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Crop Management Practices Influence the Nodule Characteristics, Yield Attributes and Yield of Groundnut

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ABSTRACT
An experiment was conducted at the Agronomy farm, College of Agriculture, Swami Keshwan and Rajasthan Agricultural University, Bikaner (Rajasthan). The treatment comprises of three tillage practices in main plots viz. T_1 – minimum tillage (MT), T_2 – deep tillage (DT) and T_3 – conventional tillage (CT) and six fertilizer management practices in sub plots i.e. (i) control (F_0)(ii) recommended dose of NK fertilizer (F_1) (iii) recommended dose of NPK fertilizer (RDF) (F_2) (iv) RDF + phosphate solubilizing bacteria(PSB) 2.5 Kg ha^{-1}(F_3) (v) RDF + PSB 2.5 Kg ha^{-1} + Arbuscular mycorrhizal fungi (AMF) 2 Kg ha^{-1} (F_4)(vi) RDF + PSB 2.5 Kg ha^{-1} + AMF 4 Kg ha^{-1} (F_5). A total of 18 treatment combinations were laid out in split plot design and replicated four times. Deep tillage (DT) produced significantly higher number of pods per plant, kernels per pod, number and dry weight of root nodules, pod yield and seed index as compared to minimum tillage. DT also recorded higher net return and B:C ratio compared to MT. Among various fertilizer management practices, RDF along with seed inoculation with PSB and AMF recorded significantly higher growth, yield and yield parameters compared to RDF without seed inoculation. Also recorded the maximum net return and B:C ratio over rest of the fertilizer management practices. Thus, deep tillagealong with RDF + PSB + AMF (4 kg ha^{-1}) enhanced groundnut yield attributes, yields and net returns.

KEYWORDS
Groundnut, Tillage, Biofertilizer, Pod yield, Economics

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INTRODUCTION

Groundnut (*Arachishypogaea* L.) is a legume crop having high economic values as it contains high quality edible oil (40-45 per cent) and vegetable protein (25 per cent) apart from having the significant amount of carbohydrates, minerals and vitamins. It grows well in the areas having long and warm summers. It is typically different from other legume crops as its pod develops below ground but like most of legumes groundnut harbour symbiotic nitrogen-fixing bacteria in their root nodules. In India it is well known for its edible oil. India is the largest producer of oilseeds in the world and oilseed sector occupies an important position in the agricultural economy of the country (Rai *et al*, 2016). It is mostly grown in western and central part of India. Under the different management practices in cultivation of groundnut intensive tillage and indiscriminate use of fertilizer is very common in these growing areas. The aim of tillage in crop production is to create favourable physical conditions for seed germination and plant growth (Jabro *et al*, 2011). Soil tillage has been a major element of crop production for centuries. Tillage is a basic and an important input to alleviate soil related constraints in crop production. It has long term effects on crop sustainability, soil properties and crop growth. In addition to these, deep tillage has various advantages, like increase in water holding capacity by opening soil to deeper depth and breaking the hard pan. The immediate cause for introducing minimum tillage was to avoid high cost of tillage due to steep rise in oil prices. According to R Rashidi and Khabbaz (2009), major benefits of tillage is the aeration resulting from pulverization. This aeration not only provides a free circulation of oxygen and water but also results in increased biological activities in the soil, including organism that fix atmospheric nitrogen. Bio-fertilizers containing useful micro-organisms instead of synthetic chemicals are known to enhance plant growth by the supply of plant nutrients and may help to retain environmental health and soil productivity. Bio-fertilizers are significant, not only for the decrease in quantity of chemical fertilizers, but also for better yield in sustainable agriculture. Thus, microbial activity plays a key role in agriculture because they are very significant in improving the movement and availability of essential mineral elements required for plant growth and ultimately helped in lowering the use of chemical fertilizers (Verma, 2017). Hence, keeping the facts in view the present investigation was planned in western region of Rajasthan.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy farm, College of Agriculture, Swami Keshwan and Rajasthan Agricultural University (SKRAU), Bikaner. The climate of this zone is

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typically arid and characterized by aridity of the atmosphere with extremes of temperature both in summer and winter season. The average annual rainfall of Bikaner is about 274 mm which is mostly received during the rainy season from July to September. The weather conditions prevailed during the crop growing period (Kharif-2019 and 2020) and data were recorded at meteorological observatory located at Agricultural Research Station, SKRAU, Bikaner. The maximum and minimum temperature ranges between 23.0 to 42.3°C and 9.1 to 30.5°C in 2019 and 27.0 to 42.3°C and 6.9 to 29.3°C in 2020, respectively (Figure 1). In order to ascertain the physico-chemical characteristics of the site, soil samples (0-30 cm depth) were collected from four different spots of the experimental field during both years. Composite sample was collected in each year and subjected to physical and chemical analysis separately. In the experiment three tillage practices viz. T_1 – minimum tillage (MT), T_2 – deep tillage (DT) and T_3 – conventional tillage (CT) in main plots and six fertilizer management practices in sub plots i.e. (i) control (F_0)(ii) recommended dose of NK fertilizer (F_1) (iii) recommended dose of NPK fertilizer (RDF) (F_2) (iv) RDF + phosphate solubilizing bacteria(PSB) 2.5 Kg ha^{-1}(F_3) (v) RDF + PSB 2.5 Kg ha^{-1} + Arbuscular mycorrhizal fungi (AMF) 2 Kg ha^{-1} (F_4)(vi) RDF + PSB 2.5 Kg ha^{-1} + AMF 4 Kg ha^{-1} (F_5) were laid out in split plot design and replicated four times. Minimum tillage plots were ploughed after plewa/ pre sowing irrigation at the time of optimum moisture by tractor drawn rotavator (5 cm). Then plots were further divided in to sub plots as per the treatment protocols and sowing was done by 'Kera' method. Deep tillage plots were ploughed after plewa by tractor drawn disc plough (25 cm) followed by rotavator. Then further divided into sub plots as per treatment for sowing of groundnut. Conventional tillage plots were ploughed after plewa by tractor drawn disc harrow (15 cm) followed by rotavator. These plots were later prepared and sowing was done with 'Kera' method. Well decomposed sheep manure@ 10 t ha^{-1} was applied in the experimental field uniformly and thoroughly mixed about three weeks before sowing of test crop (groundnut). Calculated quantity of chemical fertilizers (as per treatment) was applied at the time of final seed bed preparation in respective plots. Urea, Di Ammonium phosphate (DAP) and Muriate of Potash (MOP) were used as source of nitrogen, phosphorus and potash, respectively. Application of biofertilizers namely PSB and AMF(as per treatment) done in respective plots at the time of final bed preparation and thoroughly mixed in the soil by rotavator.

The pods of five randomly selected plants counted and average number of pods per plant was worked out and recorded as number of pods per plant. Number of kernels per pod was recorded at harvest by counting the number of kernels of ten randomly selected pods, then average value was taken to record number of kernels per pod. For counting the number of nodules per plant at 40 and 80 DAS, five plants in each plot selected randomly from sampling rows were uprooted along with roots carefully after wetting the field. After removal of plants from soil, adhered soil was washed out with a fine jet of water. The nodules were removed with the help of forceps, counted and the mean value recorded as number of nodules per plant. 100-kernels counted plot wise and weighed in grams by electronic balance. Thus, data used to record seed index in gram. After threshing the harvested plants from net plots, weight of uniformly sun dried matured pod was recorded plot wise and thereafter converted into kg ha^{-1} as pod yield.Leaf area index (LAI) was calculated by dividing leaf area plant^{-1} by the land area occupied by a single plant (Sestak *et al*, 1971). Highest LAI, was observed between 65 and 85 DAS. Groundnut crop maintained a comparatively high LAI all through the crop age, mean LAI obtained was as high as 7. On the basis of prevailing market price of input and output, economics of different treatments was worked out in terms of net returns and benefit: cost (B:C) ratio to compare the profitability of different treatments so as to arrive on an economically viable recommendation. The cost of cultivation for each treatment was subtracted from the gross returns worked out for the respective treatment to arrive at net returns for each treatment.

Net return (Rs. ha^{-1}) = Gross return (Rs. ha^{-1}) - Cost of cultivation (Rs. ha^{-1})

Treatment wise B: C ratio calculated to ascertain economic viability of different treatments using the following formula:

$$B : C\ ratio = \frac{Gross\ returns\ (Rs.\ ha^{-1})}{Cost\ of\ cultivation\ (Rs.\ ha^{-1})}$$

In order to test the significance of variance in experiments, the data were statistically analysed as per procedure described by Panse and Sukhatme (1985). The critical differences were calculated to assess the significance of treatment means wherever, the "F" test was found significant at 5 per cent level of significance.

RESULTS AND DISCUSSION

Growth and yield attributes

Different tillage practices in groundnut significantly influenced root nodule number and dry weight during both the years. Maximum root nodules and dry weight were recorded with deep tillage (DT) at 40 and 80 DAS during 2019, 2020 and on pooled data basis, it was higher by 56.08 and 31.65 and 9.05 and 2.11 per cent, respectively over MT practice (Figure 2). Whereas, at 80 DAS root nodules and dry weight both were statistically at par under DT and CT during both the years. Fertilizer management practices influenced root nodule number and dry weight during both the years (Table 1). The maximum root nodule number and dry weight were observed with F_5 treatment i.e. application of RDF + PSB (2.5 kg ha^{-1}) + AMF (4 kg ha^{-1}) which was at par with F_4 treatment, while the lowest was recorded with F_0 (control) at 40 and 80 DAS during individual year of investigation.

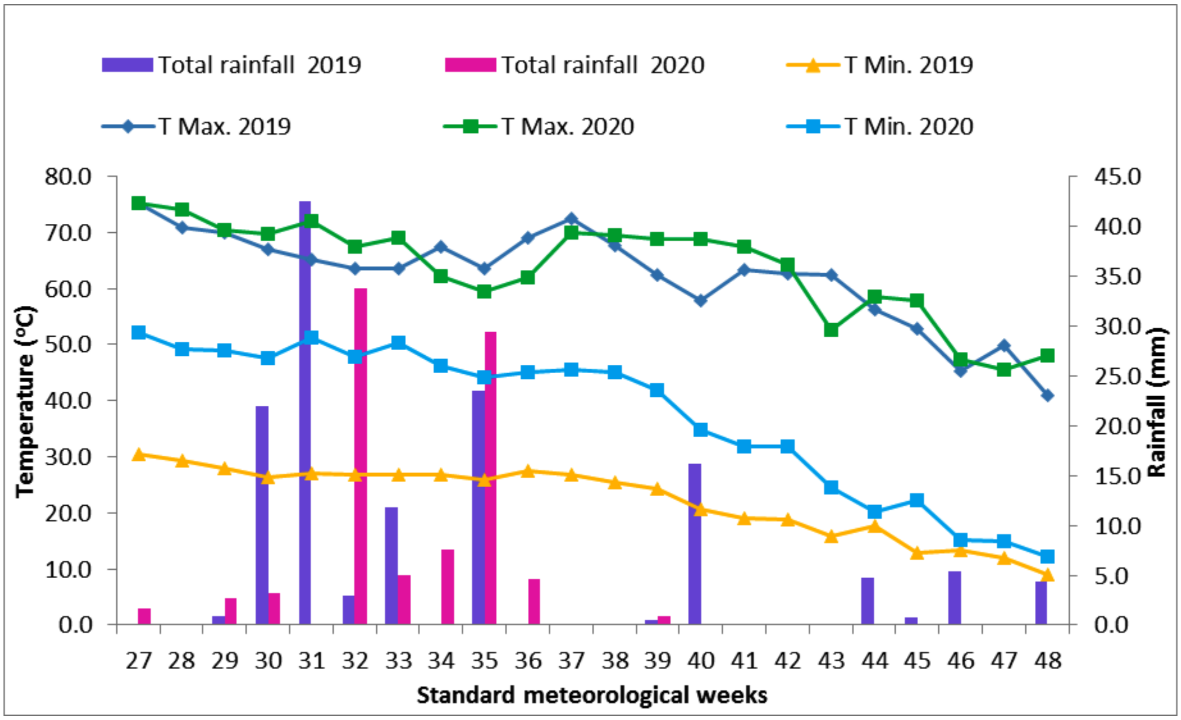

Fig. 1: Mean weekly meteorological data for the kharif season of 2019 and 2020

Table 1: Effect of tillage and fertilizer management on root nodules number and dry weight of groundnut

Treatments	Root nodules number and dry weight							
	Nodules number At 40 DAS		Nodules weight (mg) At 40 DAS		Nodules number At 80 DAS		Nodules weight (mg) at 80 DAS	
	2019	2020	2019	2020	2019	2020	2019	2020
Tillage practices								
Minimum tillage (MT)	35.83	33.79	51.33	45.43	119.63	107.83	445.82	434.93
Conventional tillage (CT)	57.83	50.83	67.00	60.37	130.04	118.00	455.27	444.05
Deep tillage (DT)	43.83	39.08	57.45	53.48	128.88	111.88	453.54	438.44
SEm±	0.93	0.81	1.21	0.90	2.12	2.47	9.74	7.41
CD (P=0.05)	3.23	2.80	4.20	3.10	7.34	8.54	33.70	25.63
Fertilizer management								
Control (No fertilization) (F_0)	40.75	37.08	52.25	47.44	123.17	110.17	436.46	423.43
Recommended dose of NK fertilizer (F_1)	45.00	41.00	57.79	52.33	124.83	112.00	441.20	437.40
Recommended dose of NPK fertilizer (F_2)	46.33	41.50	58.91	53.16	126.00	112.33	444.51	439.93
RDF+PSB @ 2.5 kg ha^{-1} (F_3)	46.83	42.00	59.70	54.22	126.75	112.92	455.40	442.06
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 2 kg ha^{-1} (F_4)	47.75	42.67	60.94	55.38	127.50	113.67	462.79	444.88
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 4 kg ha^{-1} (F_5)	48.33	43.17	61.97	56.01	128.83	114.33	468.91	447.14
SEm±	1.25	1.11	1.31	1.10	2.45	2.85	10.69	9.38
CD (P=0.05)	3.56	3.15	3.72	3.14	6.99	8.13	30.46	26.70

NS =Non-significant, DAS=Days after sowing, RDF=Recommended dose of fertilizer and PSB= Phosphate Solubilizing Bacteria, AMF=ArbuscularMycorrhizal Fungi

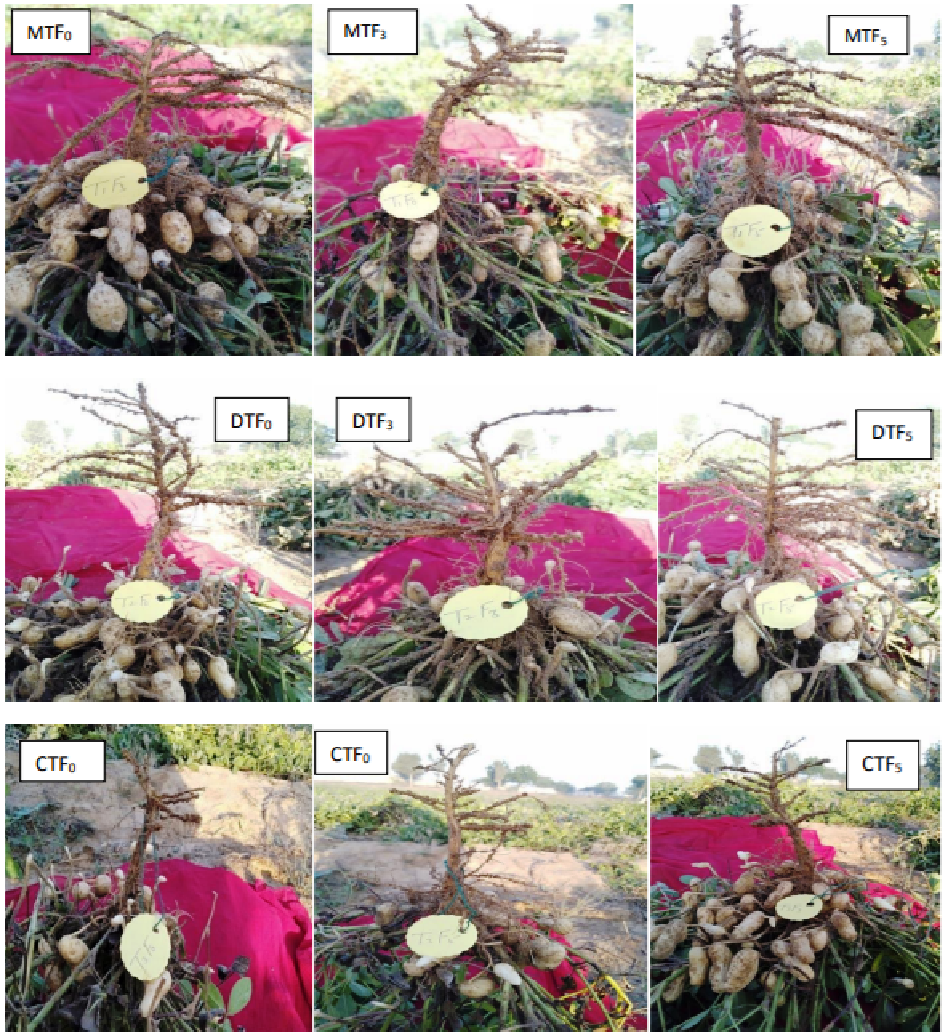

Fig. 2: Root nodules and pods performance at 80 days after sowing

A thoughtful perception of the data (Table 2) clearly indicated that different tillage practices in groundnut significantly influenced leaf area index (LAI) during both the years of study. The highest LAI (1.54 and 1.57) at 40 DAS was recorded with DT practice (T_2) and was significantly higher over CT (T_3) and MT (T_1) during the year 2019 and 2020. Conventional tillage also showed statistically edge over MT in respect to LAI at 40 DAS. At 80 DAS, maximum LAI was recorded with DT practice (4.32 and 3.92) and registered statistically superiority over MT in the year 2019 and all tillage treatments were remained at par during the year 2020. Application of RDF + PSB @ 2.5 kg ha^{1} + AMF @ 4 kg ha^{-1} (F_5) was recorded maximum LAI at 40, 80 DAS and at maturity, while the minimum LAI was recorded with F_0 (control) during the individual year of 2019 and 2020. LAI improved with advancement in growth stages from 40 to 80 DAS and further declined at maturity irrespective of fertilizer management practices. The highest mean LAI of 4.25 was attained by groundnut at 80 DAS under F_5 treatment which was at par withF_4 (4.07) followed by F_3 (3.97) and was significantly higher by 8.70, 15.49 and 32.81 per cent over F_2 (NPK-RDF), F_1 (NK) and no fertilization control (F_0), respectively. At maturity treatment F_5 was at par with F_4 and both these proved statistically superiority over F_3, F_2, F_1 and F_0. Leaf area index is an important parameter of growth analysis as it measures number of leaves per unit area which is directly proportional to the photosynthetic activity. It is a well-established fact that photosynthesis is directly related to growth and development of the plant. Rahman *et al* (2004) observed that deep ploughing improved the LAI values as compared to the shallow ploughing using power tiller, irrespective of the number of passes.

Table 2: Effect of tillage and fertilizer management practices on leaf area index (LAI) of groundnut

Treatments	Leaf area index					
	40 DAS		80 DAS		At maturity	
Tillage practices	2019	2020	2019	2020	2019	2020
Minimum tillage (T_1)	1.14	1.16	3.74	3.45	2.83	2.82
Deep tillage (T_2)	1.54	1.57	4.32	3.92	3.13	3.13
Conventional tillage (T_3)	1.35	1.38	4.00	3.67	2.91	2.93
SEm±	0.02	0.02	0.11	0.11	0.07	0.09
CD (P=0.05)	0.06	0.06	0.40	NS	NS	NS
Fertilizer management						
Control (No fertilization) (F_0)	1.24	1.27	3.25	3.15	2.58	2.49
Recommended dose of NK fertilizer (F_1)	1.27	1.30	3.84	3.53	2.89	2.87
Recommended dose of NPK fertilizer (F_2)	1.33	1.35	4.12	3.71	2.93	2.95
RDF+PSB @ 2.5 kg ha^{-1} (F_3)	1.37	1.39	4.16	3.79	2.98	3.04
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 2 kg ha^{-1} (F_4)	1.42	1.44	4.26	3.88	3.11	3.14
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 4 kg ha^{-1} (F_5)	1.45	1.47	4.50	4.01	3.23	3.27
SEm±	0.01	0.01	0.16	0.15	0.10	0.12
CD (P=0.05)	0.02	0.03	0.44	NS	NS	NS

Effect of tillage and fertilizer management practices on leaf area index (LAI) of groundnut

The mean maximum number of pods per plant (27.88) was recorded with DT and it was at par with CT (27.18) and was significantly higher by 25.02 and 2.58%, respectively over MT (Table 3). The highest number of pods per plant was recorded with F_5 treatment (28.61) i.e. application of RDF + PSB (2.5 kg ha^{-1}) + AMF (4 kg ha^{-1}) followed by F_4 treatment (27.91) and the lowest with control (21.12). The number of pods was found in order ofF_5>F_4>F_3>F_2>F_1>F_0.As data revealed that number of kernels per pod was not influenced significantly due to different tillage and fertilizer management practices in groundnut during both the years of study. Application of recommended dose of NK (F_1), NPK; RDF (F_2) and RDF + PSB and/or AMF (F_3 to F_5) increased number of kernels per pod, but did not prove statistically significant compared to control (F_0). Different fertilizer management practices significantly influenced seed index when compared with no fertilization or control plot (F_0). Rest all fertilization treatments (F_2 to F_5) significantly increased the 100- seed weight of groundnut during both the years (except in 2019 between F_0 and F_1). The highest seed index of 50.26, 52.11 and 51.19 g were recorded with F_5 treatment (i.e., application of RDF + PSB @ 2.5 kg ha^{-1} + AMF @ 4 kg ha^{-1}) and was at par with F_4 treatment followed by F_3 and F_2 while the lowest (44.14, 45.29 g) seed index were recorded with F_0 (control) during both the years. The mean maximum pod yield (3268 kg ha^{-1}) was recorded with F_5 treatment and it was at par with F_4 treatment (3205 kg ha^{-1}). While, the lowest (2267 kg ha^{-1}) pod yield was observed with F_0 (control). The ultimate effect of experimental variables is reflected in the final yield of crop and thus, it is a major criterion to identify the efficiency of various treatments in a given situation. In our study, more branching evidenced the highest number of pods per plant with deep tillage and the similar finding was also reported by Kumar *et al* (2006). Higher pods per plant with chemical fertilization+PSB, PSB+AMF might be due to better root development, nodulation and more nutrient availability as evident by increased soil available phosphorus resulting in vigorous plant growth and development which in turn resulted to better flowering and pod formation. The similar results were observed by Dutta and Bandyopadhyay (2009) in chickpea. Significantly higher number and dry weight of root nodules per plant was observed with DT as compared to MT practice, whereas it was at par to CT practice. The probable reason of higher number of nodules per plant observed in DT and CT might be due to better seedbed preparation which facilitated better root penetration and growth into soil at greater depth hence, ultimately reflected more number of nodules per plant in present investigation also. However, tillage practices did not bring about significant variations in number of kernels per pod and seed index. Soil application of recommended dose of chemical fertilizers i.e. NK (F_1) and NPK (F_2) significantly enhanced root nodule numbers and dry weight at 40 DAS as compared to no fertilizer/ control (F_0), while these three treatments statistically proved at par in this regard at 80 DAS. Thus, soil application of PSB@ 2.5 kg ha^{-1} increased the availability of phosphorus in the root zone, which resulted in to better root growth below the soil surface and development of shoot above surface as evident by higher dry matter accumulation per plant in plots fertilized with chemical fertilizers+ bio-inoculants (PSB, PSB+AMF) compared to control. Singh and Jagadeesh (2009) also reported the increased nodulation, number of nodules, nodule weight, and total biomass of groundnut with both chemical fertilizers and bio-inoculants. Seed inoculation with biofertilizers viz., Rhizobium+PSM (phosphate solubilizing micro-organisms) gave response on plant height as well as yield attributes viz., number of pods per plant, weight of pods per plant, number of mature pods per plant and seed index of groundnut as compared to control. The beneficial effect of phosphate solubilizing bacteria (PSB) as explained earlier increased the availability of phosphorus. Production of photosynthates and their partitioning between vegetative and reproductive structures might have helped in improving the yield attributes (number of pods per plant, number of kernels per pod, seed index, shelling per cent) finally the pod as well as haulm yield. Zalate and Padmani (2009) in groundnut also reported the similar results.

Both DT and CT were recorded 13.1 and 8.2% higher pod yield as compared to MT (Table 3). Similar results were also obtained by Chaudhary *et al* (2015) in groundnut. Use of bio-inoculant (PSB+AMF) with RDF increased pod yield and it might be due to the balanced nutrition along with the beneficial effects of bio-inoculants (PSB+AMF) on plant growth and development, and impact on morphological and photosynthetic components, which ultimately led to profuse root growth and nutrient uptake of the crop. Similar results were also reported by of Rahevar *et al* (2015) and Vala *et al* (2017) in groundnut. Patil *et al* (2015) revealed the increased yield of groundnut under tractor drawn tillage due to the deep ploughing that makes soil softer and facilitate the ease penetration of needles (pegs) in to the soil. Poonia *et al* (2022) found higher productivity and resource use efficiency in conventional tillage with combination of RDF + PSB @ 2.5 kg ha^{-1} + AMF @ 4 kg ha^{-1} fertilizer management practice.

Table 3: Effect of tillage and fertilizer management practices on yield and yield attributes of groundnut

Treatments	Pods per plant		Kernels per pod		Pod yield (kg ha^{-1})		Seed index (g)	
	2019	2020	2019	2020	2019	2020	2019	2020
Tillage practices								
Minimum tillage (MT)	21.1	23.50	1.55	1.62	2570	2701	45.76	46.49
Conventional tillage (CT)	25.9	28.47	1.60	1.67	2767	2938	49.56	50.45
Deep tillage (DT)	27.0	28.74	1.57	1.69	2922	3041	48.81	52.91
SEm±	0.3	0.30	0.02	0.03	57.70	65.84	1.00	1.34
CD (P=0.05)	1.1	1.03	NS	NS	199.68	227.85	3.45	4.65
Fertilizer management								
Control (No fertilization) (F_0)	20.9	21.37	1.39	1.49	2134	2400	44.14	45.29
Recommended dose of NK fertilizer (F_1)	23.2	25.73	1.50	1.58	2304	2659	47.44	49.49
Recommended dose of NPK fertilizer (F_2)	24.7	26.27	1.54	1.63	2743	2843	48.02	50.28
RDF+PSB @ 2.5 kg ha^{-1} (F_3)	25.8	28.51	1.61	1.74	2882	2967	48.51	50.93
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 2 kg ha^{-1} (F_4)	26.3	29.49	1.69	1.75	3203	3206	49.91	51.59
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 4 kg ha^{-1} (F_5)	27.1	30.09	1.70	1.76	3253	3283	50.26	52.11
SEm±	0.32	0.40	0.03	0.04	69.95	83.48	1.20	1.13
CD (P=0.05)	0.92	1.14	NS	NS	199.25	237.78	3.42	3.21

Economics

The data indicated that different tillage practices exhibited highly and significant variations in net returns during both seasons (2019 and 2020). The maximum net returns of ₹131028 ha^{-1} were secured in T_3 followed by T_2 (₹124961 ha^{-1}), then T_1 (₹113431 ha^{-1}) however, the first two named treatment remained statistically at par with each other and both registered statistically superiority over minimum tillage practice over2020 (Table 4). Data pertaining to net returns, clearly showed that the highest net return of 143086, 144143 ₹ha^{-1} obtained with fertilizer management practice F_5 proved statistically at par with F_4 (₹140599, 140261 ha^{-1}) and lowest net return of 81954 and 96726 ₹ha^{-1} were realized with control (F_0) in the year 2019 and 2020. An examination of data given in table 4 exhibit that DT resulted maximum benefit: cost ratio (2.95) which gradually decreased with CT and MT and lowest B:C ratio (2.62) was noted with MT during the year 2020. The highest B:C ratio in groundnut was obtained with F_5 (3.25, 3.20) followed by F_4 (3.21, 3.14) and F_3 (2.83, 2.86) in 2019 and 2020, respectively. The treatment consisted of DT accrued the higher net return and B:C ratio as compared to MT because of less cost involved for field preparation as compared to deep tillage operations. The higher net return by DT was due to the higher yields of groundnut during both the years. These findings are in close confirmation with that work done by Dixit *et al* (2014). The higher net returns had accrued with F_5 treatment i.e., RDF (NPK@20:32:15 kg ha^{-1}) + PSB @ 2.5 kg ha^{-1} + AMF @ 4 kg ha^{-1} (₹ha^{-1}144143) in 2020 was significantly higher over control (F_0), NK (F_1) and RDF (F_2), RDF+PSB (F_3) fertilizer management practices. Though, non-significant difference was noted between F_5 and F_4 fertilizer treatments. This might be due to higher pod yield and haulm yield obtained under this treatment, which fetched the higher net returns in comparison to production costs in terms expenses incurred including all inputs for crop raising. Patil *et al* (2015) showed that maximum net returns and B:C ratio was recorded with integrated application of 50% organics + 50% inorganics.

CONCLUSION

Groundnut is a very much upcoming crop in arid parts of Rajasthan and therefore defining its management practices is crucial for both crop and soil sustainability. Our results showed that deep tillage (DT) produced significantly higher number of pods per plant (27.88), kernels per pod (1.63), number and dry weight of root nodules (124.02, 449.66 mg), pod yield (2981 kg ha^{-1}), seed index (50.86 g) net return (127998 ₹ha^{-1}) and B:C ratio (2.91) as compared to minimum tillage (MT) on 2-years means basis. The fertilizer management practices (F_1 to F_5) produced the higher yield attributes and yields as compared to control (no fertilization). The recommended dose of fertilizer in combination with bio-inoculants (PSB and AMF) further improved the groundnut yields and profitability.

Table 4: Effect of tillage and fertilizer management on net return and B:C ratio on groundnut

Treatments	Net return (₹ha^{-1})		B:C ratio	
	2019	2020	2019	2020
Tillage practices				
Minimum tillage (MT)	106691	113431	2.52	2.62
Conventional tillage (CT)	115908	124961	2.64	2.79
Deep tillage (DT)	124968	131028	2.87	2.95
SEm±	3173	3485	0.07	0.08
CD (P=0.05)	10981	12059	0.25	0.27
Fertilizer management				
Control (No fertilization) (F_0)	81954	96726	1.94	2.24
Recommended dose of NK fertilizer (F_1)	91185	110349	2.14	2.54
Recommended dose of NPK fertilizer (F_2)	115377	120442	2.68	2.74
RDF+PSB @ 2.5 kg ha^{-1} (F_3)	122934	126919	2.83	2.86
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 2 kg ha^{-1} (F_4)	140599	140261	3.21	3.14
RDF+PSB @ 2.5 kg ha^{-1}+AMF @ 4 kg ha^{-1} (F_5)	143086	144143	3.25	3.20
SEm±	3700	4425	0.09	0.10
CD (P=0.05)	10539	12604	0.24	0.29

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