Research Article

Copy Right ©KY Publications
Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in
A Peer Reviewed & Refereed, International Open Access Journal
Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

INTEGRATED NUTRIENT MANAGEMENT IN SUNFLOWER WITH APIARY FARMING SYSTEM

G.SUMALATHA[1], T. GEETHA JEBARATHNAM[2]
[1,2]Department of Agronomy, Faculty of Agriculture
Annamalai University, Annamalai nagar, Tamil Nadu, India
sulareddy@gmail.com

ABSTRACT

Two sets of field experiments were conducted during the june-august months of 2013-2014 at Annamalai University of cuddalore district under irrigated conditions to formulate site –specific nutrient management and to assess the yield performance of sunflower +apiary farming system.The experiment consists of two main treatments; i.e, sunflower alone (M_1) ,sunflower with apiary (M_2) and nine sub treatments i.e,control (S_1), 100%RDF (S_2), 100%RDF + Azospirillum (S_3), 100% RDF +phosphobacteria (S_4), 100% RDF + vermicompost (S_5), 100%RDF+ Azospirillum + phosphobacteria (S_6), 100%RDF+ Vermicompost+ Azospirillum (S_7), 100% RDF+ vermicompost+ phosphobacteria(S_8), 100%RDF+ Vermicompost+ Azospirillum+ phosphobacteria(S_9) and it was laid out in split plot design with three replications .Highest values for seed yield and NPK uptake were observed for the combined application of all three nutrient sources of M2 treatment by specify bee pollination. However sunflower crop with apiary had a more pronounced effect than the sunflower alone.

The apiary should be provided with better feeding for a longer period of time , beside the natural feeding resources. Feed consists of 500ml sugar syrup two times a week.

Key words : Sunflower; Nutrient management; Apiary ; Dry matter production; seed yield; oil yield; economics.

INTRODUCTION

Indian vegetable oil economy is the fourth largest in the world, accounting for about 14.5 per cent of the world's oil seeds area and 6.65 per cent of the production and plays the second important role in the agricultural economy, next only to food grains in terms of area and production. This occupies an area of 27.86 m.ha with 27.98 mt of production registering productivity level of 1004 kg ha^{-1}. About 14 million persons are engaged in production and another one million in processing of oil seeds (Sonnad *et al*., 2011).

To provide oil seeds to the exploding population, it is obligatory to produce double the present oil seed production of the country. Hence there is an urgent need to augment oilseed production on sustainable basis to meet out the needs of the expanding demand. Since the possibilities expanding the cultivating area under oilseeds at the cost of other field crops are limited, exploring viable and economical crop management strategies to enhance the per hectare productivity of individual oilseed crops might be of suggestive and feasible approach.

Sunflower is an important oilseed crop for its premier oil and manifold uses of both industrial and pharmaceutical importance. Its cultivation has gained momentum due to its special features like short duration, photoperiod insensitivity, drought tolerance, adaptability to wide range of soil and climatic situations, lower seed rate, high content of quality cooking oil and high seed multiplication ratio. The experimental growth of area under sunflower cultivation is an unparalleled example for any crop and this

Research Article

Copy Right ©KY Publications
Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in
A Peer Reviewed & Refereed, International Open Access Journal
Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

stands testimony for its suitability to fit to different cropping systems and patterns in the country (Kalloo, 2003). In India, it is cultivated in 0.72 million hectares with an annual production of 0.50 million tonnes and productivity of 692 kg ha^{-1} (Directorate and economics and statistics, 2012). In Tamil Nadu, sunflower cultivation has gained importance for the past two decades and currently 0.29 lakh hectares are under cultivation with an annual production of 0.34 lakh tonnes and per hectare productivity of 1288 kg ha^{-1}. However, yield is still lower when compared to the average productivity of major sunflower producing countries in the world (2100 kg ha^{-1}). The limitations on the realization of optimum yield from this valuable oil seed crop are poor germination of seeds and improper filling of seeds. These physiological disorders of sunflower can be set right through the balanced supply of nutrients as one of the means by adopting the integrated management practices with apiary for the crop. As sunflower is a cross pollinated crop, the pollen of the plant cannot fertilize ovary of the same plant and pollen source should be from different plant. Hence , honey bee's acts as an important agents for pollination in sunflower (Kittur Nazhat, 2014). Among different species of honeybee, Indian bee (*Apis cerana*) as it is having well adaptability to Indian conditions and are of special value because they can be managed for pollination and moved to field. They are most efficient pollinators of sunflower crop because their body parts are especially modified to pick up pollen grains, they have body hair, have potential for long working hours (free, 1966;Mc Gregor,1976).

Integrated nutrient management concept is gaining momentum in view of this beneficial effect on soil, microbes and crops. Imbalance use of nutrients, the continuous use of the chemical fertilizers, escalating fertilizer costs and pollution hazards to soil, crops and environment are the other factors that intent in favour of integrated nutrition management.

There is a strong need to adopt integrated nutrient supply system by judicious combination of organic manures, inorganic fertilizers and biofertilizers to improve the soil health and sunflower productivity with apiary farming system. In this context, integrated nutrient management (INM) with apiary farming system holds great promise in meeting the growing nutrient demands of intensive agriculture and maintaining the crop productivity.

MATERIALS AND METHODS

Field experiments were conducted during 2012-2013 at Annamalai university ,Cuddalore located in Western Agro climatic zone of Tamilnadu to find out the nutrient management practice for getting higher yield of sunflower with apiary . The weather of Annamalainagar is moderately warm with hot summer months. The mean maximum temperature is 32.2C while the mean minimum temperature is 21.5C with a mean relative humidity of 88 per cent. The mean annual rainfall is 1500mm of which 1000mm is received during North –East monsoon ,400 mm during South-West monsoon and 100mm as summer showers.The experiment was laid out in a split plot design replicated thrice .Two trials were taken during same time ,under same agroclimatical conditions by maintaining certain distance between both fields *viz,* sunflower alone (M_1),sunflower with apiary(M_2). Nine sub treatments viz, control (S_1), 100%RDF (S_2), 100% RDF+Azospirillum (S_3), 100% RDF + phosphobacteria (S_4) , 100% RDF +vermicompost (S_5),100%RDF+ Azospirillum+ Phosphobacteria(S_6), 100%RDF+ Vermicompost+ Azospirillum(S_7), 100% RDF +vermicompost +Phosphobacteria (S_8), 100%RDF +Vermicompost +Azospirillum +Phosphobacteria (S_9). with respect to inorganic source the common fertilizers used were urea ,single super phosphate (SSP) and Muriate of potash (MOP) for the supply of nitrogen ,phosphorus and potassium respectively. The soil of the experiment site was having low N, and medium P and K content .In the treatments involving 50% N and the entire quantity of P and k were applied basally and the remaining 50% N top-dressed at 30 days interval.

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

Apiary is included in the trial by following all the recommended package of practices. Exposure of flowers to bee visits was ensured. The flowers from this trial was collected ,preserved and identified the yield difference between sunflower alone (M1) and sunflower with apiary (M2).The observations were recorded on plant height, leaf number per plant ,leaf area index, Dry matter production, Diameter of capitullum and Number of seeds per head, on nutrient uptake and nutrient balance sheet was worked out for NPK.

RESULTS AND DISCUSSION

SEED YIELD: The treatment S_9 (100 % RDF + Vermicompost + Azospirillum + Phosphobacteria) recorded the highest dry matter production of 5294.73 (M_1), 5509.18 (M_2) kg/ha in the first season and 5394.76 (M_1), 5512.20 (M_2) kg/ha during second season and the treatment S_1 (control) recorded the dry matter prodution during the both seasons.

Treatment with apiary combination has a significant influence on seed yield of sunflower compare to treatment with sunflower alone, as the bees pollinate each and every head as they are the good pollinators and travelers(Kittur Nazhat, 2014). And the highest seed yield recorded from treatment S_9 (100% RDF + Vermicompost + Azospirillum + Phosphobacteria) of 1456.22 (M_1), 1689.03 (M_2) kg ha^{-1} in first season and 1461.20 (M_1), 1694.08 (M_2) kg ha^{-1} during second season. And the lowest seed yield is recorded under the S_1(control).

NUTRIENT UPTAKE: The combination of inorganic fertilizers with vermicompost and biofertilizers (S_9) resulted in higher NPK uptake by sunflower, which could be attributed to increased LAI ultimately leading to higher DMP. Obviously, higher DMP resulted in the higher nutrient uptake of sunflower

Application of 100 per cent recommended dose of NPK + vermicompost @ 5t ha^{-1} + *Azospirillum* + Phosphobacteria (S_9) was recorded the highest nitrogen (N),phosphorus(P),potassium(K) uptake ie., 71.84 N (M_1), 72.95 N (M_2) kg ha^{-1} in the first season and 72.34 N (M_1), 73.35 N (M_2) kg ha^{-1} in the second season and 14.33 P (M_1),14.56 P (M_2) kg ha^{-1} in the first season and 14.93 P (M_1), 15.16 P (M_2) kg ha^{-1} in second season and 64.78 K (M_1), 67.26 K (M_2) kg ha^{-1} in the first season and 65.39 K (M_1) , 65.99 K (M_2) in the second season, respectively.

The least nitrogen, phosphorus and potassium uptake was recorded under control (S_1) during both the seasons

OIL YIELD : And the treatments significantly influenced the oil yield in both the seasons. Among the treatments, the application of 100 per cent recommended dose of NPK + vermicompost @ 5t ha^{-1} + *Azospirillum* + Phosphobacteria (S_9) was recorded the higher oil yield of 747.01(M_1), 770.01(M_2) kg ha^{-1} in the first season and 749.04(M_1), 772.04 (M_2) kg ha^{-1} in the second season, respectively. It was followed by the application of 100 per cent recommended dose of NPK + vermicompost @ 5t ha^{-1} + soil application of Phosphobacteria (S_8).

The oil yield was lesser under recorded under control (S_1) during both the seasons.

ECONOMICS: Application of 100 per cent recommended dose of NPK + vermicompost @ 5t ha^{-1} + *Azospirillum* + Phosphobacteria (S_9) had registered the highest gross return of Rs. 58,248.8 (M_1), 67,577.86 (M_2), highest net returns of Rs.57,106.8 (M_1), 55,811.42 (M_2) and higher return per rupee invested of Rs.5.07 (M_1) and Rs.5.7 (M_2) in the first season and highest gross return of Rs. 58,448.8 (M_1), 67,779.86 (M_2), highest net returns of Rs.46,976.8 (M_1), 56,013.42 (M_2) and higher return per rupee invested of Rs.5.09 (M_1) and Rs.5.76 (M_2) during the second season. The least net returns was recorded in treatment S_1 (Control).

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

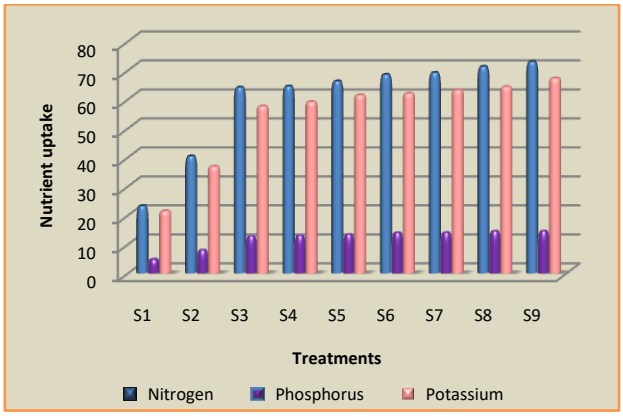
A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

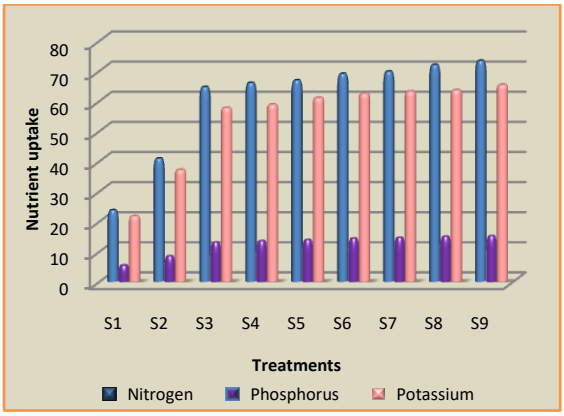
Effect of integrated nutrient management and apiary farming system on Seed & Stover yield

Sub treatment	Seed yield (kg ha^{-1})						Stover yield (kg ha^{-1})					
	First season			Second season			First season			Second season		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1	799.99	1012.38	906.18	804.96	1017.4	911.18	1448.5	1515.98	1482.24	1451.56	1518.96	1483.76
S_2	849.99	1103.94	976.96	854.97	1108.9	981.93	2537.99	2648.12	2593.05	2540.97	2651.17	2596.07
S_3	896.75	1173.99	1035.37	897.7	1177.5	1038.1	4335.91	4506.82	4421.36	4338.95	4509.84	4424.39
S_4	900.05	1165.28	1038.21	906.09	1178.65	1042.37	4335.96	4512.9	4424.43	4338.99	4515.93	4427.46
S_5	996.73	1250.67	1123.36	1001.16	1255.69	1128.42	4720.74	4905.96	4813.35	4723.75	4908.99	4816.37
S_6	1220.06	1492.64	1356.35	1225.1	1497.6	1376.35	4887.6	5044.96	4966.28	4890.61	5047.07	4968.84
S_7	1290.32	1507.42	1398.87	1295.3	1512.44	1403.87	5037.63	5060.42	5049.02	5040.69	5063.49	5052.09
S_8	1386.08	1580.74	1483.41	1391.09	1585.84	1488.46	5131.58	5327.86	5229.72	5134.6	5330.89	5232.74
S_9	1456.22	1689.03	1572.62	1461.2	1694.08	1577.64	5294.73	5509.18	5401.95	5394.76	5512.2	5453.48
Mean	1088.39	1330.67		1093.17	1336.45		4192.29	4336.91		4206.09	4339.83	

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT AND APIARY FARMING SYSTEM ON THE NUTRIENT UPTAKE (kg ha^{-1}) AT HARVESTING STAGE-WITH APIARY

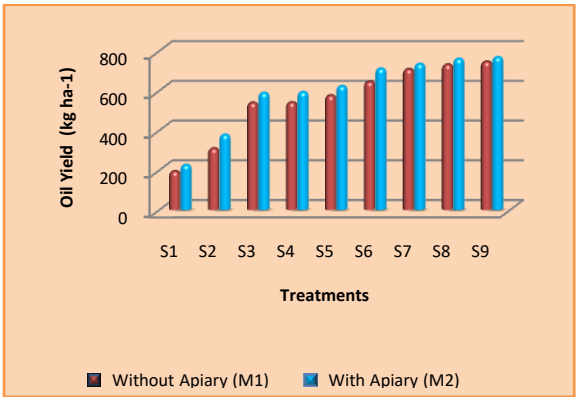


First season

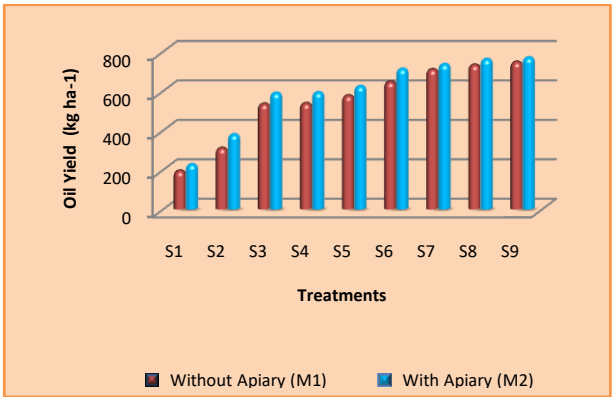


Second season

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT AND APIARY FARMING SYSTEM ON THE OIL YIELD (kg ha^{-1})



First season



Second season

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

Effect of integrated nutrient management and apiary farming system on economics

Treatments	Cost of cultivation (Rs. ha^{-1})				Gross return (Rs. ha^{-1})				Net income (Rs. ha^{-1})				Return rupee^{-1} invested			
	I Season		II Season		I Season		II Season		I Season		II Season		I Season		II Season	
	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2
S_1	10496	10790.44	10496	10790.44	31999.6	40511.86	32198.4	40712.66	21503.6	29721.42	21702.4	29922.22	3.04	3.75	3.06	3.77
S_2	10915	11209.44	10915	11209.44	33999.6	44174.26	34198.8	44372.66	23084.6	32964.82	23283.8	33163.22	3.11	3.94	3.13	3.95
S_3	11015	11309.44	11015	11309.44	35870.0	46976.26	35948.0	47116.66	24855.0	35666.82	24933.0	35807.22	3.25	4.15	3.26	4.16
S_4	11015	11309.44	11015	11309.44	36002.0	46627.86	36243.6	47162.66	24987.0	35318.42	25228.5	35853.22	3.26	4.12	3.29	4.17
S_5	11028	11322.44	11028	11322.44	39869.2	50043.46	40046.4	50244.26	28841.2	38721.02	29018.4	38921.82	3.61	4.41	3.63	4.43
S_6	11305	11599.44	11305	11599.44	48802.4	59722.26	49004.0	59920.66	37497.4	48122.82	37699.0	48321.22	4.31	5.14	4.33	5.16
S_7	11459	11753.44	11459	11753.44	51612.8	60313.46	51812.0	60514.26	40153.8	48560.02	40053.0	48760.82	4.50	5.13	4.52	5.14
S_8	11459	11753.44	11459	11753.44	55443.2	63246.26	55643.6	63450.26	43984.2	51492.82	44184.0	51696.82	4.83	5.38	4.85	5.39
S_9	11472	11766.44	11472	11766.44	58248.8	67577.86	58448.8	67779.86	57106.8	55811.42	46976.8	56013.42	5.07	5.74	5.09	5.76

CONCLUSION

The study revealed that the inclusion of apiary with sunflower was highly reliable,economically viable producing sustainable yields more than sunflower alone. With reference to nutrient management practices adopted in the experiment, 100 per cent recommended dose of fertilizer with Vermicompost, Azospirillum and Phosphobacteria was found to be the best of all the others resulting in the higher yieldof sunflower. Hence the synergistic effect of the combination organic and inorganic sourcescomplementing to the apiary inclusion had provided better yields with promising returns.

REFERENCES:

Amruthavalli, S. and K. Ramakumar Reddy. 2000. Effect of nitrogen uptake of sunflower. **J. Oilseeds Res., 17(2):** 304-306.

Degrandi-Hoffman, G and M. Chambers. 2006. Effects of Honey Bee (Hymenoptera: Apidae) Foraging on Seed Set in Self-fertile Sunflowers (*Helianthus annus* L.) **Environ. Entomol. 35**(4): 1103-1108.

Dodamani, V. 1997. Integrated nutrient management in sunflower. **M.Sc. (Ag.) Thesis,** Univ. Agrl. Sci., Dharwad.

Directorate and Economics and Statistics. 2012. Department of Agricultural and cooperation.

Greenleaf, S.S. and C. Kremen, 2006. Wild bees enhance honeybees' pollination of hybrid sunflower. **Proceedings of the National Academy of Science, USA, 103, 13890-13895.**

Jagadev singh and Singh. 1997. Integrated nutrient management in sunflower (*Helianthus annus*). **Indian J. Agron., 45(2):** 370-374.

Kallo, G. 2003. Sunflower in India. Directorate of oil seeds research, Indian council of Agric. Res., Rajendranagar, Hyderabad, India.

Kasina, M., J. Nderitu, G. Nyamasyo and M.L. Oronje. 2007. Sunflower pollinators in Kenya: Does diversity influence seed yield?. **African Crop Science Conference Proceedings, 8**:1149-1153

Kittur Nazhat. 2014. Towards sustainability: A plan to mimimize external inputs and maximize outputs. Res. J. Agriculture and forestry Sci. 24(4): 27-35.

Kulkarni, S.N. and Dhanorkar, B.K. 1998. Effect of Apis cerana indica on niger seed production in Marthwada region. **Paper presented at FAO workshop on sustainable bee keeping development**, Dharwad, 1-5 August, 1998.

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) **ISSN:2455-0221(P), 2394-2606(O)**

Nderitu, J.,G. Nyamasyo, M. Kasina, M.L. Oronje. 2008. Diversity of sunflower pollinators and their effect on seed yield in Makueni District, Eastern Kenya. **Spanish J. Agril. Res. 6**:271-278.

Osman E.B.A and M.M.M Awed. 2010. Response of sunflower (*Helianthus annus* L.) to phosphorus and nitrogen fertilization under different plant spacing at new valley. **Ass. Univ. Bull. Environ. Res. 13** (1).

Ramalingam Ajithkumar. 2003. Study the effects of integrated nutrient management with vermicompost, biofertilizers and bioagent (Penshibao) on sunflower (*Helianthus annus L.*) cv. DK 3890. **M.SC. (Ag.) Thesis,** Annamalai University, Annamalai nagar, Tamil Nadu.

Rajasri, M., K. Kanakadurga, V.Durga Rani and C.H. Anuradha. 2012. Honey bees-potential pollinators in hybrid seed production of sunflower. **International J. of Applied Biology and Pharmaceutical Technology. 3**(2) 219. available online at www.ijabpt.com

Sonnad, J. S., Raveendaran, N. Aijan and K. N. Selvaraj. 2011. Growth analysis of oil seed crops in India during pre and post WTO periods. **Karnataka J. Agric. Sci., 24**(2): 184-187.

Sunder rajurs, S. 2001. Pollination potentiality of honey bees in niger production. M.sc. (Agril) Thesis, Univ. Agril. Sci., Banglore (India).

Umeljic veroljiub. 2010. Pcelarstco-od pocetnika do profesionalca. Durga izdanje. ISBN 978-86-901835-4-8. Izdavae veroljiub Umeljic, kragu.

Venkatakrishnan, A.S. and N. Balasubramanian. 1996. Yield maximization in sunflower. **Madras Agric J., 83(12):** 791-792