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Agronomy

Yield and Yield Attributes of Groundnut (*Arachis Hypogaea* L.) as Influenced by Organic Practices in Semi Arid Region

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Abstract

Field experiments were conducted during three consecutive kharif seasons of research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur to study the effect of organic practices on the yield and yield attributes of groundnut in semi arid region with the treatments comprised of T1-Farmer's practices, T2- 7.5 t FYM +PSB+ PSM+ Bio-Pesticides, T3- T2 + Seed treatment with PSB+ PSM+ Bio-pesticides, T4 – T3 + Foliar spray of pseudo-monas, T5 – T3 + Foliar spray of NSKE @ 5 %, T6 - T3 + Foliar spray of Panchagavya and T7-Absolute control, T8-100% RDF (15kg N+ 60 kg $_2O_5$/ha). The results revealed that in treatment T5, application of farmyard manure (FYM) (7.5 t/ha) inoculated with microbes (bio fertilizers+bio-pesticides) 15 days before sowing (heapit) and seed treatment with bio fertilizers+bio-pesticides at the time of sowing gave significantly higher pod yield (2750 kg/ha) over absolute control (2151 kg/ha) and FYM without inoculated with microbes but at par with other treatments. The same trend was also observed in B:C Ratio (3.66) with treatment T5 (T3 + Foliar spray of NSKE @ 5 %). The study indicated that the groundnut showed greater response to the application of organic practices (i.e., organic farming) under semi arid region.

Highlights

Farmyard manure (7.5 t/ha) inoculated with microbes (bio fertilizers+bio-pesticides) + seed treatment with bio fertilizers+bio-pesticides gave highest pod yield (2750 kg/ha).

Keywords: Groundnut, organic packages, bio-pesticides, yield, yield attributes

Groundnut (*Arachis hypogaea* L.) is the major oilseed crop and also known as poor men's cashew nut and wonder nut. India produced 8.26 mt from 5.86 mh area, with an average yield of 1411 kg/ha of Groundnut, while the contribution of Rajasthan in production was 0.68 mt from 0.35 mh area, with an average yield of 1943 kg/ha during 2010-11 (Agricultural statistics at a glance, 2012). Okello *et al.*, 2010 reported that groundnut seeds contain 40-50% oil, 20-50% protein, and 10-20% carbohydrate depending on the variety and some essential minerals and vitamins. In conventional agriculture, chemical fertilizers and pesticides are used to increase crop yield as well as to control pests, which not only affects soil environment but also threat to human health. Contrary to this, organic practices minimize the environmental pollution and the use of non-renewable natural resources. It protects long term fertility of soil by maintaining organic matter and providing crop nutrients indirectly by using relatively insoluble nutrient

resources, which are made available to plants by the action of soil micro-organisms. Since the organically grown food are much in demand world wide and also fetch premium prices in export market, therefore, the organic farming is becoming popular and their products have higher demand round the world. Organic manures contribute to plant growth through their favorable effects on the physical, chemical and biological properties of soil. Organic manures also have a pronounced residual effect on the nutrient availability and enhancing productivity of field crops(Rakshit *et al.*, 2008, Rakshit, 2013). Olowoake and Adeoye, 2013 and Sisodia and Kewat, 2012 reported higher yield in maize and rice with organic manures respectively. High yields of groundnut and sustainability in its production can be obtained with better fertility management practices especially with organic farming practices (Nagaraj *et al*., 2001). The production and productivity of groundnut fluctuates seasonally depending upon rainfall, pest and disease outbreak. The present study aims to access the performance of organic practices on sustainable yield and yield attributes of groundnut especially in semi arid regions.

Materials and Methods

The present experiments were carried out at research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan) during three consecutive kharif seasons of 2008-09 and 2010. Durgapura is situated in the eastern part of Rajasthan and lies between 26^0 51' North latitude and $75^0$47'east longitude and at an elevation of 390 m. It falls under semi arid climatic conditions, which is characterized by the features of hot dry summers and cool dry winters. The annual rainfall ranges from 500-600 mm. The rainfall of the locality is often erratic and ill-distributed along with an occasional long dry spells or frequent heavy rainy days during rainy season. The mean daily maximum temperature ranges from 22.0 to 40.6 ^{0}C and daily minimum temperature ranges from 8.3 ^{0}C to 27.3 ^{0}C. In some of the years, maximum temperature reaches as high as 48 ^{0}C in the month of May or June, while minimum temperature falls down to a limit of 1 ^{0}C during end of December or January months. The relative humidity varies from season to season. It ranges between 80 to 95% during rainy season, which goes upto 100% and 20 to 30% during winter and summer seasons, respectively. The soil of the experimental field had a uniform topography. The soil type of the experimental field was loamy sand with sand (87.7 %), silt (5.6%), clay (7.7%), 8.3 pH, 0.24% organic carbon and 143.3, 33.0, and 223.6 kg/ha available N, P_2O_5 and K_2O respectively.

The present investigation was comprised of 8 treatment combinations consisting with different organic practices *viz.* T1-Farmer's practices, T2- 7.5 t FYM +PSB+ PSM+ Bio-Pesticides, T3 - T2 + Seed treatment with PSB+ PSM+ Bio-pesticides, T4 – T3 + Foliar spray of pseudo-monas, T5 – T3 + Foliar spray of NSKE @ 5 %, T6 - T3 + Foliar spray of Panchagavya, T7-Absolute control and T8-100% RDF (15kg N+ 60 kg $_2O_5$/ha) were tested in a randomized block design with three replications and the net plot size was 18.0 sq m with 35cm row to row and 15 cm plant to plant spacing . The varieties Girnar-2 was sown in the month of June of 2007, 2008 and 2009 respectively. Four irrigations were given. Phorate 10 G at the time of sowing @ 25 kg/ha and Chloropyriphos 4 lit/ha with irrigation was used to control white grub. Seeds (kernels) were treated with Dithan M-45 at the rate of 3 g/kg to avoid the possible occurrence of the seed and soil borne diseases.

All the physiological parameters were recorded at 30 days after sowing (DAS) and at maturity every year and means were calculated and used for the interpretation of the results. The data were statistically analyzed for the test of significance at 0.05% probability level. The Benefit-cost ratio which gives an indicative of the true monetary gain over every rupee of investment under a particular treatment was worked out by using the following formula:

$$\text{Benefit-cost ratio} = \frac{\text{Gross monetary return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Results and Discussion

Table 1 revealed that management of groundnut through organic practices significantly influenced pod weight, plant population, kernel yield, pod yield and haulm yield over farmers practices and control during each year of study. Highest plant population (183.69 th/ha) and 100 kernel weight (66.56 g) were observed in treatment T5 (T3 + Foliar spray of Panchagavya). Highest oil content (51.16 %) was observed in treatment T3 (T2 + Seed treatment with PSB+ PSM+ Bio-pesticides) followed by treatment T4 (T3 + Foliar spray of pseudo-monas) (51.14 %). But the number of pods/plant (23.55) were highest in treatment T4 (T3 + Foliar spray of pseudo-monas). The lowest pod yield and haulm yield were obtained in absolute control. Treatment T5 (T3 + Foliar spray of NSKE @ 5 %) showed significantly the highest pod yield (2768 kg/ ha) but kernel yield (2067 kg/ha) and haulm yield (3002 kg/ha) was observed in treatment T3 (T2 + Seed treatment with PSB+ PSM+ Bio-pesticides) over rest of the treatments under study.

The lowest haulm yield (2359 kg/ha) and pod yield (2151 kg/ha) and kernel yield (1418 kg/ha) was recorded in absolute control during all the years which revealed the in-efficiency of fertilization as reported by Deshmukh *et al*., 2005 that the beneficial effect of FYM in conjunction with recommended dose of fertilizers may be due to the effect of organic matter in improving physical, chemical and biological environment of soil conducive to better plant growth. This was in agreement with the findings of Sisodia and Kewat, (2012), Malligawad and Parameshwarappa, (2006), Malligawad *et al*., (2007) who have reported that organic farming maintains dynamic soil nutrient status and safe environment. Dharma, 1996 observed that FYM might have stimulated the activities of microorganisms that made the plant nutrients readily available to the crops which augmented pod yield of groundnut. Olowoake and Adeoye, 2013 reported that application of FYM increased the availability of nutrients to crop, increasing moisture content of soils and enhanced the availability of potassium to plant which resulted in higher maize yield. FYM application had increased the dry matter production, which might be due to increased release of macro as well as micronutrients in better extraction by the groundnut. In general, crop growth was found better in the plots having organic package treatments than in absolute control treatment (Table 1).

The importance of organic to inorganic manuring in groundnut plants was emphasized by Okello, 2010 and Ahmed *et al.*, 1997 who stated that the highest dry matter accumulation, kernel yield and oil content were achieved by fertilization with farmyard manure as there was significant increase in organic C, available N and P content of the soil with application of FYM possibly due to the increase in decomposition product of organic matter which resulted in better performance. All the organic practices significantly influenced the shelling % and SMK % (sound mature kernels) over absolute control treatment (Table 2). The lowest shelling % and SMK % were obtained in absolute control. Treatment T5 (T3 + Foliar spray of NSKE @ 5 %) showed highest shelling percent (75.42 %) and SMK (86.77 %) followed by treatment T3 (T2 + Seed treatment with PSB+ PSM+ Bio-pesticides) over rest of the treatments under study.

The economic analysis of the treatments was made with different sub-heads as cost of cultivation and gross as well as net returns as per hectare basis and finally as profitability (benefit: cost ratio). The data on these parameters are presented in Table 3. The monetary value of the marketable produce is termed as Gross return. The gross return values varied due to effect of different organic package treatments (Table 3). Gross return is directly related to the value of the marketable produce, which could be realized from the existing market price of the produce. The Gross return value was maximum (Rs 88564 Rs/ha) with treatment T5 (T3 + Foliar spray of NSKE @ 5 %). The higher gross returns of these treatments were due to higher pod yield. Treatment, T7 (absolute Control) led to record significantly minimum gross return of Rs 68993/ha in totality as it recorded less pod and haulm yields. The cost of cultivation was maximum (Rs 25476/ha) under treatment T6 (T3 + Foliar spray of Panchagavya) followed by treatment T4 (T3 + Foliar spray of pseudo-monas) (Rs 25375/ha). The lowest cost of cultivation was observed in treatment T5 (T3 + Foliar spray of NSKE @ 5 %).

The maximum net returns (Rs 64371/ha) was obtained under treatment T5 (T3 + Foliar spray of NSKE @ 5 %) over all the organic package treatments including absolute control treatment, followed by treatment T3 (T2 + Seed treatment with PSB+ PSM+ Bio-pesticides) (Table 3). The B: C ratio was maximum (3.66:1) under treatment T5 (T3 + Foliar spray of NSKE @ 5 %) (Table 3), due to the maximum gross return value with the lowest cost of cultivation associated with it, followed by treatment T3 (T2 + Seed treatment with PSB+ PSM+ Bio-pesticides) . Thus it could be concluded that investment on the use of every unit of organic package was more remunerative. The treatment T6 (T3 + Foliar spray of Panchagavya) had the minimum B:C ratio (3.32:1) among all treatments as it recorded less pod and haulm yields. Similar results were observed by Chandrasekaran *et al.*, 2007.

Conclusion

The study was undertaken at research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan) during three consecutive kharif seasons of 2008, 2009 and 2010 to study the effect of organic practices on the yield and yield attributes of groundnut in semi arid region. The results indicated that the groundnut showed greater response to different organic practices under semi arid region. The study also revealed that under semi arid conditions with moderately less rainfall, sustainable yields of groundnut can be obtained with organic practices involving application of farmyard manure with microbes (bio fertilizers+bio-pesticides) and seed treatment with bio fertilizers+bio-pesticides.

Table 1: Effect of various organic practices on growth, yield attributes and yield of groundnut during 2008, 2009 and 2010.

Treaments	Plant Population (000/ha)				No of Pods/Plant				Pod Wt/Plant (gm)				100KernelWt (gm)				Kernel Yield (Kg/ha)				Pod yield kg/ha				Haulm yield kg/ha			
	2008	2009	2010	Mean	2008	2009	2010	Mean	2008	2009	201	Mean	2008	200	201	Mean	2008	2009	201	Mean	2008	2009	2010	Mean	2008	2009	2010	Mear
T1-Farmer's practices	191.85	174.44	179.62	181.97	22.13	18.07	20.33	19.84	26.4	25.13	30.9	27.50	40.89	67.9	76.5	61.79	922	1692	199	1536	1388	2750	2978	2372	957	3203	3629	2596
T2-7.5 t FYM +PSB+ PSM Bio-Pesticides	186.85	169.25	172.03	176.04	24.20	19.60	22.00	21.93	27.8	31.13	38.2	32.42	42.07	68.1	73.7	61.31	1103	2218	261	1979	1638	3099	3357	2698	1129	3611	4079	2939
T3- T2 + Seed treatment v PSB+ PSM+ Bio-pesticid	192.59	175.92	178.33	182.28	23.73	19.93	22.48	20.04	27.3	30.20	37.1	31.55	41.44	68.4	74.1	61.35	1101	2358	274	2067	1638	3174	3438	2750	1101	3722	4185	3002
T4 – T3 + Foliar spray of pseudo-monas	185.37	171.11	179.44	178.64	24.20	21.47	25.00	23.55	28.7	30.20	37.1	32.02	41.71	71.1	77.0	63.28	1057	2199	2604	1953	1574	3116	3390	2693	1074	3629	4129	2944
T5 – T3 + Foliar spray of NSKE @ 5 %	196.66	177.77	176.66	183.69	25.33	20.73	22.46	22.84	28.8	30.26	37.3	32.12	43.10	71.2	77.1	63.82	1226	2269	268	2059	1685	3084	3535	2768	1138	3444	4081	2887
T6 - T3 + Foliar spray of Panchagavya	190.74	174.49	179.62	181.61	24.80	20.86	23.93	23.10	28.6	29.80	36.7	31.73	53.04	70.4	76.2	66.56	1058	2185	270	1983	1546	2972	3385	2634	1055	3481	4124	2886
T7-Absolute control	188.18	176.85	175.92	180.31	21.20	18.20	20.78	20.06	24.0	24.40	29.9	26.14	37.97	71.7	74.9	61.54	780	1596	187	1418	1250	2500	2705	2151	851	2926	3300	2359
SEm ±	7.01	4.71	4.50		0.89	1.10	1.20		0.96	1.17	1.04		3.62	2.37	2.68		52	100	114		77	128	118	48	57	126	159	
CD at 5%	NS	NS	NS		NS	NS	NS		2.97	3.63	4.24		NS	NS	NS		163	309	348		239	397	359	148	176	389	484	
CV%	6.61	4.68	4.48		6.58	9.61	9.29		6.09	7.10	6.77		11.17	10.5	6.16		8.86	8.37	7.98		8.80	7.42	6.21		9.48	6.37	6.91	

Table 2: Influence of various organic practices on Shelling % and SMK% of groundnut during 2008, 2009 and 2010.

Treaments	Shelling %				SMK%				Oil%			
	2008	2009	2010	Mean	2008	2009	2010	Mean	2008	2009	2010	Mean
T1-Farmer's practices	66.56	61.56	66.95	65.02	87.36	88.36	90.02	88.58	50.80	50.76	50.21	50.59
T2-7.5 t FYM +PSB+ PSM+ Bio-Pesticides	67.36	71.46	77.85	72.22	82.70	82.70	84.63	83.34	50.90	50.83	50.24	50.65
T3- T2 + Seed treatment with PSB+ PSM+ Bio-pesticides	67.20	74.28	80.85	74.11	86.33	86.03	87.66	86.67	51.66	51.20	50.64	51.16
T4 – T3 + Foliar spray of pseudo-monas	67.20	70.54	76.78	71.50	86.23	85.00	86.60	85.94	51.33	51.40	50.70	51.14
T5 – T3 + Foliar spray of NSKE @ 5 %	72.66	73.57	80.05	75.42	86.26	86.23	87.83	86.77	51.36	51.16	50.56	51.02
T6 - T3 + Foliar spray of Panchagavya	68.56	73.36	79.81	73.91	91.40	86.73	88.36	88.83	51.33	51.10	50.60	51.01
T7-Absolute control	62.56	63.48	69.48	65.17	77.13	76.30	77.70	77.04	47.20	47.26	46.76	47.07
SEm ±	1.08	1.56	1.59		3.27	2.24	2.33		0.20	0.25	0.27	
CD at 5%	3.34	4.81	4.85		NS	6.92	Ns		0.64	0.78	0.84	
CV%	2.78	3.87	3.61		6.64	4.60	4.68		1.71	1.87	0.95	

Table 3: Economics of the treatments under various organic practices in groundnut during 2008, 2009 and 2010.

Treatments	Gross returns (Rs/ha)				Cost of cultivation (Rs/ha)				Net returns (Rs/ha)				B:C ratio
	2008	2009	2010	Mean	2008	2009	2010	Mean	2008	2009	2010	Mean	
T1-Farmer's practices	47718	83319	96598	75878	20000	23000	24840	22613	27718	60319	71758	53265	3.36
T2-7.5 t FYM +PSB+ PSM+ Bio-Pesticides	56312	94506	108868	86562	21900	24900	26890	24563	34412	69606	81978	61998	3.52
T3- T2 + Seed treatment with PSB+ PSM+ Bio-pesticides	56256	96864	111510	88210	21990	24990	26890	24593	34356	71874	84620	63616	3.59
T4 – T3 + Foliar spray of pseudo-monas	54090	95019	109958	86355	22690	25690	27746	25375	31400	69329	82212	60980	3.40
T5 – T3 + Foliar spray of NSKE @5 %	57881	93600	114212	88564	22890	23890	25800	24193	34991	69710	88412	64371	3.66
T6 - T3 + Foliar spray of Panchagavya	53128	90687	109798	84537	22790	25790	27850	25476	30338	64897	81948	59061	3.32
T7-Absolute control	42952	76278	87750	68993	17500	20500	22140	20046	23952	57278	65610	48946	3.44

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