter production, SPAD chlorophyll meter reading and relative leaf water content of groundnut at harvest were significantly higher with the vertical tillage with subsoiler at 60 cm depth at 1 m interval (M_4) compared to rest of the tillage practices during 2016, but plant height, leaf area index and dry matter production were not influenced by tillage practices during 2015 (Table-1). This might be due to the reason that in M_4 , subsoiling was done upto a depth of 60 cm that allowed the roots to penetrate into deeper soil layers which absorbed more amount of nutrients and soil moisture resulting in higher plant growth characters. The next best tillage practice in producing higher growth characters was vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3), which was significantly higher than deep ploughing with disc plough (M_2). The lowest values of these growth parameters were registered with conventional tillage (M_1) practice which was significantly lower than rest of the tillage practices tried. Similar increase in plant growth parameters due to subsoiling was noticed by Ramana *et al*. (2015) and Kumar *et al*. (2014).

Among the nutrient management practices tested, significantly higher plant height, leaf area index, total dry matter production, SPAD chlorophyll meter reading and relative leaf water content of groundnut at harvest were recorded with 125% RDF (S_5). This might be attributed to higher dose of fertilizer application which resulted in more availability of major nutrients to plants that helped in differentiation and expansion of component cells resulting in taller plants producing higher dry matter, chlorophyll content and tissue water status. Higher dose of nitrogen and phosphorous encourage the formation of new cells, cell division and cell multiplication. Similar findings were also reported by Patil *et al*. (2010) and Elayaraja and Singaravel (2009). Fertilizer dose of 100% RDF was the next best treatment in producing higher growth parameters followed by 75, 50% RDF and control, with a significant disparity between any two of them. These results were in accordance with the findings of Venkateswarlu (2006). Among the treatmental combinations tried, the interaction effect was found to be non-significant in influencing the plant growth parameters of groundnut during both the years of experiment.

Table 1. Growth parameters of groundnut at harvest as influenced by tillage and nutrient management practices during *kharif*, 2015 and 2016

Treatments	Plant height (cm)		Leaf area index		Dry matter production (kg ha^{-1})		SPAD chlorophyll meter reading		Relative leaf water content (%)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Tillage practices										
M_1	35.2	35.0	2.05	2.19	5797	5737	36.48	38.02	80.72	78.96
M_2	35.5	35.3	2.07	2.29	5840	5777	36.79	38.22	81.43	79.83
M_3	35.9	35.8	2.09	2.36	5843	5864	36.63	38.54	83.16	80.79
M_4	36.1	36.0	2.09	2.47	5858	5902	36.98	38.56	84.67	81.48
SEm±	0.06	0.02	0.05	0.02	29.7	32.7	0.07	0.06	0.49	0.47
CD (P=0.05)	NS	0.09	NS	0.09	NS	115	0.27	0.23	1.74	1.67
Nutrient management practices										
S_1	35.2	35.0	2.03	2.18	5755	5750	36.22	37.87	81.49	79.11
S_2	35.4	35.3	2.05	2.26	5786	5785	36.47	38.08	81.91	79.75
S_3	35.7	35.5	2.08	2.32	5833	5815	36.76	38.32	82.32	80.38
S_4	36.0	35.7	2.10	2.41	5875	5851	36.97	38.61	83.00	80.82
S_5	36.3	36.0	2.13	2.48	5923	5899	37.16	38.79	83.76	81.26
SEm±	0.01	0.02	0.03	0.02	27.4	6.52	0.06	0.03	0.12	0.18
CD (P=0.05)	0.05	0.06	0.01	0.07	9.4	18.0	0.19	0.08	0.36	0.53
Interaction										
S at M										
SEm±	0.15	0.06	0.01	0.05	66.4	73.3	0.17	0.14	1.10	1.06
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
M at S										
SEm±	0.07	0.04	0.07	0.05	34.2	34.8	0.14	0.08	0.54	0.58
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatments:

Main plot: Tillage practices

M_1 : Conventional tillage

M_2 : Deep ploughing with disc plough upto a depth of 30 cm

M_3 : Vertical tillage with subsoiler upto a depth of 40 cm at 1 m interval

M_4 : Vertical tillage with subsoiler upto a depth of 60 cm at 1 m interval

Sub plot : Nutrient management practices

Control (S_1); 50% RDF (S_2); 75% RDF (S_3); 100% RDF (S_4) and 125% RDF (S_5)

Table 2. Yield attributes and yields of groundnut as influenced by tillage and nutrient management practices during *kharif*, 2015 and 2016

Treatments	Number of filled pods plant^{-1}		Hundred pod weight (g)		Hundred kernel weight (g)		Pod yield (kg ha^{-1})		Haulm yield (kg ha^{-1})	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Tillage practices										
M_1	20	17	98.2	96.7	34.6	34.2	3279	2427	3980	3719
M_2	21	17	101.3	97.6	36.6	35.2	3468	2625	4024	3818
M_3	26	22	111.3	105.8	44.6	38.3	3695	2757	4026	4105
M_4	25	18	108.0	104.7	43.0	36.0	3547	2727	4042	4246
SEm±	0.37	0.90	7.23	5.28	1.43	0.70	34.3	14.3	29.71	114.65
CD (P=0.05)	1.0	3.0	2.0	1.4	0.40	0.20	121	50	NS	NS
Nutrient management practices										
S_1	21	16	98.0	95.2	36.4	34.8	2965	2180	3938	3757
S_2	23	18	101.5	98.5	37.2	35.5	3378	2488	3970	3862
S_3	24	19	105.7	102.8	38.5	36.2	3734	2885	4017	3995
S_4	24	21	110.2	105.2	41.8	36.6	3815	2994	4058	4042
S_5	23	18	108.0	104.1	39.3	35.9	3595	2673	4106	4204
SEm±	0.39	0.91	5.00	3.66	1.51	0.71	44.6	16.9	27.47	296.64
CD (P=0.05)	1.0	2.0	1.7	1.2	0.70	0.24	130	49	9.0	102.0
Interaction										
S at M										
SEm±	0.84	2.01	4.58	3.34	0.91	0.44	76.7	32.1	66.44	256.38
CD (P=0.05)	NS	NS	NS	NS	NS	NS	267	102	NS	NS
M at S										
SEm±	0.79	1.86	3.71	2.71	1.33	0.48	86.8	33.6	34.22	216.27
CD (P=0.05)	NS	NS	NS	NS	NS	NS	260	101	NS	NS

Treatments:

Main plot: Tillage practices

M_1 : Conventional tillage

M_2 : Deep ploughing with disc plough upto a depth of 30 cm

M_3 : Vertical tillage with subsoiler upto a depth of 40 cm at 1 m interval

M_4 : Vertical tillage with subsoiler upto a depth of 60 cm at 1 m interval

Sub plot : Nutrient management practices

Control (S_1); 50% RDF (S_2); 75% RDF (S_3); 100% RDF (S_4) and 125% RDF (S_5)

Among the tillage practices tried, maximum number of filled pods plant^{-1}, hundred pod, hundred kernel weight and pod yield were recorded with vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3), which was significantly higher than with rest of the tillage practices during two years of investigation (Table-2).Pod yield of groundnut mainly depends on partitioning ability of photosynthates from growth parameters *viz.,* plant height, leaf area index, dry matter production and relative leaf water content to developing pods for producing more number of total pods plant^{-1}, filled pods plant^{-1} and hundred kernel weight which inturn led to increased pod yield (Labana *et al.* 1980). Vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) produced higher yield attributes and pod yield of groundnut due to better translocation of photosynthates from source to developing pods on account of overall improvement in vegetative growth which favourably influenced the flowering and fruiting in groundnut. In addition, the favourable soil conditions *viz*., more availability of nutrients and moisture provided better growth thus producing maximum number of filled pods plant^{-1} and pod yield of groundnut. The results supported the findings of Mathukia *et al*. (2015) and Kumar *et al*. (2014).The vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) was the next best treatment in producing higher yield attributes and pod yield of groundnut followed by deep ploughing with disc plough (M_2) with significant difference between them. The lowest pod yield was obtained with conventional tillage (M_1) during both season of *kharif*, 2015 and 2016.

Maximum number of filled pods plant^{-1}, hundred pod and kernel weight were produced with 100% RDF, followed by 125, 75, 50% RDF and control, with a significant disparity among the treatments. These results are in accordance with findings of those Jampragni *et al*. (2014) and Sharma *et al*. (2013). This might be due to adequate availability of nutrients to the crop to put its maximum potential in producing higher number of filled pods plant^{-1}, hundred pod and kernel weight. Maximum pod yield of groundnut was recorded with 100% RDF which was statistically on par with 75% RDF during *kharif*, 2015 but during *kharif*, 2016 it was significantly higher than 75% RDF. These results are in accordance with findings of Pacharne *et al*. (2015), Jampragni *et al*. (2014). This might be due to application of 100% RDF that includes gypsum and zinc sulphate increased significantly the pod yield and yield attributes of groundnut over 125% RDF. Fertilizer dose of 100% RDF was sufficient for realisation of higher pod yield of groundnut. This result indicated that gypsum and zinc sulphate along with N, P and K fertilizer at recommended level brought about a positive effect on pod yield of groundnut. Minimum number of filled pods plant^{-1}, hundred pod and kernel weight and pod yield of groundnut were registered with control treatment due to insufficient availability of nutrients, which lead to severe competition between plants and there by reduced all the yield components during both the years of study. These results are in accordance with the findings of Reddy *et al*., 2011.Haulm yield of groundnut was influenced by tillage and nutrient management practices. Higher haulm yield was obtained with 125% RDF followed by 100, 75, 50% RDF and control treatments, with a significant disparity among them during both the years of experimentation. Among the treatmental combinations, maximum pod yield was obtained with vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) in combination with 100% RDF (S_4) which was significantly higher than with rest of the combinations tried.

The present investigation revealed that maximum pod yield and the economic returns were obtained with the cultivation of groundnut under vertical tillage with subsoiler at 40 cm depth at 1 m interval in combination with 100% RDF which was comparable with vertical tillage with subsoiler at 60 cm depth at 1 m interval at 100% RDF on sandy clay loam soils of Southern Agro-climatic Zone of Andhra Pradesh.

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