Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 9 ~ Issue 4 (2022) pp: 21-26
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Effect of *insitu* Moisture Conservation Practices and Integrated Nutrient Management on Productivity Enhancement of sunflower under Dry land Condition

Kalaghatagi, S. B., Geeta Kalaghatagi and Guggari, A. K. Department of Agronomy, College of Agriculture,Vijayapura
University of Agricultural Sciences, Dharwad -580 005, Karnataka India

***R**eceived 28 Mar, 2022; **R**evised 06 Apr, 2022; **A**ccepted 08 Apr, 2022 © The author(s) 2022.*
P**ublished with open access at **www.questjournals.org

In most of the semi-arid regions of the world, sunflower is grown in marginal areas with low soil fertility and hence yield levels are considerably low. Excessive use of chemical fertilizers and other agro chemicals, which are the important inputs in modern farming, create depletion in soil fertility, so it is imperative for the farmers to manage soil fertility level for sunflower cultivation with an integrated way of using organic and inorganic manures, as correcting nutrients lead to sustainable high crop yields. Organic manure provides all the nutrients that are required by plants. It helps in maintaining C: N in the soil, thereby increases the fertility and productivity of the soil. Inadequate soil moisture and poor fertility statusofthe soil are the two major constraints for higher productivity of the crop in the dry lands of semi- arid tropics. Hence, for simultaneous improvement of the nutrients and moisture supplying capacity of the soil, copious use of organic manures and adoption of *insitu* moisture conservation practices may be the only solutions in sustaining the crop yields. The optimum sowing time of Sunflower is second fortnight of August and there is ample scope for *in situ* rainwater harvesting through proper land configuration during June and July to conserve rain water. In this contest, present study was conducted for effective conservation of rain water with optimum nutrient supply to Sunflower under dry land condition.

I. METHODOLOGY:

A field experiment was conducted during *kharif* 2017 and 2018 under rainfed condition at College of Agriculture, Vijayapura, Karnataka and is situated at 16^0 49' North latitude, 75^0 43' East longitude and at an altitude of 593.8 m above the mean sea level. The experiment was consisted of 15 treatment combinations involving three moisture conservation practices as main plots *Viz*., M_1- No moisture conservation (flat bed), M_2-Compartment bunding, M_3-Broad bed & furrow and five nutrient levels as subplots viz,, S_1-100 per cent inorganic (35:50:35 kg N:P_2O_5:K_2O per ha), S_2- 50 per cent inorganic + 50 per cent organic through FYM, S_3-50 per cent inorganic + 50 per cent organic through vermicompost, S_4-50 per cent inorganic + 50 per cent organic through goat manure, S_5-RDF + 8 t FYM ha^{-1} (Recommended package of practice of the state). The experiment was laid out in split plot design with three replications. The formation of *insitu* moisture conservation structures mainly compartment bunds were formed with the help of bund former and broad bed and furrows were opened with the help of ridger plough during second fort night of June after light harrowing in order to remove the weeds. The amount of N, P_2O_5 and K_2O required for each treatment was calculated as per the treatment details and they were given in the form of urea, DAP and MOP. With respect to organic sources, viz., FYM, Vermi compost and goat manure, nutrient requirements were calculated based on the nutrient contents. At the time of sowing, the furrows were opened with the help of hand marker at a row spacing of 60 cm and then the Sunflower seeds were hand dibbled at 5 cm depth and covered with soil. The total annual rainfall received during sunflower growing period (Agust to November)was 765.1 mm during 2017 and 466.3 mm during 2018 with rainy days of 46 and 30, respectively. The BBF structures act as excess rainfall disposing as well conserving structure during 2017 which fecilitated better crop growth. The highest monthly rainfall of 188.3 mm was received in September followed by 161.0 mm in August and 148.8 mm in October. The rainfall received during cropping period (August -November) as well as total rainfall was higher during 2017, while, it was lower during 2018 when compared with mean of 36 years. The data collected from the experiment at different growth stages and at harvest was subjected to statistical analysis as described by Gomez and Gomez (1984). The level of significance used for 'F' and 't' tests was at 5 per centprobability.

II. RESULTS:

Effect of moisture conservation practices

The two years pooled data (Table 1) revealed that, significantly higher total dry matter production plant^{-1} (47.79g), head diameter (8.15 cm), number of seeds per head (315) and seed weight per head (15.61 g) were recorded in broad bed and furrow and was on par with compartment bunding, while, higher test weight of 4.18 g was also recorded with compartment bundingas compared to flat bed method (without moisture conservation practice). This was mainly due to higher soil moisture availability during crop growth period in these moisture conservation treatments, which resulted in better growth and development of sunflower. The results of the investigation are in accordance with the previous research carried by Paulpandi*et al.* (2008) and Mudalagiriyappa*et al*. (2012), who observed higher moisture content in compartment bunding and BBF treatments.

The data on seed yield indicated that, compartment bunding practice recorded significantly higher seed and stalk yields (935 and 2271kg ha^{-1}, respectively) as compared to other moisture conservation practices, but it was on par with broad bed and furrow method. The increase in seed yield due to both the moisture conservation was to an extent of 62.32 and 54.70 per cent over the flat bed method (without moisture conservation practice). The higher seed and stalk yields in these treatments over flat bed was due to an opportunity of higher *in situ* moisture conservation, which lead to higher moisture availability in the root zone during critical stages of the crop growth (Table 4a, 4b and 4c) and had helped in improving the metabolic and physiological processes of the crop which in turn resulted in significantly higher growth and yield attributes (Table 1 and 2). These results are in conformity with the findings of Paulpandi*et al.* (2008) in sunflower, Nalawade and More (1993) and Patra*et al.* (1996) in groundnut, who reported that, broad bed and furrow methods helped to improve the growth andyield of the crops.

Effect of Integrated Nutrient Management Practices

In the present investigation, significantly higher total dry matter production per plant was recorded with application of RDF + 8 t FYM ha^{-1} (51.09 g) , higher head diameter (8.29 cm), number of seeds per head (393.39), seed weight per head (15.95 g) and test weight (4.95 g) as compared to othernutrientlevels. (T a b l e 1) Thiswasdueto s u p p l y o f balancednutritionthroughconjunctiveuseof organic manures and inorganic fertilizers resulting in optimum availability of nutrients to the crop growth and development and which enhanced higher nutrient uptake. Similar results were reported by Nanjundappa*et al*. (2001) and Paulpandi*et al.* (2008) in sunflower.

Pooled data of two years revealed that, application of RDF (35:50:35 kg N, P_2O_5 and K_2O ha^{-1}) + 8 t FYM ha^{-1} was found superior and recorded significantly higher seed yield of sunflower (940 kg ha^{-1}) over other nutrient management practices.(Table 3) The increase in sunflower seed yield with RDF + 8 t FYM ha^{-1} was 54.35 per cent over supplying nutrients through inorganic sources alone (RDF). This was mainly due to the reason that, RDF coupled with FYM, provided optimum availability of nutrients including trace elements for better root growth and development, that in turn helped in better nutrient uptake by the plants from the soil. These results are in conformity with Nanjundappa*et al.* (2001), who reported that, application of different combination of organic and inorganic sources of nutrients *i.e.* RDF + 10 t FYM ha^{-1} significantly increased seed yield. Similar results were reported by Thanki*et al.* (2004) and Byrareddy*et al.*(2008).

Interaction effect

The pooled data in Table 1 revealed that, significantly higher dry matter production per plant was recorded with the combination of broad bed and furrow method of moisture conservation along with the application of RDF + 8 t FYM ha^{-1} (50.76 g plant^{-1}).

Economic yield is a function of many yield contributing parameter like head diameter, number of seeds head^{-1} and seed weight head^{-1} (Table2). They were significantly higher in the interaction between broad bed and furrow method of moisture conservation practice and application of RDF + 8 t FYM ha^{-1}. Significantly higher seed yield of sunflower was obtained in the treatment combination of *in situ* moisture conservation practice with compartment bunding and application of RDF + 8 t FYM ha^{-1} (1081kg ha^{-1}) and which was on par with broad bed and furrow method of moisture conservation and with application of RDF + 8 t FYM ha^{-1} followed by application of 50 per cent inorganic + 50 per cent organic through goat manure. (Table 2 & 3).The higher seed yield was mainly due to higher moisture conservation due to compartment bunding and broad bed and furrow treatments as well as optimum nutrient supply by conjunctive use of organic and inorganic sources of nutrients, that lead to better translocation of photosynthates from source to sink. The higher growth and yield parameters recorded due to moisture conservation by compartment bunding resulted in significantly higher net returns was noticed in compartment bunding (Rs.33,058 ha^{-1}) and was on par with broad bed and furrow method of moisture conservation (Rs 30,081 ha^{-1}). The interaction between compartment bundingalong with application of 50% inorganic nutrient + 50% organic nutrients through goat manure showed higher net returns(Rs.44,971 ha^{-}

[1]). Similar trend was observed with respect to benefit cost ratio (1.99). Which was mainly due to higher seed yield of sunflower.

III. Conclusion

The investigation revealed that, growing of sunflower with formation of compartment bund or broad bed and furrow during second fortnight of June with the application of 50 per cent organic manures + 50 per cent in-organicsimproved the growth and yield components which enhanced the productivity of sunflower.The higher yield per unit area resulted in higher economic returns under dry landsituation.

Table 1: Plant height, total dry matter accumulation and head diameter of sunflower as influenced by moisture conservation and nutrient managementpractices.

Treatment	Plant height (cm) 90 DAS			Total dry matter accumulation (g/plant)			Head diameter (cm)		
	2017	2018	Pooled Mean	2017	2018	Pooled Mean	2017	2018	Pooled Mean
Moisture conservation practices(M)									
M_1	174	155	139	75.56	15.87	45.12	10.1	4.75	4.73
M_2	176	160	181	76.60	17.00	47.33	10.53	5.18	5.43
M_3	184	160	154	79.08	16.49	47.85	11.14	5.15	4.92
S.Em. ±	3.83	1.86	2.97	0.66	0.03	0.32	0.24	0.07	0.06
C.D. at 5 %	NS	7.31	11.66	2.59	0.11	1.24	0.96	0.28	0.25
Nutrient management practices (S)									
S_1	173	140	158	68.00	15.64	42.06	10.28	4.9	4.75
S_2	176	162	156	77.57	16.41	47.07	10.32	4.9	4.98
S_3	176	162	157	74.33	15.75	45.42	10.3	5.24	5.06
S_4	177	159	158	81.82	15.95	49.12	10.8	4.99	5.12
S_5	189	165	161	83.67	18.51	50.16	11.27	5.31	5.23
S.Em. ±	3.05	3.70	3.50	0.38	0.05	0.19	0.18	0.14	0.14
C.D. at 5 %	8.89	10.81	10.21	1.12	0.16	0.56	0.54	NS	0.42
Interaction (M × S)									
M_1S_1	163	127	127	66.76	12.46	39.61	9.18	4.55	4.55
M_1S_2	181	139	139	75.55	14.98	45.27	10.02	4.76	4.76
M_1S_3	164	142	142	72.58	15	43.79	9.61	4.76	4.76
M_1S_4	173	144	144	80.23	15.16	47.70	10.66	4.77	4.77
M_1S_5	187	146	146	82.66	15.79	49.23	11.05	4.83	4.83
M_2S_1	172	127	200	64.51	19.94	42.22	10.85	5.29	5.29
M_2S_2	170	179	179	77.63	17.95	47.79	10.61	5.31	5.31
M_2S_3	184	178	178	74.78	17.64	46.21	10.24	5.44	5.44
M_2S_4	177	176	176	82.16	17.7	49.93	10.25	5.45	5.45
M_2S_5	180	173	173	83.90	17.07	50.49	10.71	5.65	5.65
M_3S_1	183	147	147	72.74	15.96	44.35	10.82	4.4	4.40
M_3S_2	177	149	149	79.51	16.76	48.14	10.32	4.89	4.89
M_3S_3	181	153	153	75.63	16.87	46.25	11.04	4.99	4.99
M_3S_4	181	154	154	83.08	16.39	49.73	11.5	5.13	5.13
M_3S_5	200	165	165	84.43	17.08	50.76	12.03	5.2	5.20
S.Em. ±	2.33	6.41	6.06	0.66	0.09	0.33	0.61	0.25	0.25
C.D. at 5 %	NS	18.72	17.68	1.94	0.27	0.96	1.77	NS	0.73

Main plot - Moisture conservation practices M_1- Flatbed method (control)M_2- Compartment bunding
M_3- Broad bed and furrow
Sub plot - Nutrient management

S_1- 100 % inorganic source (RDF)
S_2- 50 % inorganic source + 50 % organic through FYM
S_3- 50 % inorganic source + 50 % organic through vermicompost
S_4- 50 % inorganic source + 50 % organic through goat Manure
S_5- RDF + 8 t FYM ha^{-1} (Recommended package of practices)

Table 2: Yield attributing characters of sunflower as influenced by moisture conservation and nutrient management practices.

Treatment	No. of seeds $head^{-1}$			Seed weight $head^{-1}$ (g)			Test weight (g)		
	2017	2018	Pooled Mean	2017	2018	Pooled Mean	2017	2018	Pooled Mean
Moisture conservation practices(M)									
M_1	455.3	111.9	279.5	21.9	4.4	12.5	4.2	3.4	3.7
M_2	479.6	138.4	313.7	25.2	4.8	15.2	4.4	3.9	4.2
M_3	515.5	115.9	315.1	26.8	4.5	15.8	4.5	3.5	4.0
S.Em. ±	3.01	5.12	7.38	0.88	0.44	0.40	0.05	0.17	0.06
C.D. at 5 %	11.83	20.09	21.54	3.44	NS	1.58	0.19	NS	0.23
Nutrient management practices (S)									
S_1	340.2	102.7	224.7	21.0	3.9	12.3	3.6	3.5	3.5
S_2	468.1	126.7	291.0	27.0	5.1	15.7	4.6	3.3	4.0
S_3	431.1	109.1	276.8	22.8	4.2	13.6	4.1	3.9	3.8
S_4	529.3	134.1	328.0	25.3	4.3	15.0	4.8	3.4	4.3
S_5	648.8	137.7	393.4	27.1	5.3	15.9	5.0	3.9	4.4
S.Em. ±	2.26	7.28	4.26	0.83	0.22	0.45	0.07	0.15	0.09
C.D. at 5 %	6.58	21.24	12.44	2.43	0.65	1.32	0.20	0.44	0.26
Interaction (M × S)									
M1S1	316.5	94.7	205.6	15.8	3.4	8.1	3.3	2.8	3.0
M1S2	458.0	101.3	279.6	25.3	3.2	14.3	4.4	3.1	3.7
M1S3	414.6	102.5	258.5	22.9	3.4	13.1	4.0	3.2	3.6
M1S4	481.2	109.9	295.6	21.5	3.9	12.7	4.7	3.3	4.0
M1S5	606.5	110.0	358.2	24.0	4.1	14.1	4.8	3.4	4.1
M2S1	339.6	123.8	231.7	22.1	4.1	13.2	3.7	3.8	3.7
M2S2	467.9	128.3	298.1	25.5	5.1	15.3	4.7	3.8	4.3
M2S3	420.4	150.3	285.3	23.4	5.5	14.4	4.1	3.9	4.0
M2S4	549.7	154.7	352.2	26.4	5.5	16.0	4.9	4.3	4.6
M2S5	620.5	182.1	401.3	28.6	5.8	17.2	4.9	4.4	4.7
M3S1	364.6	109.1	236.8	25.1	5.9	15.5	3.8	3.4	3.6
M_3S_2	478.5	112.1	295.3	30.2	4.7	17.5	4.6	3.5	4.0
M_3S_3	458.5	114.8	286.6	22.1	4.5	13.3	4.3	3.6	3.9
M_3S_4	556.9	115.3	336.1	27.9	4.6	16.2	4.8	3.7	4.2
M_3S_5	719.3	122.0	420.7	28.6	4.6	16.6	5.1	3.7	4.4
S.Em. ±	5.51	12.61	7.38	1.46	1.12	0.79	0.21	0.26	0.15
C.D. at 5 %	13.27	36.80	21.54	4.25		2.29	NS	NS	NS

Table 3: Seed yield, stalk yield and harvest index of sunflower as influenced by moisture conservation and nutrient management practices.

Treatment	Seed yield (kg ha^{-1})			Stalk yield (kg ha^{-1})			Harvest index (%)		
	2017	2018	Pooled Mean	2017	2018	Pooled Mean	2017	2018	Pooled Mean
Moisture conservation practices(M)									
M_1	994	158	576	2348	588	1468	29.80	21.33	25.56
M_2	1390	507	935	3023	1519	2271	31.14	29.43	30.28
M_3	1466	354	923	3085	1069	2077	32.03	25.48	28.76
S.Em. ±	41	28.98	17	104	59	61	0.28	3.39	1.78
C.D. at 5 %	117	113.81	68	295	232	238	1.10	NS	NS
Nutrient management practices (S)									
S_1	887	330	609	2643	867	1755	25.03	23.73	24.38
S_2	1253	324	788	2685	958	1822	31.84	24.53	28.19
S_3	1312	329	821	3042	1061	2051	29.97	25.17	27.57
S_4	1447	351	899	2873	1139	2006	33.47	25.93	29.70
S_5	1518	362	940	2850	1270	2060	34.63	27.70	31.17
S.Em. ±	37	8	13	99	74	56	0.42	3.56	1.84
C.D. at 5 %	76	23	39	205	215	163	1.22	NS	5.37
Interaction (M × S)									
M1S1	737	142	439	2569	366	1468	22.27	19.18	20.73
M1S2	1117	128	622	2384	466	1425	31.94	20.45	26.20
M1S3	957	128	543	2434	625	1529	28.23	21.85	25.04
M1S4	1049	182	615	2126	674	1400	33.08	22.03	27.55
M1S5	1113	209	661	2225	810	1518	33.46	23.13	28.30
M2S1	872	465	669	2571	1423	1997	25.36	27.35	26.36
M2S2	1237	484	860	2718	1451	2084	31.30	28.17	29.73
M2S3	1519	485	1002	3404	1529	2466	30.87	28.63	29.75
M_2S_4	1654	476	1065	3309	1549	2429	33.35	30.38	31.86
M_2S_5	1667	495	1081	3115	1644	2379	34.83	32.61	33.72
M_3S_1	1053	384	719	2788	811	1800	27.47	24.67	26.07
M_3S_2	1405	360	883	2954	958	1956	32.29	24.98	28.64
M_3S_3	1460	375	917	3289	1029	2159	30.82	25.04	27.93
M_3S_4	1638	396	1017	3183	1193	2188	33.98	25.38	29.68
M_3S_5	1775	382	1078	3211	1355	2283	35.60	27.35	31.48
S.Em. ±	64	14	23	171	127	97	0.72	6.17	3.18
C.D. at 5 %	149	40	68	397	372	282	2.11	NS	9.29

Table 5. Economics of sunflower as influenced by moisture conservation and nutrient management practices.

Treatment	Cost of cultivation (`Rs. ha^{-1})	Gross returns (Rs. ha^{-1})			Net returns (Rs. ha^{-1})			B:C		
		2017	2018	Pooled Mean	2017	2018	Pooled Mean	2017	2018	Pooled Mean
Moisture conservation practices(M)										
M_1	22,812	38,831	8,495	23,663	16,019	-12,420	3,599	1.71	0.44	1.04
M_2	23,562	54,276	25,906	40,091	30,714	2,344	33,058	2.30	1.10	1.70
M_3	23,812	57,256	20,449	38,853	33,444	-3,363	30,081	2.40	0.80	1.63
S.Em. ±	-	1130	593	735	1598	1081	978	0.05	0.06	0.03
C.D. at 5 %	-	4438	2328	2888	4557	4247	3844	0.19	0.24	0.12
Nutrient management practices (S)										

S_1	20,854	34,655	17,798	26,227	13,800	-3,056	10,744	1.66	0.84	1.25
S_2	22,463	48,925	17,457	33,191	26,462	-5,006	21,456	2.18	0.77	1.47
S_3	22,463	51,227	17,750	34,489	28,764	-1,551	27,213	2.27	0.78	1.53
S_4	22,463	56,513	18,924	37,718	34,049	-3,539	30,510	2.51	0.83	1.67
S_5	28,732	59,286	19,487	39,386	30,554	-9,246	21,308	2.06	0.67	1.37
S.Em. ±	-	1015	870	574	1435	1683	958	0.04	0.03	0.02
C.D. at 5 %	-	2962	NS	1675	2980	4915	2798	0.13	0.08	0.07
Interaction (M × S)										
M_1S_1	20,271	28,769	7,633	18,201	8,498	-12,638	-4,140	1.42	0.37	0.89
M_1S_2	21,880	43,606	6,897	25,251	21,726	-14,983	6,743	1.99	0.31	1.15
M_1S_3	21,880	37,360	6,915	22,137	15,480	-5,479	10,001	1.71	0.31	1.01
M_1S_4	21,880	40,961	9,788	25,375	19,081	-12,092	6,989	1.87	0.44	1.16
M_1S_5	28,149	43,460	11,243	27,351	15,311	-16,906	-1,595	1.54	0.39	0.97
M_2S_1	21,021	34,071	25,054	29,562	13,050	4,033	17,083	1.62	1.19	1.40
M_2S_2	22,630	48,305	26,060	37,182	25,675	3,430	29,105	2.13	1.15	1.64
M_2S_3	22,630	59,314	26,132	42,723	36,684	3,502	40,186	2.62	1.15	1.89
M_2S_4	22,630	64,602	25,629	45,115	41,972	2,999	44,971	2.85	1.13	1.99
M_2S_5	28,899	65,091	26,653	45,872	36,192	-2,246	33,946	2.25	0.92	1.59
M_3S_1	21,271	41,125	20,708	30,917	19,854	-563	19,291	1.93	0.97	1.45
M_3S_2	22,880	54,865	19,415	37,140	31,985	-3,465	28,520	2.40	0.85	1.62
M_3S_3	22,880	57,008	20,205	38,606	34,128	-2,675	31,453	2.49	0.88	1.69
M_3S_4	22,880	63,975	21,354	42,665	41,095	-1,526	39,569	2.80	0.93	1.86
M_3S_5	29,149	69,307	20,564	44,936	40,158	-8,585	31,573	2.38	0.70	1.54
S.Em. ±	-	2486	1507	994	2486	2916	1660	0.10	0.05	0.04
C.D. at 5 %	-	5818	4400	2902	5818	8513	4847	0.25	0.14	0.12

References

[1]. Anonymous, 2018, Agricultural Statistics at a Glance 2018, Ministry of Agriculture & Farmers Welfare, Directorate of Economics and Statistics, Govt. of India, p. 161.

[2]. Byrareddy, K., Uppar, D. S., Vyakaranahal, B. S., Hiremath, S. M., Hunje, R. and Nadaf, H. L., 2008, Effect of integrated nutrient management on sunflower hybrid (KBSH-1) seed production. *Karnataka J. Agric. Sci*., 21(2): 171-175.

[3]. Channappa, T. C., 1994, *In-situ* moisture conservation in arid and semi-arid tropics, *Indian J. Soil Cons*., 22 (1&2): 26-41.

[4]. Gomez, K. A. and Gomez, A. A., 1984, *Statistical Procedure for Agricultural Research,* An International Rice Research Institute Book, Willy Inter Science Publication, New York, USA, 680.

[5]. Mudalagiriyappa., Ramachandrappa, B. K., Nanjappa, H. V., 2012, Moisture conservation practices and nutrient management on growth and yield of *rabi*sorghum (*Sorghum bicolor*) in the vertisols of peninsular India. *Agric. Sci.,* 3(4): 588-593.

[6]. Nalawade, S. K. and More, S. D., 1993, Effect of land configuration on yield and nutrient content of groundnut cultivars in medium black soils. *J. Maharashtra Agric. Univ*., 18(3): 498-499.

[7]. Nanjundappa, G., Shivraj, B., Janarjuna, B. and Sridhara, S., 2001, Effect of organic and inorganic sources of nutrients applied alone or in combination on growth and yield of sunflower (*Helianthus annuus*L.). *HELIA*. 24(34): 115-120.

[8]. Patra, A. K., Tripathy, S. K., Samui, R. C. and Nanda, M. K., 1996, Effect of potassium, nutrition and type of storage containers on seed quality of stored groundnut pods. *Int. Arachis News lett.*,16:56-58.

[9]. Paulpandi, V, K., Ganesaraja, V. and Kavitha, M. P., 2008, Studies on the effect of *in situ*moisture conservation and integrated nutrient management on growth and yield of sunflower in rainfed*vertisol*. *Legume Res.,* 31(3): 174-178.

[10]. Thanki, J. D., Patel, A. M. and Patel, M. P., 2004, Effect of nitrogen, phosphorus and farm yard manure on growth, yield, quality and nutrient uptake of Indian mustard (*Brassica juncea*). *J. Oilsseds Res*., 21 (2): 296-289.