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Accomplishment of various tillage and nutrient management enactment on yield along with nutrient uptake in groundnut

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Abstract
A research experiment was conducted during *kharif*, 2019 & 2020 at Krishi Vigyan Kendra, Reddipalli, Anantapuramu campus of Acharya N.G. Ranga Agricultural University to investigate the effect of tillage practices and nutrient management practices on yield along with nutrient uptake in groundnut. Research work was conducted in a split-plot design with three replications. The results indicated that pod yields were highest with vertical tillage with chisel plough compared with mould board plough and conventional tillage (farmers practice). Irrespective of tillage practices, nutrient management practices significantly influencing the pod yield in two years of study. 125% RDF proved to be the best treatment compared to control and which was similar result with 100% RDF. Similarly NPK uptake was highest with vertical tillage with chisel plough over other tillage practices. Nutrient uptake was also highest with 125% RDF compared to other nutrient management practices.

Keywords: Groundnut, tillage along with nutrient management practices, yield, yield related attributes in NPK uptake

Introduction
Groundnut one of the principal economic crops, which stands second most cultivated legumes and forthmost in edible oil production and its cultivation visible in more than 100 countries. India stands second largest in production of groundnut in the world but varied productivity is observed (Tiwari *et al*., 2018) [19]. In India groundnut productivity is much less as compared to other leading countries due to soil heterogeneity, improper fertilization, climatic abberations, poor cultural practices adopted by farmers, growing the energy crop groundnut under energy starved conditions like marginal and sub-marginal lands (mainly under rain fed condition), deficiency of calcium, low soil pH, biotic and abiotic stress and many social and economic factors. (Kumar, 2012) [12]. Tillage is one of the basic agro-technical operations in agriculture since it influences on soil properties where crop growth involves physical modification of soil properties for the purpose of promoting crop production (Babu *et al*., 2008) [1]. Tillage practices are influencing the soil physical properties like bulk density, water holding capacity, stability in aggregation character and so on. Recently, it was concluded that due to ploughing at the same depth every year continuously with tractor drawn implements for years together under conventional tillage systems caused compaction of sub soil inturn of 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. 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. Few studies completed by earlier investigators showed positive effect of subsoiling on crop yield (Reeves and Mullins, 1995; Tursic *et al*.,, 1998) [15, 20].

Improving the soil fertility by providing adequate nutrients to the crop could be a viable option to raise the productivity of groundnut. Various researchers working in this area opined that none of the inorganic and organic sources of nutrients alone can meet the total plant nutrient needs of the crop adequately. Hence, an integrated use of nutrients from chemical, organic manures, bio fertilizers is the most efficient way to supply plant nutrients for sustained crop productivity and improved soil fertility (Vala *et al.,* 2018) [21]. Nutrient management ensures the plant nutrient supply through optimization of benefits from all possible sources of plant nutrients in an combined manner to achieve as well as sustain the desired crop productivity while maintaining soil fertility and can be considered as an important tool for sustainable agriculture to achieve the sustainable development goals (SDG) to ensure sustainable consumption and production patterns. Keeping this in view the present experiment was conducted to study the effect of tillage and nutrient management on yield and nutrient uptake in groundnut.

Materials and Methods

The field experiment was conducted at KVK farm of Reddipalli village of Anantapuramu district, Andhra Pradesh, ANGRA University in groundnut for *kharif*, 2019 - 2020. The experiment was designed and executed in split plot with three replications and with tillage practices in main plot whereas nutrient management practices in sub plots. The main treatments were, M_1: Vertical tillage with Chisel plough, M_2: Tillage with Mould board plough and M_3: Conventional tillage. Nutrient management practices consists of S1:75% Recommended dose of fertilizers, S2: 100% Recommended dose of fertilizers, S3: 125% Recommended dose of fertilizers, and S4: Control (No fertilizers). Recommended dose of fertilizers consists of FYM @10 t ha^{-1}. The soils of research plot was sandy loam in texture, neutral in soil reaction, soils are non saline. The soil was less in organic carbon (0.29%), available N (142 kg ha^{-1}), high in available P (20.4 kg ha^{-1}) and medium in available K (194 kg ha^{-1}). The RDF was given in the form of urea, SSP, and MOP. Standard procedure was followed in application of fertilizers in treatments. K6 variety with seed rate of 120 kg ha^{-1} sown in the third week of June every year at spacing of 30 cm between the rows and 10 cm within the row. Seed treatment was done with Imidachloprid @ 2.0 ml/kg seed and D.M.-45 @ 3 gm kg seed before sowing. Pod Yield and haulm yield were recorded after harvest. Plant samples were collected from each treatment at harvest, processed and analysed as per standard procedures. The nitrogen estimation was done by Kjeldahl's method, phosphorus with Vanadomolybdo phosphoric acid, yellow colour method (Jackson, 1973) [9] and potassium by reference of tri-acid digested material by using flame photometer (Jackson, 1973) [9]. Uptake of nitrogen, phosphorus and potassium was obtained by multiplying yield data with concentration of nutrients. The data was statistically analysed by Panse and Sukhatme (1985). The critical differences were calculated for assessing the significance of treatment means wherever, the "F" test was found significant at 5 per cent level of significance.

Results and Discussion

Pod yield

Yield as pods of groundnut was very significantly influenced by the tillage along with nutrient management practices during two years of research study when the data was pooled over years. Similarly the interaction studies between tillage and nutrient a management was found to be significant in influencing pod yield data taken (Table 1).

Highest yield of groundnut pods was observed with vertical tillage with Chisel plough (M1) which was significantly higher than rest of the tillage practices that were carried out in research work, this is in accordance with findings of Prieto *et al*., 2009 [14] and Wiatrak *et al*., 2004 [22]. Yield of groundnut pods mainly depending on yield improvement characters which were significantly highest by using chisel plough since there is better partitioning of photosynthates to developing pods. This might be attributed quantum of nutrient absorption increased due to better root development under vertical tillage reflected in good development and utterance of yield components, which finally resulted in highest pod yield. The next treatment good in recording highest groundnut pod yield was mould board plough (M2) with significant disparity among them during the both years *viz*., 2019 and 2020 of experiment. Lower pod yield was observed with conventional tillage (M3) during both the years of investigation. This might be due to that the compacted layer was not loosened conventional tillage method, the rooting of groundnut was shallow finally results in lower moisture and nutrient uptake and fast depletion of moisture in the root zone. The final results are in similar with findings of those Jordan *et al*., 2008 [10] and Barbosa *et al*. (1989) [2]. Similar results were also obtained by Chaudhary *et al*. (2015) [6]; Bala and Nath (2015) [3] in groundnut.

Other than tillage methods, pod yield was high with 125% recommended dose of fertilizers which was statistically similar result with 100% recommended dose of fertilizers during *kharif*, 2019 & 2020. These results are similar with findings of by Singh *et al*. (2010) [16]. This may be due to the applied 125% ecommended dose of fertilizers that increased notably the pod yield and other yield attributes of groundnut compared to the control. 100% recommended dose of fertilizers was sufficient for obtaining higher groundnut pod yield. This final result indicated that with N, P and K fertilizer at recommended level has been positively affected on pod yield of groundnut. The next best treatment in recording higher yield of groundnut was 75% RDF with a significant disparity among these treatments. Control treatment has recorded lower pod yield compared to all practices of nutrient management for two years of study.

Haulm Yield

Groundnut Haulm yield was significantly affected by the nutrient management practices along with tillage practices (Table 1). The interplay effect between the tillage or standard cultivation and nutrient management practices was also found to be significant.

In the tillage practices investigated, higher haulm yield was obtained with chisel plough (M1) followed by mould board plough (M2), and conventional tillage (M_1) with significant incongruity within the tillage treatments in two years of study. This may be due to increased vegetational growth pertaining to plant height, leaf area and dry matter production finally resulting in increased yield of haulm in treatment M_4. These results were in accordance with Kumar *et al*. (2014) [11]. Irrespective of tillage practices, yield of halumn was increased significantly with further increase in fertilizer dose from control to 125% RDF. Higher yield of haulm was recorded in 125% RDF, which was significantly higher than remaining of nutrient management methods tested during the two *kharif"*s. This might be due to improved plant height and more dry matter output because of more nutrient availability. All these findings are in similar statement results reported by Elayaraja and Singaravel (2011) [7]. The best treatments order in producing significantly increasing

order of haulm yield production was 100% recommended dose of fertilizers accompanied by 75% recommended dose of fertilizers and control, with a significant disparity between them. Lower haulm yield was obtained with control treatment which was significantly less than with rest of the nutrient executive practices tried during two seasons of research work in kharif. These results are in accordance with Bhagavata Priya *et al*. (2021) [4].

Table 1: Pod and haulm yield (kg ha^{-1}) of groundnut as influenced by tillage and nutrient management practices during 2019 and 2020

Treatments	Groundnut pod yield (Kg/ha)		Groundnut haulm yield (Kg/ha)	
	2019	2020	Pooled	2019
Tillage practices	1208	1285	1246	1682
M_1	1115	1123	1098	1690
M_2	1002	981	1017	1456
M_3	10.66	32.75	19.02	21.58
S.Em+	41.86	128.58	74.69	84.74
CD (P=0.05)	1208	1285	1246	1682
Nutrient management practices				
S_1	1103	1122	1113	1490
S_2	1161	1234	1203	1738
S_3	1254	1328	1252	1883
S_4	915	912	914	1326
S.Em+	25.15	22.46	15.35	26.24
CD (P=0.05)	74.74	66.72	45.60	77.97
Interaction				
S at M				
S.Em+	23.16	38.90	26.58	45.46
CD (P=0.05)	68.81	115.57	78.98	135.06
M at S				
S.Em+	22.71	46.98	29.86	44.89
CD (P=0.05)	67.49	139.59	88.73	133.39

Table 2: Sequel of different nutrient management practices on concentration and uptake of nutrients

Treatments	Groundnut (kharif)					
	Nitrogen		Phosphorus		Potassium	
	2019	2020	2019	2020	2019	2020
Tillage practices						
M_1 (Tillage with chisel plough)	35.9	47.3	3.7	4.5	36.5	42.0
M_2 (Tillage with MB plough)	35.2	36.9	3.5	3.7	34.5	33.7
M_3 (Farmers practice)	28.0	27.6	3.0	3.3	28.2	30.6
S.Em+	0.22	0.96	0.22	0.23	0.24	0.54
CD(P=0.05)	0.88	3.78	NS	NS	0.95	2.19
Nutrient management practices						
S_1 (75% RDF)	29.0	32.6	2.6	3.2	27.9	32.7
S_2 (100% RDF)	36.2	43.7	4.0	4.1	38.0	38.7
S_3 (125% RDF)	42.5	50.6	4.8	5.1	45.6	47.8
S_4 (Control)	24.6	22.1	2.2	2.9	20.6	22.7
S.Em+	0.68	1.88	0.19	0.22	0.90	1.27
CD (P=0.05)	2.02	5.59	0.55	0.66	2.66	3.77
Interaction						
S at M						
S.Em+	1.18	3.26	0.32	0.39	1.55	2.21
CD (P=0.05)	3.50	NS	0.96	NS	4.61	NS
M at S						
S.Em+	1.05	2.98	0.35	0.41	1.37	1.99
CD (P=0.05)	3.11	N S	1.05	N S	4.06	N S

Nutrient (NPK) uptake

Vertical tillage practice (M1) recorded significantly greater N uptake (35.92 and 47.26 kg ha^{-1}) compared to control (27.96 and 27.61 kg/ha.), respectively in 2019 and 2020. The nitrogen uptake was observed highest under M1 since if nitrogen uptake is more than accumulation of dry matter in the plant will be more and also the same with nitrogen content (Sunilkumar *et al*. 2005) [17]. Same output was given by Tanuja Poonia *et al*., 2022) [18]. In all the nutrient related practices 125% recommended dose of fertilizers showed the significant highest N uptake (42.45 and 50.55 kg /ha.) compared to the control (24.55 and 22.11 kg /ha.) for the year 2019 and 2020. The top most P uptake (3.7 and 4.5 kg ha^{-1}) was observed with Vertical tillage method which showed significant edge on the control (3.0 and 3.5 kg/ha.), in the year of 2019 and 2020. Phosphorus consumption increased significantly by applying nutrient management practices over control (S4) and maximum values of 13.1 and 14.8 kg ha^{-1} formed in S3 and S2 treatment and minimum P uptake values (8.3 and 13.2 kg ha^{-1}) noted under control during 2019 and 2020. Vertical tillage showed significantly increased K uptake (36.5 and also the 42.0 kg ha^{-1}) during 2019 and 2020 over farmers practice. P uptake was more or highest due to more number of branches, dry matter, pod yield, haulm leads to higher p uptake or might be due to availability of more phosphorous with root proliferation. Similar findings corroborate with the study of Bhatt (2013) [5]. Applying of 125% recommended dose of fertilizers significantly recorded top most potassium uptake (45.6 and 47.8 kg/ha) and it was at par with S2 in both the years. Availability nitrogen, phosphorous and potassium is achieved due to enriched form of organic manure and chemical fertilizers application favoured the direct addition of these nutrients to the available soil pool. These results are in similar or agreement with the findings of Fasil Mohmood *et al*. (2017) [8].

Conclusion

Results of study explained the pragmatic effects of vertical tillage method with chisel plough on groundnut pod yield, uptake of nutrients in groundnut compared to conventional shallow tillage. 125% RDF recorded the maximum pod yield which was on par with 100% and over control. Hence, to intensify the groundnut dry matter, number of pods per plant, pod yield, nutrient uptake, deep tillage along with RDF can be recommended to the growers in the Scarce rainfall zone of A.P.

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